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Govender, Yashila. (2024). The potential of regenerative agriculture in creating climate adaptive and gender inclusive food systems: a study of rural communities in Mpumalanga, South Africa. [Master's dissertation, University of the Witwatersrand, Johannesburg]. WIReDSpace. https://hdl.handle.net/10539/45215

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THE POTENTIAL OF REGENERATIVE AGRICULTURE IN CREATING CLIMATE ADAPTIVE AND GENDER INCLUSIVE FOOD SYSTEMS: A STUDY OF RURAL COMMUNITIES IN MPUMALANGA, SOUTH AFRICA.

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Dissertation

Submitted in fulfilment of the requirements for the degree of

Master of Science

School of Animal, Plant and Environmental Sciences (APES)

University of the Witwatersrand, Johannesburg, South Africa

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September 2024

ABSTRACT

Numerous social-ecological risks to food systems are brought on by industrial agriculture – resulting in various narratives around the sustainability of agriculture, offering a solution to the problems confronting this system. One of these narratives is regenerative agriculture (RA), which has recently gained popularity. The potential of regenerative agriculture could contribute to sustainable agriculture and is capable of addressing climate adaptation challenges and potentially fostering gender inclusivity within food systems. Despite growing interest around regenerative agriculture, this concept is not well understood or researched in South Africa, especially in rural farming villages. This research delves into the multifaceted domain of regenerative agriculture and looks to describe this in the South African context. This study sets out to achieve three research questions, what is the definition of regenerative agriculture in a South African context, what is the current understanding around this concept among smallholder farmers in farming villages of Bushbuckridge and if so, how does regenerative agriculture considers the local gender dynamics in rural farming communities?

A mixed methods approach was used for this study. Ten expert interviews with key stakeholders in the agricultural sector were conducted to construct a definition of regenerative agriculture tailored to South African conditions. Thereafter, individual interviews were used to gauge the level of understanding and adoption of regenerative practices among smallholder farmers in the villages of Bushbuckridge. This sample consisted of 74.2% female and 25.8% male. Finally, an in-depth analysis of how regenerative agriculture compared with local dynamics in rural farming communities was conducted through participatory engagement. A total of 54 participants participated in focus group discussions.

The results indicate there is a multifaceted understanding of regenerative agriculture in South Africa, with most experts indicating that regenerative agriculture is practiced under the name of conservation agriculture (CA). Aspects of both practices have some commonalities with agroecology, such as principles of soil conservation, polyculture and no-tillage that are highly promoted in South Africa. Additionally, smallholder farmers in Mpumalanga practice regenerative agriculture, with different adoption rates in different villages. Furthermore, this research highlights that the adoption of regenerative agriculture in rural farming communities requires further discussion and stakeholder engagement, especially with women, and includes socio-economic and cultural factors.

This study contributes to the broader discourse on regenerative agriculture by providing a context-specific definition, indicating that regenerative agriculture is an overlap of agroecology and conservation agriculture in South Africa, shedding light on the challenges and opportunities for smallholder adoption, and emphasizing the importance of community-based approaches in regenerative agriculture educational programs. The research underscores the need for tailored education and extension programs that account for local conditions and socio-cultural factors.

Keywords: Regenerative Agriculture, Climate Adaptation, Smallholder Farmers, Mpumalanga.

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SENATE PLAGIARISM POLICY

Declaration by Students

I Yashila Govender (Student number: 1615207) am a student registered for Master of Science (Dissertation) in the year 2024. I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that ALL the work submitted for assessment for the above course is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.

Signature:  Date: 5 September 2024

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Prof Laura Pereira, and co-supervisor, Mulako Kabisa for their supervision throughout the course of this project. A special thanks to Prof, whose patience was unmatched during my unconventional moments of culinary-inspired research. Beyond the supervision – thank you for inspiring me, believing, and seeing the potential in

me, pushing me, supporting me and for your patience with me. Thank you for your endless motivation and for creating a safe space for me to experiment and grow. I am so fortunate to have supervisors that provided me with invaluable insight and brimming with support at every step of the way.

I would like to thank Prof Wayne Twine for his assistance with locating the study areas, communicating with the Amashangana tribal council about this project and for his guidance with moving around Wits Rural and the study areas. My deepest appreciation and thanks go to Thulaphi for her assistance with interpretation on the field. On long days on the field, thank you for being such fun – your anecdotes and stories are one of the highlights of this research.

I would like to thank the Amashangana tribal council and the village Ndunas for their support of this research project. A heartfelt thanks to the participants in the villages of Athole, Allandale-A and New Forest for their openness and readiness to assist in this project. Thank you to all respondents of this study – to the expert participants, smallholder farmers and women of the community.

I am grateful to Dr. Yuvan Mathias Shunmugam for encouraging me on the path of academia. I would also like to thank my family, peers and colleagues for their endless support and pep talks along the way, Jivesh Naidoo, Cameron Sivalingam, Saness Moodley, Verona Govender, Flavia Kigozi, Kai, and many others – thank you for all the coffee runs and random check-ins!

This research was made possible by The Amrut foundation, a huge heartfelt thank you to Hemang Desai and Maunas Mehta for the opportunity to conduct this research and for the motivation along the way.

DEDICATION

I would like to dedicate this thesis to my mother, Sushee Govender and father, Siva Govender for supporting me throughout the course of this degree. My deepest thanks, love and appreciation goes to you both for always supporting my dreams and aspirations. Thank you both for taking leave and for running around with me on the field. My appreciation for you both knows no bounds – you have supported, guided, and dealt with all my dwindling emotions during this time and for that I will forever be grateful.

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CHAPTER 1

INTRODUCTION TO REGENERATIVE AGRICULTURE, GENDER AND CLIMATE CHANGE

1.1 INTRODUCTION

Evidence indicates that the world produces enough food to sustain one and a half times the current population (FAO, 2015), despite this, approximately 780 million people are thought to be impacted by hunger (FAO, IFAD, UNICEF, WFP and WHO, 2023) and 1 in 9 people are hungry (Boliko, 2019). The United Nations World Food Program (UN WFP) has found that women and children represent 60% of the chronically hungry population worldwide. This statistic highlights the unequal burden of hunger they bear and points to the injustices present in our global food systems (Scott-Villers *et al*., 2016; FAO, IFAD, UNICEF, WFP and WHO, 2023). While there are many causes of why almost 10% of the world is hungry - poverty, inequality, and lack of purchasing power are the largest contributing factors (Roser and Ritchie, 2019). It is estimated that if food production were to continue on the current inequitable trajectory, increased levels of food insecurity would emerge from rising levels of poverty in developing nations (Waldmueller, 2015).

Although the global pledge to accomplish the Sustainable Development Goals by 2030, goals 2 (zero hunger), 3 (better health), 5 (gender equality), 8 (economic growth), 12 (consumption and production), 13 (climate action), 14 (life below water), and 15 (life on land) are all interconnected (Gordon *et al*., 2017; Pereira *et al*., 2020), however, there has been insufficient action to change the trajectory of food systems. The emphasis lies in the global food system redesign to achieve ecological sustainability and social justice, especially in view of the climate crisis (Wiebe *et al*., 2015; Rockstrom *et al*., 2020; Loring, 2021). The climate crisis will be experienced differently for distinct groups of people and different geographical locations (Miatton and Karner, 2020; Solomonian and Di Ruggero, 2021). Rich northern nations are the main sources of climate change but are also less vulnerable to its detrimental effects (Ripple *et al*., 2022). However, indigenous peoples and developing nations in the global south are most at risk to the effects of climate change (Miatton and Karner, 2020). Therefore, for the adaption to climate change, social justice is an integral process in providing equal opportunities, resources, and wealth (Somomonian and Di Ruggero, 2021). Furthermore, the availability and quality of water, soil, and biodiversity,

essential for food production, are altered by climate change, which has an influence on food security, especially in rain-fed agricultural systems (IPCC, 2021; FAO, 2023).

In arid areas such as South Africa that is known for being a water scarce country, agriculture is highly reliant on rain, thus, putting agriculture in South Africa at risk of climate change (IPCC, 2021; Olabanji *et al*., 2021). With an increased uncertainty of what the future holds with regards to climate disasters, there is a threat to livelihoods that depend on agriculture for both food and income (Holt-Gimenez, 2019; Loi *et al*., 2022). As the second-largest source of greenhouse gas (GHG) emissions, accounting for 22% of emissions, agriculture both influences and is impacted by the climate system (IPCC, 2022). The dangers to agriculture increase with rising temperatures and an increase in the frequency and intensity of extreme weather occurrences (Anderson *et al*., 2020; Shazad *et al*., 2021).

Because of societal and cultural norms, varying effects of climate change vulnerabilities are anticipated for men and women (IPCC, 2022). It is argued that due to climatic stress, the role of women in rural communities will be made more challenging on a daily basis (Ongora and Ogara, 2011), with impacts including travelling further distances for clean water and firewood and spending more time growing and caring for livestock and the exacerbation of already existing inequalities (Quisumbing and Doss, 2021).

In order to combat the gendered effects of climate change, adaption techniques that empower and strengthen women's resilience should be promoted. According to the IPCC (2022), adaptation is the process of minimising harm or taking advantage of changes in response to the actual or anticipated effects of climate change. Some examples of adaptation measures are improving water management, diversifying livelihoods, strengthening social networks, and enhancing access to information and resources (UN Women, 2020). However, adaptation is not a neutral process, as it can either reinforce or challenge existing power structures and inequalities and have trade-offs and synergies with other development goals (Eriksen *et al*., 2011). Therefore, it is critical to take a gender-sensitive approach to adaptation, one that acknowledges the varying demands, preferences, roles, and skills of men and women and guarantees meaningful involvement and benefit-sharing in the formulation and implementation of policies (UN Women, 2020).

Regenerative agriculture (RA) is a promising strategy for gender-sensitive adaptation, offering an alternative method of food production. As noted by Newton *et* al. (2020), RA not

only aims to address the pressing environmental and social challenges, but also to contribute positively to these sectors. Regenerative food systems not only provide sustenance for human consumption, but also deliver key benefits such as carbon sequestration, biodiversity conservation, the facilitation of balanced and diverse diets, and the preservation of cultural social integrity (Seymour and Connelly, 2022). Practices of RA aim to minimize fertilisers and pesticides, tillage, and avoidance of bare soil (Newton *et al*., 2020). Despite the increasing popularity of regenerative agriculture, the concept is not fully developed, thus the range of advantages and disadvantages are not fully understood in various parts of the world, especially in rural settings.

1.2 STATEMENT OF THE PROBLEM

In South Africa, particularly in rural areas like Mpumalanga, climate change is making it increasingly difficult to grow crops. This is a pressing issue where access to information is often limited. Regenerative agriculture, a method that aims to reverse climate change effects, enhance food security, and halt environmental damage, is emerging as a potential solution. However, its definition and application are still widely debated. Adoption of regenerative agriculture is complex, influenced by various social, economic, and cultural factors, and is particularly challenging for smallholder farmers who play a crucial role in global food production but typically have fewer resources and limited technology.

In the rural communities of Bushbuckridge, Mpumalanga, the impact of climate change is compounded by gender inequality within the food production system. Although regenerative agriculture could potentially improve climate resilience and support gender equality, its practices are not well understood or used by the local smallholder farmers. This study focuses on the potential of regenerative agriculture to foster a food system in Bushbuckridge that is better equipped to adapt to climate changes and includes both men and women equitably. It will delve into the local interpretation and effects of regenerative agriculture, examine the existing knowledge and obstacles, and assess how it addresses gender dynamics.

1.2.1 RESEARCH QUESTIONS

The primary aim of this research is to identify if there is any potential for regenerative agriculture in creating an inclusive food system, which addresses gender imbalances in rural South African communities, specifically in Bushbuckridge, Mpumalanga.

Based on the problem statement and subsequent aim, the following research questions have been formulated to guide the research process:

1. How does regenerative agriculture, as understood in the South African context, contribute to the adaptation and mitigation of climate change in rural communities in Mpumalanga?

2. What is the current level of understanding and perception of regenerative agriculture among smallholder farmers in rural agricultural communities in Mpumalanga, and what barriers exist to its implementation?

3. If any, in what ways does regenerative agriculture address gender dynamics and contribute to creating more inclusive food systems in rural communities in Mpumalanga?

Answered togther, these questions aim to address the overarching research question for this study, which is:
What is the potential of regenerative agriculture systems in creating more climate-adaptive and gender-inclusive food systems in rural communities in Mpumalanga, South Africa?

1.3 INTRODUCTION TO KEY LITERATURE

This subsection provides an overview of the key literature that has influenced this study; a more detailed review will follow in Chapter 2.

The historical context and sustainability challenges in agriculture have been extensively discussed by Patel (2014) and Mohan *et al*. (2020). These works highlight the evolution of agricultural practices and the ongoing sustainability issues faced by the sector including the impacts of the green revolution. Key studies by Pingali (2012) and the Intergovernmental Panel on Climate Change (2021) explore the intricate relationship between agriculture and climate change, emphasizing the impact of changing climate patterns on agricultural productivity.

Research by the United Nations Framework Convention on Climate Change (UNFCC) (2020) and Munyai *et al.* (2021) delves into the vulnerabilities of agricultural systems to climate change and the various adaptation strategies employed to mitigate these effects. Different approaches to agriculture, including regenerative agriculture, have been discussed by authors such as Bless *et al*. (2023), Newton *et al*. (2020) and Tittonell *et al*. (2022). These studies provide insights into sustainable agricultural narratives and their overlap with regenerative agriculture. Influential works by the FAO (2023) and Malapit *et al*. (2019) examine the intersection of gender with climate change and agriculture, highlighting the unique challenges faced by women in this context, indicating that women's roles are affected

by societal norms. Key literature specific to South Africa's agricultural sector and its climate challenges includes works by Elleboudt (2012) and Giller *et al*. (2011), which discuss the regional impacts of climate change on agriculture and the duality in South African agriculture.

The following chapter will delve deeper into these themes, providing a comprehensive review of the literature that forms the foundation of this study.

1.4 METHODOLOGY

This research explored current agricultural practices and knowledge of regenerative agriculture among smallholder farmers in Bushbuckridge, Mpumalanga. This study used an explorative approach, involving key informant interviews with academics, researchers, farmers, and non-profit and non-governmental organizations. These interviews helped define regenerative agriculture in the South African and Mpumalanga contexts. Individual interviews and focus group discussions in three villages assessed the knowledge and practice of regenerative agriculture. A gender lens was applied to evaluate if regenerative agriculture considers gender and its potential to contribute to gender-equitable food systems.

1.5 ETHICS

Ethical approval was granted by the University of the Witwatersrand non-medical ethics committee. An ethics application was created and reviewed by the university and a certificate was obtained.

1.6 SCOPE OF THE STUDY

This study focused on smallholder farmers in the rural communities of Bushbuckridge, Mpumalanga. The research was confined to New Forest, Athole and Allandale-A within this region. Data collection was limited to key informant interviews, individual interviews, and focus group discussions. The study specifically examined the knowledge and practices of regenerative agriculture, with an emphasis on gender considerations and the potential for gender-equitable food systems. The findings are contextualized within South Africa and Mpumalanga and may not be generalizable to other regions or farming communities.

1.7 STRUCTURE OF THE DISSERTATION

This dissertation is organized into five chapters. Chapter one has presented an introduction to the research, the importance of this study, the overarching research question and subsequent

research questions. The second chapter presents a literature review of climate, agriculture, gender and provides a South African context into all three of these topics. Chapter three presents the methods and methodology used to collect this data and introduces the gender lens to analyse this research. Chapter four presents a desktop review of regenerative agriculture backed by expert interviews. Chapter five presents the results of the understanding around regenerative agriculture in Bushbuckridge municipality and the state of local gender dynamics surrounding regenerative agriculture. Chapter six presents a discussion of the results and a conclusion with a summary and recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

2. INTRODUCTION

Current food systems are often labelled as 'broken' because they fail to feed hungry populations and contribute to environmental harm, while also being impacted by climate change, raising concerns about their effectiveness in addressing global food security and sustainability challenges (Holt-Giménez, 2019; Al-Kaisi and Lal, 2020). Regenerative agriculture is an approach to farming that aims to enhance soil, biodiversity, the water cycle, and the communities that depend on them (Newton *et al*., 2020). There have been various attempts at defining this concept, one approach based on principles such as minimizing soil disturbance, maximizing crop diversity, integrating livestock, and applying agroecological practices (Gordon *et* al., 2022). Regenerative agriculture has been proposed as a potential solution to address the challenges of climate change and food insecurity, especially in rural areas where smallholder farmers are most vulnerable. However, the concept of regenerative agriculture is not well-defined or widely understood globally, with various social, economic, and institutional barriers that hinder adoption and implementation. Moreover, a gender dimension of regenerative agriculture has not been adequately explored or integrated, which is important internationally. Moreover, in a South African context, where women play a significant role in food production and household livelihoods, it is vital to take gender into account. This literature review chapter aims to provide a comprehensive overview of the current state of knowledge around agriculture, climate and women in South Africa, with a focus on the current literature on climate change, current food systems, regenerative agriculture, and rural women from a global perspective to a local South African Mpumalanga context.

2.1 THE HISTORY OF AGRICULTURE AND ASSOCIATED CHALLENGES FOR SUSTAINABILITY

Agriculture, a practice dating back 15,000 years, has undergone significant transformations, notably marked by the Green Revolution in the mid-20th century, which introduced advanced agricultural techniques such as high-yielding varieties of crops, synthetic fertilizers, and pesticides (Rhodes, 2017). This period of technological innovation, beginning in the early 20th century and spreading globally until the late 1980s, greatly increased food production,

particularly in developing countries, and played a crucial role in reducing hunger and poverty worldwide (Patel, 2013; Rhodes, 2017). While the Green Revolution, pioneered by Norman Borlaug, achieved impressive yields through new wheat varieties, its impact was marred by heavy reliance on fertilizers, pesticides and Green Revolution technologies such as advanced irrigation methods (Patel, 2013; Mohan *et al*., 2020). While this approach has proven effective in certain areas, particularly in boosting rice yields, it has also resulted in widespread dietary shifts (Gollin *et al*., 2021). However, it's important to note that the economic aspects of chemical inputs and green revolution technologies, along with their health, societal, and environmental repercussions, were often overlooked in the context of developing countries (Pingali, 2012; Abayechaw and Dikir, 2022). Africa faced challenges as the approach was not tailored to regions relying on orphan crops (sorghum, millet and cowpea), causing nutritional deficiencies and health issues (Pingali, 2012; Patel, 2013). The Green Revolution was challenged in an African context with drivers such as an increasing population, increased reliance on livestock and crops, climatic changes, rainfed agriculture, staple crops, lack of suitable infrastructure and traditional farming systems were not taken into consideration – ultimately, leading to its lack of implementation in Africa (Abayechaw and Dikir, 2022). Furthermore, monoculture practices during the Green Revolution made crops vulnerable to pests, and excessive pesticide and fertilizer use negatively impacted soil health and led to land degradation (Waldmeuller, 2015).

Despite its drawbacks, modern agriculture, commonly termed "industrial" or conventional agriculture, remains predominant in Europe and North America, characterized by maximizing yields through intensive practices involving fertilizers, pesticides, biotechnology, monoculture, and heavy machinery (Leaky, 2020; Gordon *et al*., 2022). The long-term impacts of conventional farming methods on biodiversity, water resources, and soil health are the basis of concerns regarding sustainability and equality in traditional agriculture (FAO, 2012). Furthermore, there's a rising conversation about how these techniques can disproportionately impact marginalized groups and small-scale farmers, perhaps creating a larger divide between huge agribusinesses and impoverished farmers in rural areas. The ramifications include water and land pollution, biodiversity loss, soil degradation, formation of dead zones, and heightened greenhouse gas emissions (Leaky, 2020; Gordon *et al*., 2022). These issues necessitate a critical revaluation of agricultural practices to mitigate environmental impacts and ensure long-term food security. For the context of this thesis, food security is defined as “the condition in which all people, at all times, have physical, social,

and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2012). Food security and food sovereignty are distinct concepts; the former emphasizes the availability of food, while the latter is concerned with the right to define one's food systems. Food sovereignty extends beyond mere access to food; it is a broader term that includes the right of people to healthy and culturally appropriate food produced through sustainable methods. It also encompasses the right to define their own food and agriculture systems, emphasizing local autonomy, agency, and moral economy (Clapp, 2022).

The Green Revolution affected millions of smallholder farmers, many of whom were pushed out of farming by larger corporations, farmers that had more capital, or the degrading soils that led to soil erosion (Pereira *et al*., 2018). In response to the challenges posed by conventional agriculture, smallholder farmers have increasingly adopted agroecological practices. However, it's important to acknowledge that the application of agroecology has been diverse and, at times, contentious. Critics argue that without careful implementation and oversight, agroecology can be misapplied, potentially undermining its foundational principles of sustainability and equity. Despite these concerns, approaches including climate-smart agriculture (CSA), conservation agriculture (CA), organic farming, agroforestry, silvopasture, and regenerative agriculture, continue to evolve, reflecting a dynamic field that strives to balance productivity with ecological integrity (Tittonell *et al.,* 2022).

According to HLPE (2019):

> "With the use of minimal negative externalities and stressing the importance of local knowledge and participatory processes that develop knowledge… Agroecological approaches recognize that agrifood systems are coupled social-ecological systems from food production to consumption and involve science, practice and a social movement"

Since the 1980s, global agroecological movements have been driving modern agroecological practices through local traditional knowledges (Altieri *et al*., 2022). Agroecology refers to a combination of agronomy and ecological concepts for the enhancement of ecosystem services, overall enhancement of biodiversity, while serving a social purpose of context specific agriculture – which modern day agriculture aims to achieve (Jeanneret *et al*., 2021).

African agriculture reflects a unique trajectory in the context of the Green Revolution's global impact. The continent's dependence on orphan crops, which are plants that are not widely

traded international, posed opportunities such as overall diet improvement and sustainability of food production (Dawson *et al*., 2019; Ashebir, 2022). These crops, typically grown in Africa, Asia, and South America, are integral to local diets and are poised to make a significant impact on global food security. Their unique adaptation to the local environment, despite lagging breeding technology, underscores their potential to enhance the resilience of food systems in Africa (Patel, 2013; Tadele, 2018). South Africa, a key player in the African agricultural landscape, possesses a dual agriculture system a stark contrast between the well-developed commercial sector and the small-scale farming practices. This system is a legacy of historical socio-economic structures, where approximately 87% of agricultural land is occupied by commercial farms, while smallholder farmers work the remaining 13% (Mtshali and Akinola, 2021). The disparity in land use and ownership has implications for productivity, sustainability, and equity in the agricultural sector, highlighting the need for policies that bridge the gap between modern and traditional farming to ensure a more inclusive and productive agricultural future for South Africa (Hebinck *et al.,* 2018; Shackelton *et al.,* 2019). While recent initiatives in South Africa such as agroecology, climate-smart agriculture, conservation agriculture, and regenerative agriculture are indeed innovative, it's important to recognize that not all practices under these labels represent a departure from the norm. Some methods may be repackaged under these progressive terms without substantial changes to traditional practices. Therefore, it's crucial to critically assess each initiative to determine whether it truly contributes to a holistic and environmentally conscious approach to farming (Patel, 2013; Tadele, 2018; Rudolph and Muchesa, 2023).

2.2 AGRICULTURE AND CLIMATE CHANGE

The agriculture sector is responsible for approximately a third of the current global anthropogenic GHG emissions (IPCC, 2022; Lynch *et al*., 2021). This is through the release of carbon dioxide, methane and nitrous oxide (Lynch *et al*., 2021). The main sources of GHG emissions are cattle belching and the addition of fertilisers, which makes up 65% of agricultural emissions, while other sources include poor soil management practices, management of manure and the conversion of land into agricultural fields (Reddy and Reddy, 2015; Chen *et al*., 2020). Human activity contributes to climate change variability by the emission of GHGs, through the change in land use and use of non-renewables, this influences the land surface temperature that has implications for agricultural land (IPCC, 2019).

Climate change will modify the functionality of agriculture through changes in precipitation, temperature, carbon dioxide, climate variability and surface water runoff (Calzadilla *et al*.,

2014). Based on current projections, climate change is expected to raise temperature by 2-3°C by mid-century (IPCC, 2022). Climate change will impact the world differently – visible through the decrease in grain yields and changes of water availability in the global south (Lynch *et al,* 2021). According to de Lima *et al*. (2021), the effect of climate change on the agricultural sector would lead to a 5% increase in crop prices due to production losses as a result of climate change and as temperatures rise. This increase in food prices will leave individuals of a lower economic circumstance without access to food (IPCC, 2021). Climate change poses a significant threat to food security for humans and the well-being of livestock. As temperatures rise, livestock are likely to experience declines in fertility and productivity, alongside increased susceptibility to immune and endocrine diseases (Das *et al*., 2016).

Current food systems are responsible for 70% of water extracted from natural ecosystems, affect biodiversity negatively via agricultural expansion and urbanisation (Anwar *et al*., 2013; Pörtner *et al*., 2021). It is expected that the uncertainty of climate change will further negatively impact global food systems (IPCC, 2021). The global climate conditions are expected to be a determinant of crop productivity, as plant phenology and metabolic processes are highly reliant on temperature, carbon dioxide and water availability (Anwar *et al*., 2013). In addition to this, productivity of agriculture will be affected by extreme weather events (floods, droughts, heat waves etc.) (IPCC, 2021).

2.3. WHAT IS REGENERATIVE AGRICULTURE?

Robert Rodale coined the term “regenerative agriculture” to bring about a “ground-up” outlook on the current agriculture systems (Rodale, 1983). While there is no clear definition of regenerative agriculture, The Carbon Underground (2017) describes it as “a holistic management practice that facilitates the closing of the carbon cycle, building soil health and crop resilience through strengthening photosynthetic processes”. The concept of regenerative agriculture was popularized by the Netflix documentary *Kiss the Ground*, which was made in collaboration with various regenerative agriculture stakeholders – while this documentary has garnered a lot of attention, it ended with no clear definition (Tickell, 2017; O’Donoghue *et al*., 2022). In short, regenerative agriculture practices are purely dependent on the geographical location and climatic setting and thus not all practices may be effective for all agricultural settings (Giller *et al*., 2021). Local farmers must evaluate in a local context what regenerative practice influences which ecosystem service and can use these guidelines to aid them in achieving various regenerative objectives at a local level (Figure 2.3.1).

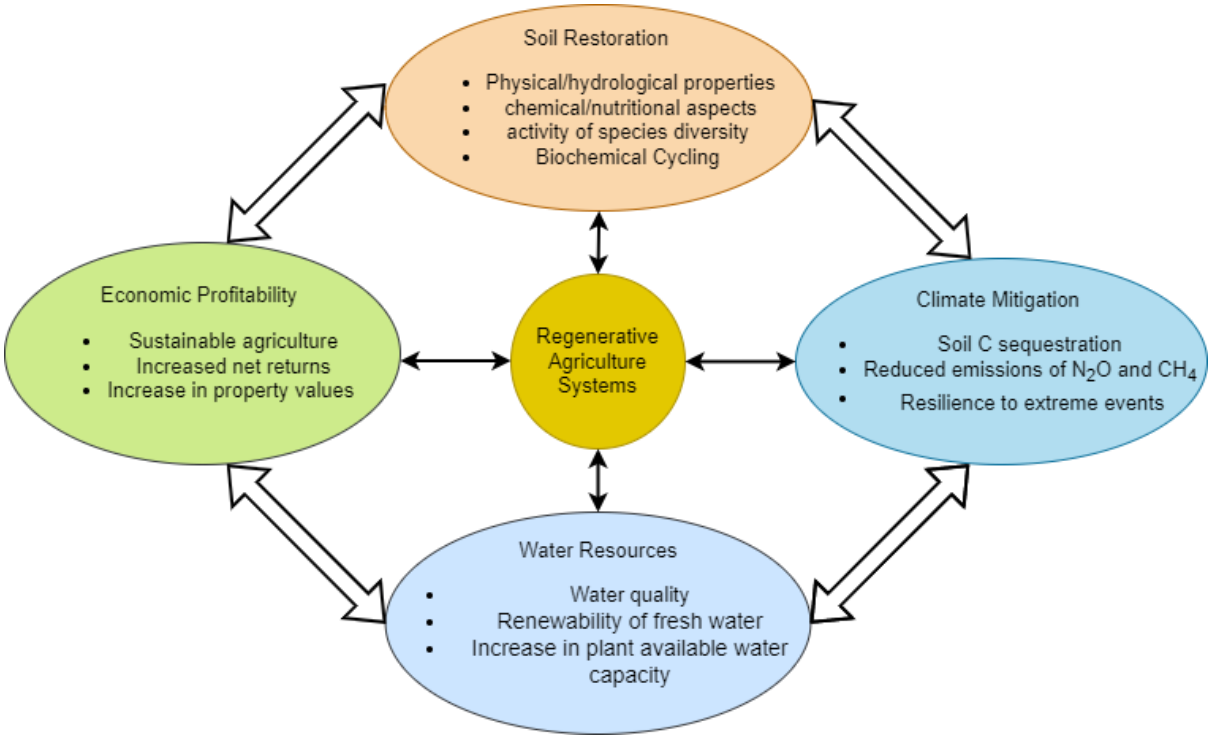

Figure 2.3.1: Basic impacts of regenerative agriculture systems when applied. Source: (Al-Kaisi and Lal, 2020).

There is an aim for a radical shift in how we interact with agriculture, implying that conventional methods are not sufficient in preventing further environmental degradation (Friedrich and Kassam, 2016). Accordingly, a potential approach to sustainable agriculture is regenerative agriculture. Despite this growing interest in regenerative agriculture, the opposing views and discourses around regenerative agriculture lack clarity with no one true definition available, some scholars going as far as indicating that regenerative agriculture cannot be defined using a single definition (Soloview and Landua, 2016) and others providing various definitions (Newton *et al*., 2020; Tittonell *et al*., 2022). However, regenerative agriculture is a blend of many approaches rather than a single one, that may differ based on the situation and the farmers' objectives (Sands *et al*., 2023).

Common terms used adjacent to regenerative agriculture in the literature and from the interviews included “agroecology,” “organic regenerative farming,” “carbon farming,” “sustainable agriculture” and “conservation agriculture” (Newton *et al*., 2020; Giller *et al*., 2021). The overlap and use of these terms interchangeably suggest that there is an overlap in definition, research, and practices with these forms of agriculture (Khangura *et al*., 2023). Research indicates that regenerative agriculture can be defined through the combination of

process and outcomes-based definitions (Newton *et al*., 2020). However, according to the results of this study, and further backed by literature, three categories can be used to characterise regenerative agriculture (Sands *et al*., 2023). The categories exhibit some overlap, particularly concerning practices and principles. Additionally, the categories can be further delineated into three distinct terms: 1) Practices, 2) Outcomes, and 3) Principles.

The practice definition of regenerative agriculture is the application of the principle in a context-dependent way leading to various outcomes. A principles definition of regenerative agriculture can be listed as four main principles follows: 1) no-tillage, 2) increased diversity of plants, 3) integration of livestock, 4) covering of soil (LaCanne and Lundgren, 2018, Fenster *et al*., 2022). However, based on further research, an additional principle was added 5) eliminating chemical fertilizers (LaCanne and Lundgren, 2018, Fenster *et al*., 2022). This definition encompasses the biophysical capacities and the aims of regenerative agriculture, which are context-independent (Lal, 2020; Newton *et al*., 2020; Sands *et al*., 2023). The outcomes involve promotion of carbon sequestration, improving soil health, overall biodiversity, and improving resilience and economic opportunities generated from practicing regenerative agriculture (Grant, 2017; Newton *et al*., 2020). The integration of principles and outcomes highlights the importance of the biophysical and social outcomes of regenerative agriculture.

> "*A method of farming with the goal of improving not only the environment but also the social and economic aspects of sustainable food production by using soil conservation as the starting point to regenerate and contribute to ecosystem services (providing, regulating, and supporting services).*" (Schreefel *et al*., 2020)

While the integrative definition using principles and outcomes of regenerative agriculture is more holistic than the others (Figure 2.3.2), some academics argue that this definition is too broad and does not encompass the cultural and traditional knowledge that forms the foundation of regenerative agriculture (Newton *et al*., 2020; Sands *et al*., 2023).

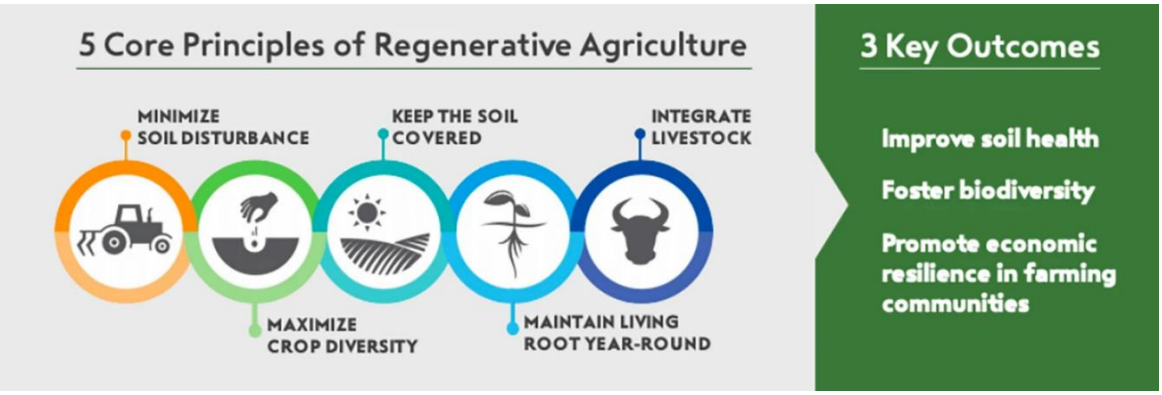

Figure 2.3.2: An integration of core principles and outcomes of regenerative agriculture. Source: (General Mills, 2019).

Newton *et al*. (2020) draws the conclusion from their review that there is no one definition of regenerative agriculture; instead, they emphasize various strategies that stakeholders and policymakers may find acceptable. However, the range of choices, some not including the cultural and traditional aspects, allows for the repurposing by stakeholders to suit agendas or to exclude minorities (Gordon *et al*., 2022; Sands *et al*., 2023).

Often confused with each other in the literature, regenerative agriculture and agroecology have similarities including rehabilitation of soil health, ecosystem restoration and a dependence on ecosystem and biological services – including the crop and livestock integration, use of seasonal crops and polyculture (Schreefel *et al*., 2020; Giller *et al*., 2021; Sands *et al*., 2023).

2.3.1. Agroecology or Regenerative Agriculture?

The concepts displayed by agroecology indicate that it is interdisciplinary and intersects with various other forms of sustainable agriculture practices (Figure 2.3.3). According to FAO (2019), Agroecology feeds knowledge into the various other types of sustainable agriculture approaches including climate-smart agriculture, conservation agriculture, organic agriculture and regenerative agriculture.

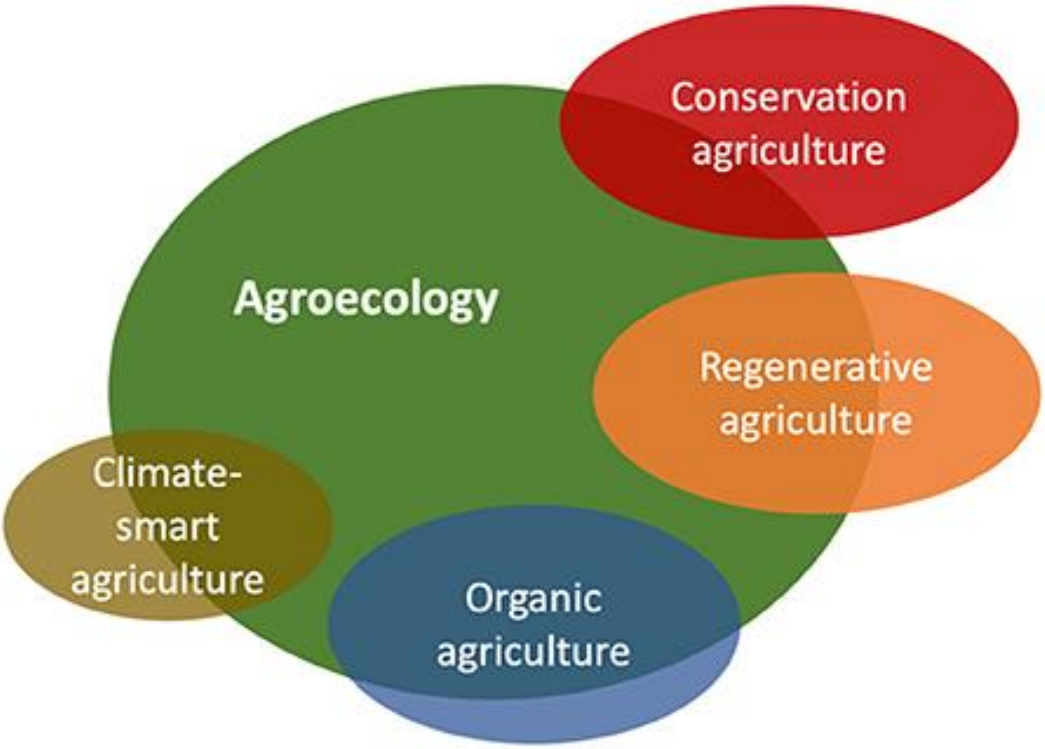

Figure 2.3.3: The overlap of agroecology and other practices of sustainable agriculture. Source: (Tittonell *et al*., 2022).

Over the years, agroecology has adopted various definitions, with different stakeholders emphasizing various aspects of agroecology. Namely, agroecology is defined by as a science, practices/principles, and movement (Wezel *et al*., 2009; Pereira *et al*., 2018; Greenberg and Drimie, 2021). As a scientific concept, the term 'agroecology' is a combination of the disciplines of ecology and agronomy, in which many scientists saw an interdependent relationship between these two disciplines (Wojtkowski, 2019). A growing challenge of the green revolution brought on a rise on the calls to consolidate agronomy and ecology in different ecological contexts, allowing for science to focus on interactions between plans, animals, crops, soil and climate. Further enhancing our understanding of soil and nutrient cycles, pest control, biodiversity, and the robustness of crop yields (FAO, 2018; Gliessman, 2021).

In the 1970s and 1980s agroecology was popularized due to the green revolution – smallholder farmers were seeking out alternatives to industrial agriculture, to improve their declining yields, eroding soil and loss of overall biodiversity (Charlie and Garnett, 2021). Thus, various agronomists along with farmers combined knowledge from indigenous farming practices and agroecology to form farming practices without the use of external inputs, such

as chemical fertilisers and pesticides, to maximise production in an environmentally conscious way (Alteri *et al*., 2012). Some of these practices include crop rotations, cover crops, crop-livestock integration, polyculture, organic fertilisers (manure), integrated pest management and crops for household consumption (Wezel *et al*., 2009; Wezel *et al*., 2014).

Practices of agroecology developed as a result of worsening poverty and inequality from the green revolution and smallholder farmers struggling to keep up with large-scale agriculture in markets – smallholder farmers began working together as a community and with other civil organizations to create localized markets to avoid competition from retailers and producers from the national and international markets (Chaparro-Africano, 2019). Agroecology was now associated with wider movements to revive traditional and indigenous practices, popularising spiritual beliefs and cultural practices in agriculture and highlighting the importance of seed saving (Greenberg and Drimie, 2021). These practices of agroecology developed into the principles of agroecology or the elements of agroecology (FAO, 2018), as we know them today (Figure 2.3.4).

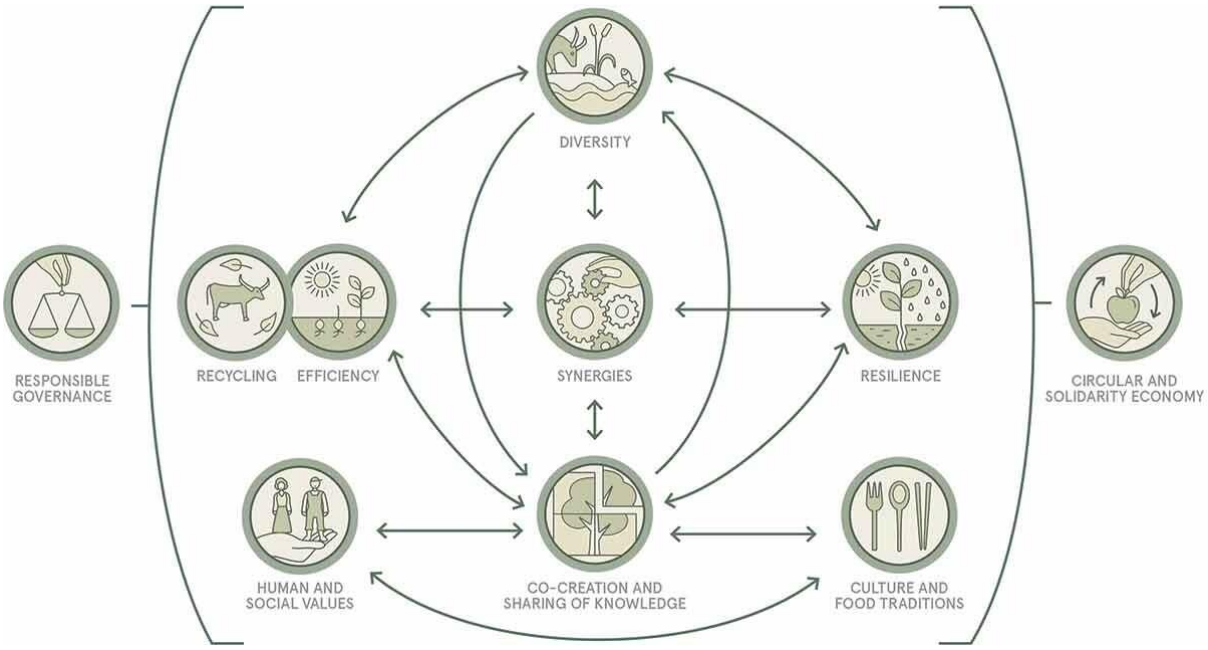

Figure 2.3.4: Elements of agroecology. Source: (FAO, 2018)

Farmer organizations, academics and NGOs united in the 1990s to stand against neoliberalism and the capitalist front that agriculture had begun to take, forming a political stance on agriculture and the policies around trade at an international level emphasizing food sovereignty (Charlie and Garnett, 2021). With food sovereignty forming a basis of the agroecological movement, its association became stronger with peasant and indigenous

farming movements such as La Via Campesina and Navdanya (Charlie and Garnett, 2021; Cruz and van de Fliert, 2023). Thus, agroecology the movement was born. The Green Revolution resulted in environmental movements in the Global South to consider the social-ecological views in the broader system – leading to the expansion of peasant movements and demands for a return to the agroecological methods employed by women and indigenous farmers (Barrios *et al*., 2020; Gliessman, 2021). Agroecology as a movement "is inseparable from a particular set of values and priorities, including the rejection of anthropocentric worldviews and solely technological or market-based responses to problems; the expansion of collective rights and the commons; racial and gender equality; and respect for diversity." (Carlile and Garnett, 2021).

There is one critical difference between regenerative agriculture and agroecology – political activism. Agroecology is embedded within political activism and peasant movements emphasizing food sovereignty, hence, its strong association with peasant movements and other social movements (Barrios *et al*., 2020; Gliessman, 2021). While there are some articles that emphasize regenerative agriculture and social movements, there are no strong movements emphasizing the involvement of regenerative agriculture (Tittonell *et al*., 2022; Bless *et al*., 2023).

In their review, Tittonell *et al.* (2022) indicated three distinct categories of regenerative agriculture, namely: philosophy, development and corporate (Figure 2.3.5). By using the 10 elements of agroecology, they were able to delineate these vastly different and broad meanings.

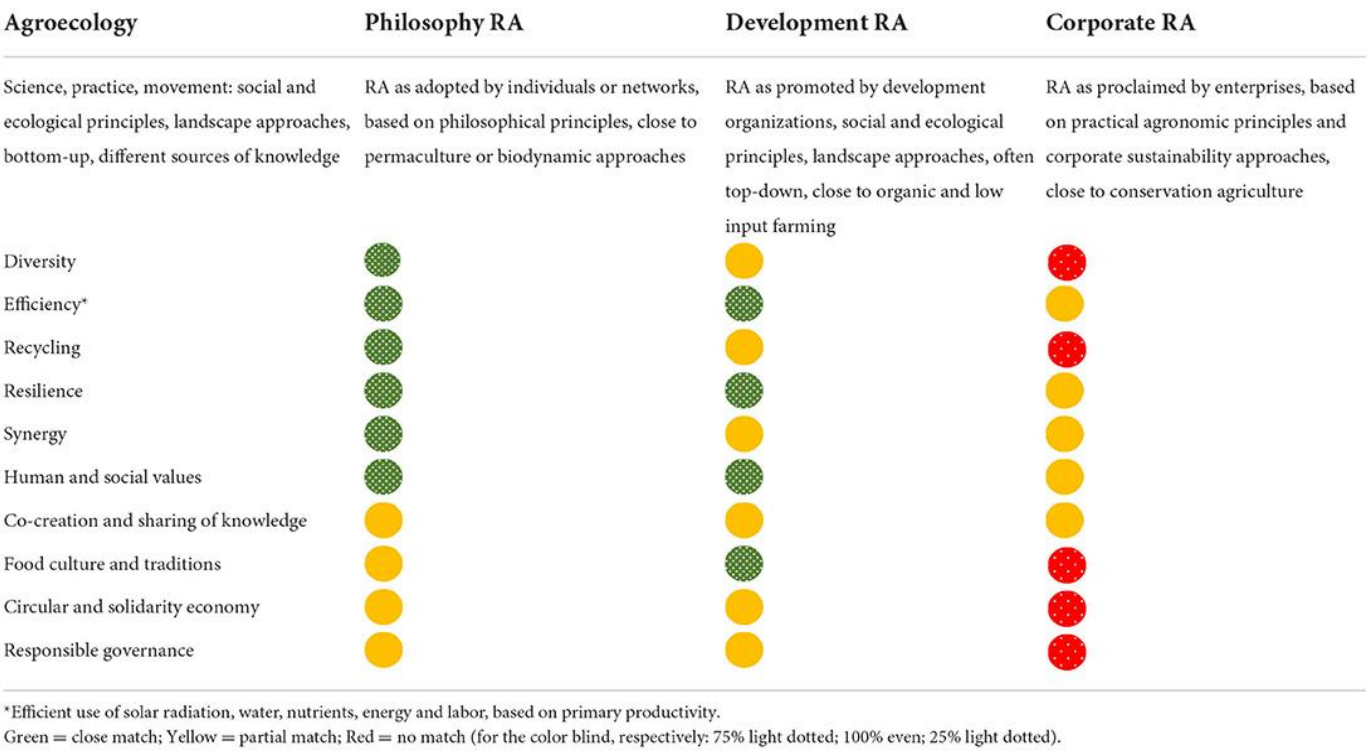

Figure 2.3.5: Using the FAO's "10 elements of agroecology," a comparison between agroecology and three different forms of regenerative agriculture (FAO, 2018). Source: (Tittonell *et al*., 2022).

Put simply, the "Philosophy RA" is a type of regenerative agriculture that highlights ecological principles. It is within this type of regenerative agriculture in which agroecology is replicated the most, the focus of this type of regenerative agriculture is on the human values and the ecology of the smallholder farm. Additionally, "Development RA", like philosophy RA focuses on the social and ecological aspects of agroecology except developmental organizations promoting RA, where various technologies are promoted. Lastly, "Corporate RA" is the type of RA that is promoted by large companies in which there is less focus on agroecological practices (Corbeels *et al*., 2020). Here, there is a reliance on external inputs such as fertilisers.

While Regenerative agriculture remains the most widely compared approach to Agroecology, there are other overlaps between other sustainable agriculture narratives, such as organic agriculture/farming, conservation agriculture, climate-smart agriculture and sustainable intensification. In their review, Bless *et al*. (2023), indicate that regenerative agriculture overlaps with other sustainable agriculture narratives (Figure 2.3.6).

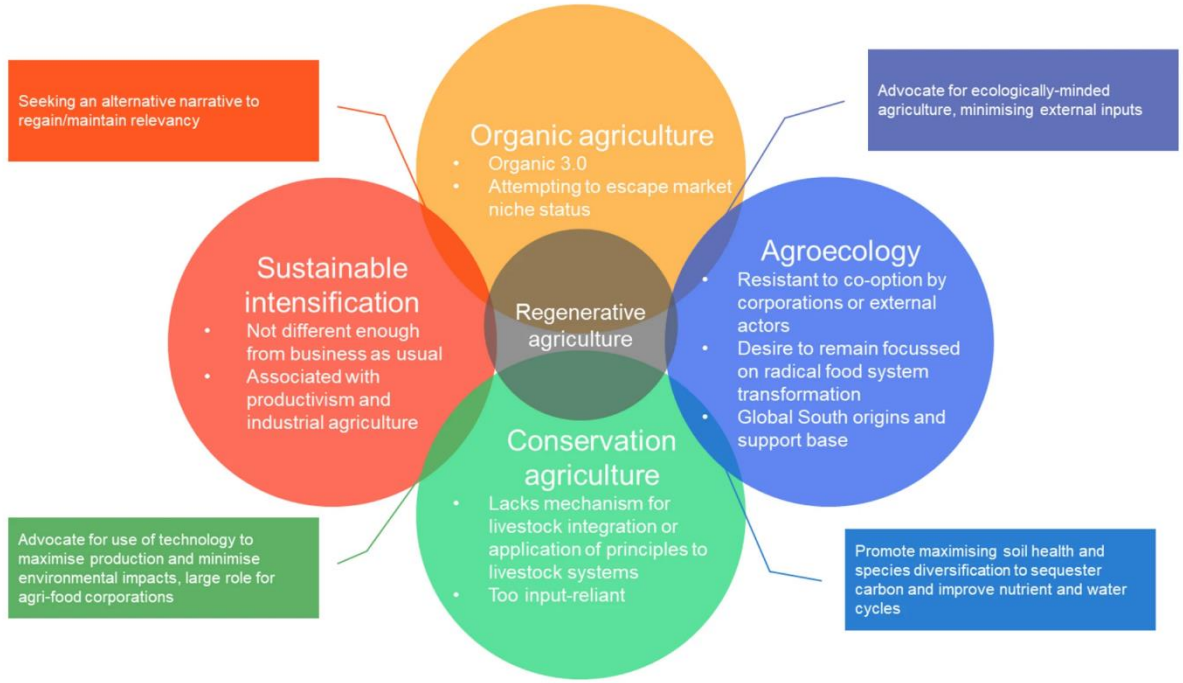

Figure 2.3.6: Sustainable agriculture narratives and their overlaps with regenerative agriculture. Source: (Bless *et al.*, 2023).

2.3.1.1 Organic Agriculture and Regenerative Agriculture

Organic Agriculture (OA) is a farming approach that prioritizes the use of natural processes and materials to maintain soil health and ecological balance, steering clear of synthetic substances like chemical fertilizers and pesticides (Rhodes, 2017). Regenerative Agriculture, while sharing OA's core value of soil vitality, takes a more proactive stance in ecological restoration. RA employs methods such as crop rotation, cover cropping, and composting to not only avoid synthetic inputs, but also to actively improve soil organic content and microbial life, thus aiding in the recovery of soil ecosystems (Lal, 2015). Additionally, RA adopts broader strategies for ecosystem revival, such as agroforestry, integrated pest management, and reintegrating animals into cropping systems, which contribute to richer soils and increased carbon capture. In essence, while OA forms the basis for sustainable agriculture by minimizing damage, RA seeks to advance these practices by actively repairing and enhancing the environment (Rodale Institute, 2020).

2.3.1.2 Conservation Agriculture and Regenerative Agriculture

Conservation Agriculture (CA) and RA share a commitment to reducing soil disturbance and promoting soil health. CA emphasizes soil cover, minimal tillage, and varied crops to prevent erosion and enhance water retention. RA also values ecosystem services, including water

regulation, pollination, and habitat creation, aiming to design agricultural systems that resemble natural environments (Kassam *et al.,* 2014; Lal, 2015; Pretty *et al.,* 2020). This approach not only focuses on soil preservation, but also aims to rejuvenate entire ecosystems, contributing to sustainable environments and livelihoods (Schreefel *et al.,* 2020). While both CA and RA strive to improve soil conditions and reduce erosion, RA adopts a more comprehensive strategy for managing ecosystems.

2.3.1.3 Sustainable Intensification and Regenerative Agriculture

Sustainable Intensification (SI) aims at enhancing farm productivity while being mindful of environmental health (Shrestha *et al*., 2021). SI focuses on boosting yields from existing farmland using fewer resources, thereby improving the efficiency of resource utilization. In contrast, RA encompasses not just productivity but also the restoration of ecosystems and community resilience. It employs methods like agroecology and agroforestry to rejuvenate natural systems and address broader issues such as climate change and social inequality. While SI is primarily concerned with production efficiency, RA's comprehensive strategy integrates agricultural practices into a larger social and ecological framework.

2.3.1.4 Climate Smart Agriculture and Regenerative Agriculture

Climate Smart Agriculture (CSA) is an approach developed by the Food and Agriculture Organization (FAO) of the United Nations to help transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. It aims to achieve three main objectives: (1) sustainably increasing agricultural productivity and incomes, (2) adapting and building resilience to climate change, and (3) reducing and/or removing greenhouse gas emissions, where possible (FAO, 2013). CSA is often more focused on achieving specific climate-related goals—productivity, adaptation, and mitigation—within the existing agricultural paradigm. In contrast, RA has a broader ecological focus, emphasizing the restoration of ecosystem health and function.

2.3.1.4 Permaculture and Regenerative Agriculture

Both permaculture and RA aim to create sustainable and resilient agricultural systems that enhance biodiversity, improve soil health, and restore natural ecosystems. They both promote practices that work with natural processes rather than against them, reducing the need for synthetic inputs and enhancing the farm’s ecological balance (Rhodes, 2017). permaculture is more of a design framework that can be applied to all aspects of human life, including agriculture, housing, community planning, and water management (Schreefel *et al*., 2020).

Broadly, RA builds from the existing approaches to agriculture distinguishes itself from other sustainable agriculture approaches by its focus on not just sustaining but actively regenerating ecosystems.

However, these approaches focus more broadly on the global perspective, the same might not be said in a South African perspective.

2.3.2. Foundations of regenerative agriculture?

Regenerative agriculture is not necessarily a new concept, its practices were the foundation of pre-colonial knowledge systems across the world. Many of the regenerative agriculture practices have emerged from different cultures, times and geographical settings independently (Sands *et al*., 2023). Furthermore, these practices are known to lessen and reverse human impacts on landscapes (Levin, 2022). Regenerative agriculture is based on Indigenous knowledge systems that have been the base of many agricultural practices. These practices are as follows:

1. Intercropping: In semi-arid/ arid conditions in Southern Africa, reoccurring droughts and infertile soils risk effective agricultural production resulting in food insecurity (Namatsheve *et al*., 2020). As a result, effective utilization over an extended period is critical (Giller et *al*., 2011). Intercropping is notably a widespread practice in sub-Saharan Africa, whereby, grain legumes are intercropped with staple cereal crops increases nitrogen cycling and availability in the soil (Nezomba *et al*., 2015). Research favours the practices of intercropping, this includes the availability of nutrients (Nezomba *et al*., 2015; Xue *et al*., 2016), pest management (Chabi-Olaye *et al*., 2005), an increase in diversity (Ojiem *et al.,* 2014) and overall soil health (Ngwira *et al.,* 2012). However, this is subject to climate variability. A study focusing on the cowpea as a sole crop intercropped with cereal rotations has indicated that climate risks result in an increased risk of crop failure (Kermah *et al*., 2018).
2. Crop rotation: Not to be confused with intercropping, crop rotations refer to the practice of growing various crops on the same land in different sequences of time – here the soil is used by one crop and replenished by another (Selim, 2019). However, intercropping is growing crops on the same land at the same time. According to literature, crop rotation improves the overall soil structure and composition of the soil (Dury *et al*., 2012). Additionally, this practice reduces the use of chemical pesticides and herbicides – with studies indicating that the use of crop rotation reduces the risk

of diseases and pests (Selim, 2019). Some researchers have indicated that the inconsistent use of various crop rotations is negatively associated with this practice and has led to decreased profitability (Garbelini *et al*., 2022). In contrast, it has been reported that diversified crops lead to higher profitability (Volsi *et al*., 2021).

3. Cover cropping: Not to be confused with intercropping, cover cropping is the process whereby the farmer plants ground cover during harvest so as not to leave the soil bear- they are usually planted between the rows of primary crops (Pokharel *et al*., 2023). Research indicates cover crops play a role in sustainable crop production and strengthening of ecosystem services by improving soil health, soil moisture, organic matter retention and the regulation of greenhouse gas emissions (Daryanto *et al*., 2018; Beaumelle *et al*., 2021).
4. Mulching: Following the practice of regenerative agriculture, mulching, covering of the soil and cover crop residue can be categorised under the same sub-category as the same benefits can be observed. Mulching here means to cover the soil surface with plant elements including leaves, grass and crop residue (Iqbal *et al*., 2020). Covering the soil provides the increased activity of soil-enhancing organisms such as earthworms (Kader *et al*., 2019; Iqbal *et al*., 2020).
5. Integrated livestock system: An integrated livestock system is an agricultural system that combines the production of both crops and animals (Uduji and Okolo-Obasi, 2017). Research indicates that the integration of livestock into cropping systems have important benefits (Uduji and Okolo-Obasi, 2017). Excrement from livestock is collected and used as manure to improve crop production, reducing the requirement for fertilizers. Thus, enhancing the soil structures and nutrients found in the soil (Hendrikson *et al*., 2005).
6. Reduced tillage: Evidence has suggested that no-tillage methods can reduce soil CO_2 emissions and at a larger scale the potential mitigation of climate change (Abdalla *et al.,* 2021).
7. Polyculture/Planting of multiple crops: Similar to intercropping, polyculture has been proven to have positive effects on overall soil health by the improvement of the soil structure and soil fertility (Hirschfeld and Van Acker, 2021). While some research indicates that integrating polyculture reduces pests (Adamczewska-Sowińska and Sowiński, 2020; Bamboriya *et al*., 2022), another paper indicates that food security is impacted negatively by polyculture (Loomis, 2022).

These practices form the basis of regenerative agriculture and can be practiced according to different geographic locations and conditions (Bergmann *et al*., 2022; Jordon, 2022).

Other practices that are not included in the current understanding of regenerative agriculture, but are important include:

1. Biochar: In their review, Faucon *et al*. (2023), indicated that the combination of agroecology and the bioeconomy could create more resilient agriculture through the implementation of biochar. Biochar is used to improve soil structures, health and nutrients all while sequestering carbon (Bolan *et al*., 2022). Biomass is defined as solid substance that originated from living organisms, which is comprised of biological, organic and inorganic substances (Zubairu et al., 2023).
2. Drought-resistant crops: Drought-resistant crops refer to crops that are adapted to survive arid conditions with little assistance and minimal water, while these are suitable for smallholder farmers - these crops are most suited to small-scale farming that does not have the equipment to control growing conditions (Verma *et al*., 2018).
3. Seed saving: As a result of climate change and inequalities posed by modern food systems, seed saving – a practice that is as old as time, is another form of regenerative agriculture (Wijerathna-Yapa and Pathirana, 2022). Saving seeds holds many advantages, it preserves crop diversity, it is cheaper to buy seeds, seeds can be passed down from generation to generation and the resilience of seeds is ensured by testing crops to various environmental conditions (Singh *et al*., 2015; Peres, 2016).

The literature indicates that regenerative agriculture lacks precise and uniform definitions and standards, making the measurement of its outcomes and impacts challenging (Tittonell *et al*., 2022). This proves difficult for scaling and disseminating regenerative agriculture among farmers, consumers and policymakers and overcoming knowledge gaps such as markets, incentives, skills and policies. Hence, there is a need for more research and evidence-based studies of economic, environmental and social trade-offs of regenerative agriculture, especially to assess the compatibility in different regions – including communities of South Africa, which have been subject to limited research in this field.

2.4 VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE

The potential to suffer negative consequences from climate change is known as climate change vulnerability, and it can affect both natural systems and people (Gumel, 2022;

Ngcamu, 2023). Vulnerability is influenced by factors such as exposure, sensitivity, adaptive capacity and development patterns (IPCC, 2022). Climate change vulnerability is higher in some regions than others, and Africa's significant reliance on natural resources, limited socioeconomic development, and high susceptibility to climate hazards make it one of the most vulnerable continents (UNFCCC, 2020). Here, regenerative agriculture emerges as a sustainable narrative in this scenario, offering a sustainable pathway that not only mitigates climate change vulnerability by enhancing ecosystem resilience and adaptive capacity, but also revitalizes the socio-economic fabric of communities. By prioritizing soil health, biodiversity, and water conservation, regenerative practices can transform vulnerable regions into bastions of sustainability and resilience.

Reduced water availability, decreased crop productivity, increased food insecurity, loss of biodiversity and ecosystem services, damage to infrastructure and human health, migration and displacement, and an increase in conflict and violence are just a few of the numerous and interconnected effects of climate change that Africa is experiencing (IPCC, 2022). Higher temperatures are predicted to make these impacts worse, and they may interact with other risk factors like conflict, population growth, urbanisation, and inequality (IPCC, 2022). Moreover, climate change exacerbates existing inequalities and vulnerabilities, especially for women, children, indigenous peoples, and poor and marginalized groups (UNEP, 2024).

There is a diverse range of climatic zones on the African continent, from arid deserts to humid forests, and each one faces various challenges and opportunities for adaptation. For example, in the arid and semi-arid regions of northern and southern Africa, where rainfall is projected to decrease and temperatures to increase, water conservation and management, drought-resistant crops and livestock, and early warning systems are some of the possible adaptation options (IPCC, 2022). In contrast, in the humid tropics of central and western Africa, where rainfall is projected to increase and cause more flooding and landslides, improved drainage and flood protection, resilient infrastructure and housing, and integrated water resources management are some of the possible adaptation options (IPCC, 2022).

Adaptation is essential, as the projections indicate Sub-Saharan Africa would likely experience some of the most severe effects of climate change, such as increased droughts, heat waves, floods, biodiversity loss, food insecurity, water scarcity, and health risks (Munyai *et al*., 2021; IPCC, 2022). Here, adaptation is key in reducing the risks and costs of climate change, where the effects are already being felt and the adaptive capacity is low (Mortreux *et*

al., 2020; Schipper, 2020). The ability to adapt to climate change, mitigate to effects and consequences, or seize opportunities is known as adaptive capacity (Matewos, 2017; Chepkoech *et al*., 2020).

Africa is at a turning point where, if adaptation is not scaled up, and accelerated throughout the continent, attempts to meet the Sustainable Development Goals may be compromised by climate change (UNDP, 2018). Many rural populations reside in flood or drought-prone areas with limited infrastructure and resources (Munyai *et al*., 2021). Furthermore, the majority of people living in rural areas are dependent on agriculture for a living. (Snyder *et al*., 2020).

The IPCC (2022) lists several risks, including decreased food security and crop productivity, increased drought and scarcity of water, loss of ecosystem services and biodiversity, damage to infrastructure and human settlements, higher rates of illness and mortality, and decreased opportunities for economic growth and livelihood. To cope with these challenges, countries need to implement adaptation strategies that are context-specific, participatory, multi-sectoral, and aligned with their development goals.

Some examples of adaptations include improving water management and irrigation systems, promoting climate-smart agriculture and agroforestry, enhancing early warning systems and disaster risk reduction, diversifying income sources and livelihoods, strengthening social protection and safety nets, investing in resilient infrastructure and renewable energy, and supporting community-based adaptation and indigenous knowledge systems (Anwar *et al*., 2013; Makate *et al*., 2019; Makate, 2020; Aryal *et al*., 2020).

Enhancing agricultural communities' ability to adapt to the challenges encountered requires combining climate change-related concerns with market risk factors, existing climate variability, and other policy domains like sustainable development (Matewos, 2020). The goal of South African government initiatives and policies since 1994 has been to assist smallholder farmers (Chapman *et al*., 2021). However, initiatives to bring about changes have been undermined by government departments that are understaffed and have a diminishing expertise base (Wilk et al., 2013).

Adaptation to climate change can increase resilience and decrease vulnerability, but it has limits and costs. Adaptation options vary depending on the context and sector, but some general principles include integrating climate information into planning and decision-making,

enhancing institutional and governance capacities, promoting participatory and inclusive approaches, diversifying livelihoods and income sources, investing in ecosystem-based solutions, and strengthening disaster risk management (IPCC, 2022). Regenerative agriculture and gender-inclusive food systems play a pivotal role in this framework, as they not only restore and maintain ecological health, but also ensure equitable participation and benefits across genders, thereby enhancing the overall sustainability and resilience of food systems. These principles are aligned with the IPCC's 2022 insights and underscore the importance of integrating gender equality and ecological integrity into the core of climate adaptation strategies (IPCC, 2022).

2.5. GENDER, CLIMATE CHANGE AND AGRICULTURE

While there are undoubtedly consequences for the economy, business corporations and agriculture systems, the social impact or the gendered impact of climate change is often overlooked (Barnes *et al*., 2021). According to IPCC (2021), the effects of climate change will affect people of all ages, genders, and socioeconomic classes, with the poorest people most likely to be affected. Although the impact that climate change will have on the rural poor is documented, the gendered aspect is often overlooked (Balehey *et al*., 2018; Glazebrook *et al*., 2020; Ide *et al*., 2021). Gender equality and women empowerment are critical in achieving inclusive and sustainable food systems. However, women often face multiple constraints and barriers that limit their participation and benefits from agricultural activities. Some of these barriers include accessing resources, benefitting from agricultural market chains, and being part of discussions that influence their livelihoods – including discussions around climate change (Quisumbing and Doss, 2021). Due to the prevalence of patriarchy in many societies especially rural communities, women and children are vulnerable to climate inequalities (Barnes *et al*., 2021; FAO, 2023). In light of climate change disasters, it has been found that women and children are 14 times more likely to face more extreme consequences than men (WHO, 2013) this includes exposure to gender-based violence and sexual violence (Bridget-Mahoney, 2016).

The manifestation of climate disasters as a consequence of the climate crisis often impacts the education of women, whereby adolescent girls are compelled to leave school to help in migration or to allow their male siblings access to education (Abid *et al*., 2018). In other cases, girls are forced to leave school to fetch water to run the household or may drop out of

school during puberty due to inadequate sanitation facilities (Bridget Mahoney, 2016). This exacerbates the existing gender equality gap and disadvantages women.

Women constitute a large role in the global agricultural workforce, accounting for 43% of the overall workforce in the Global South, 20% in Latin America, and 50% in Africa (FAO, 2011). Agriculture is vital for the employment of women in rural communities. However, despite their role in agriculture, they continue to undertake it with limited agricultural resources – recognized as the "the gender gap in agriculture" (FAO, 2023; Quisumbing *et al*., 2014). The gender gap in agriculture is a hinderance to the overall productivity in agriculture – these include factors such as gendered labour division, resource constraints and limited access to knowledge around climate conditions (Nyasimi and Huyer, 2017). Therefore, measuring and improving empowerment of women in agriculture is a vital task to understand the opportunities and barriers that could allow for better policy development (Quisumbing *et al*., 2023).

The differences in socially constructed roles between men and women is known as gender; these differences lead to different interactions within a society (Ongoro and Ogara, 2011). The social behaviour within a community is thus determined for how men and women interact with the environment and each other (Enssle and Kabisch, 2020). It is expected that in the onset of a climate disaster such as floods and droughts, the response elicited would be different between men and women (Jost *et al*., 2016). According to gender norms dictated in different cultures, men would migrate closer to towns and cities to find jobs to provide for their families while women would stay behind in their rural community to manage the household (Rivera, 2021). Less access to agricultural land, services, and inputs that may be utilised to adapt to change makes responsibilities like taking care of the home, raising children, and gathering firewood and water particularly challenging (Ongoro and Ogara, 2011). Gendered social norms of communities thus inhibit the adaptive response of women in a community (Jost *et al*., 2016).

According to the FAO, men and women adapt to the climate in different ways depending on their knowledge and resource availability (FAO, 2023). Furthermore, it is acknowledged that women do not have the same access to resources in comparison to men (Jost *et al*., 2016). Research has revealed that women have limitations in their access to resources and education, including ownership opportunities, creating an obstacle to the development of a society that is more inclusive of all genders (Ajani et al., 2013; Huyer, 2016).

Studies exploring gender and climate change in a rural context have revealed that members of communities, especially male members, do not understand how climate change affects women (Eastin, 2018). In addition to this, studies have also revealed that women have been affected by societal norms that dictate the role of women is to be looked after in a community and this also acts as a barrier towards equality (Ampaire *et al*., 2018). In general, in rural communities, because men have better access to resources and socio-economic circumstances, they are more prepared for climate disasters than women (Eastin, 2018). Apart from differences in gender to climate change, other factors shape the vulnerability of women.

Malapit *et al*. (2019) developed the Women's Empowerment in Agriculture Index (WEAI) to measure women's empowerment in agriculture. The WEAI is a composite index that measures women's empowerment across five domains: production, resources, income, leadership, and time. Gender parity in empowerment within households is also measured and areas of disempowerment for women and men are measured (Malapit *et al*., 2019). The WEAI has been applied in 50 countries and has generated evidence on the linkages between women's empowerment and various development outcomes, including resilience, agricultural productivity, food security, nutrition, health, and education (Malapit and Quisumbing, 2015; Quisumbing *et al*., 2022).

Furthermore, a local-level tool has been created to reflect on specific objectives that each region aims to achieve. Key challenges of this include: ensuring the cultural relevance and sensitivity of the indicators and domains; capturing the complexity and dynamism of women's empowerment processes; discussing the potential trade-offs and synergies between aspects of empowerment; including qualitative and participatory methods to substantiate quantitative surveys and enhancing the capacity and commitment of national statistical systems to collect, analyse, and use gender-disaggregated data on empowerment of women (Quisumbing *et al*., 2023). Specialized tracking of market inclusion and value chains that monitor women's empowerment in agriculture in various stages presents an opportunity for further research and collaboration with multiple stakeholders involved in gender equality and food systems (Quisumbing and Doss, 2021).

According to Jost *et al.* (2016), Climate Smart Agriculture may provide the access to opportunities for rural women to obtain an income while maintaining the household and family. These initiatives have been shown to empower rural women by providing access to productive assets, labour-saving technologies, and market linkages, which enable them to

increase agricultural productivity and secure sustainable income while balancing household and family responsibilities (UN Women, 2020). In contrast, studies have indicated that conservation agriculture is highly labour intensive and discourages women participating in different practices (Aliber and Hart, 2009).

Nkonki-Mandleni *et al*. (2022) in their paper states that there should be more provisions made for women and as such training and dissemination of information that allows for women to gain skills encouraging their participation. While agroecology recognizes the vital role of women in food systems, (Mestmacher and Braun, 2021; Trevilla Espinal *et al*., 2021; Zaremba *et al*., 2021), Nath and Athinuwat (2021) argue that without addressing social gender norms and patriarchal structures, farming alone cannot empower female smallholders.

Therefore, it is essential to critically examine the intersection of gender dynamics and agricultural practices, to understand whether the principles of regenerative agriculture can truly be transformative for women in rural communities, just as they have been in agroecology. While the literature is limited in regenerative agriculture and women involvement, previous studies based on women and agroecology and conservation agriculture provide an opportunity to identify if regenerative agriculture holds the same opportunities for women in a rural setting. Globally, the number of hungry people would drop by 17% and agricultural productivity might rise by 30% if rural women were given the same chances as males (FAO, 2011). In addition to this, advancing gender equality by providing resources to women provides an economic means to further better themselves and awards rural women to be the catalyst of change within their community (Ampaire *et al.,* 2020).

2.6 THE SOUTH AFRICAN AGRICULTURAL SECTOR AND CLIMATE CHANGE

To address the dualism in South African agriculture, it is essential to recognize the contrast between the large-scale, commercially driven farms that are predominantly owned by a small percentage of the population, usually white minority and males, and the smallholder farms that support the livelihoods of the majority in rural areas (Mtshali and Akinola, 2021). This dichotomy not only reflects the historical inequities in land ownership but also underscores the current challenges in ensuring equitable access and opportunity within the agricultural sector. The Land Audit Report indicates there are a total of 37 078 289 ha of farmlands that are owned by individuals in South Africa of which 72% are White, 15% Coloured, 5% Indians and 4% are Black. In addition to this, 72% of farms are owned by males, followed by 13% owned by females and the last 5% is co-owned between the two (DoRDLR, 2017).

According to estimates, 70% of people living in rural areas rely on agriculture for a living (DoRDLR, 2017).

In the agricultural industry, there were 40,122 large-scale farms and almost 300,000 small-scale farms as of the 2017 Agricultural Census conducted by Stats SA (2020). The General Household Survey of 2019 revealed that 2.3 million households were involved in agricultural production activities oriented towards subsistence in addition to the 300,000 units (Stats SA, 2020). Smallholder farmers primarily seek food security in agriculture on farms ranging between 1 and 5 hectares (Elleboudt, 2012). Small-scale farmers practise subsistence agriculture on plots less than a hectare including a few animals, while commercial farmers have land of hundreds or thousands of hectares, crops, and a large number of livestock are cultivated. In numerous African countries smallholder agriculture is predominant (Giller *et al.*, 2011; Henriksson-Malinga *et al*., 2018). Here, Greenberg's typology, which differentiates between black smallholder farmers, black commercial farmers, and white small-scale commercial farmers, provides a useful tool for understanding the overlap and distinctions between smallholder and commercial farming categories (Greenberg, 2015). This highlights that smallholder farmers, often engaged in subsistence agriculture, operate on plots less than a hectare, while commercial farmers manage significantly larger landholdings with extensive crop and livestock production. Used to distinguish between these groups based on land size, type of agriculture practiced, and economic objectives, thereby clarifying the differences in figures and characteristics.

The predominance of dry land in South Africa's rural areas is concerning for farmers who rely on rainfed crop production (Fukuda-Parr and Taylor, 2015). Smallholder farmers use indigenous knowledge systems as coping mechanisms to lessen the consequences of floods and droughts brought on by unpredictable climate conditions due to limited access to knowledge of current farming practices. (Masuku *et al.*, 2017; Lukhele-Olorunju and Gwandure 2018; Akanbi *et al*., 2021). Forecasts suggest there is a rapid change in temperature in South Africa (Figure 2.6.1).

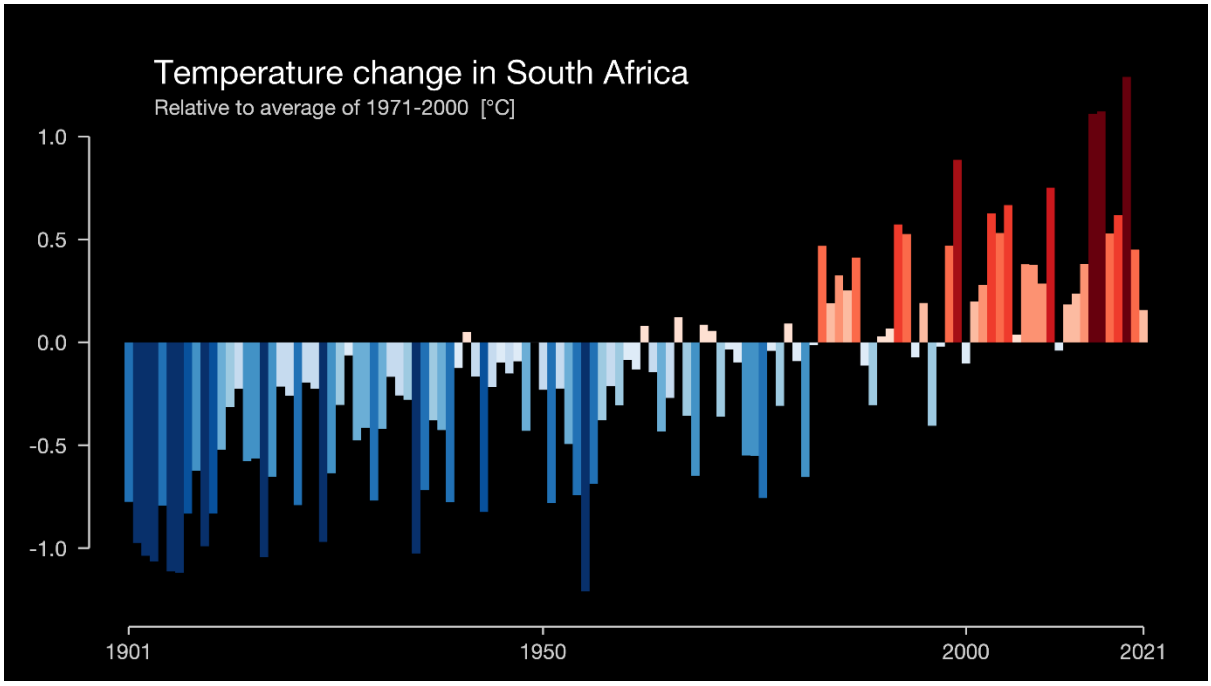

Figure 2.6.1: Temperature change in South Africa from 1901-2021. Source: (Institute for Environmental Analytics, 2022).

South Africa has adopted aspects of industrial agriculture, contributing to its productivity. However, some challenges persist, including access to markets and seeds, limiting the potential benefits of sustainable agricultural approaches (Greenberg, 2015). The environmental and social impacts of industrial agriculture are profound and multifaceted, encompassing not only the degradation of natural ecosystems, but also the disruption of local communities and traditional farming practices. An approach must therefore integrate strategies that mitigate these adverse effects, fostering agricultural systems that are not only productive but also regenerative, preserving biodiversity, soil health, and water resources while supporting the socio-economic well-being of farming communities. During the apartheid era of agriculture, there was a base figure of 100 000 white farmers with large farms averaging 1000 hectares of land in size – accounting for 86% of South Africa's agricultural land (Ngam, 2021) These farms were well-funded, highly mechanized and included cheap labour by other racial groups (Ngam, 2021; Zantsi, 2021). However, there has been a change in the importance of community farms in recent times (Hilson, 2016; Bjornlund *et al*., 2020). Emerging farmers operate community farms with the help of the household and some community members and local preferences are considered with this type of farming (Perez *et al*., 2015).

2.6.1. South African adaptation

South Africa has a rich diversity of local and indigenous knowledge and practices that can support adaptation to climate change. However, these are often overlooked or undervalued by formal institutions and policies. Executing adaptations must consider, respect, and incorporate local and indigenous knowledge, as well as foster dialogue and collaboration between different knowledge systems (IPCC, 2022; UNEP, 2024).

Knowledge sharing among farmers is a key strategy for choosing and implementing innovative farming techniques in South Africa that will help with climate change adaptation (Makate, 2020; Talanow *et al*., 2021). Additionally, farmers are cautious while adopting new techniques if they lack sufficient funds (Autio *et al*., 2021).

However, adaptation alone may not be sufficient to avoid significant losses and damages from climate change. There is also a need to increase access to finance, technology, information, and capacity building for adaptation across Africa, especially for the most vulnerable groups and communities. International cooperation and solidarity are essential to address the challenges of climate change in South Africa and to ensure a fair and equitable distribution of responsibilities and benefits (UNFCCC, 2020). Humans' ability to facilitate the adjustments of natural systems (via migration, compositional changes, etc.) will lead to successful adaption to a changing climate (Noble *et al*., 2014; Pereira *et al*., 2017). Moreover, more research and data are required on the current and future impacts of climate change, as well as the effectiveness and costs of adaptation measures.

2.7 IMPORTANCE OF THE STUDY

Agricultural productivity in South Africa is threatened by climate change, especially in rural areas where there is inadequate information available (Fonta *et al*., 2011; Muluneh, 2021). This challenge is exacerbated by the reliance on rain-fed agriculture, which is vulnerable to erratic weather patterns and prolonged droughts, further affecting smallholder farmers who form the backbone of rural agriculture in South Africa (Sinyolo *et al.,* 2021). The lack of localized, context-specific data and adaptive knowledge continues to hinder farmers' capacity to effectively respond to these climatic changes, thus threatening food security and livelihoods.

Regenerative agriculture has emerged in North America, The United Kingdom, New Zealand and Australia, as a promising strategy to deal with the urgent issues of environmental

degradation, food security, and climate change (Toensmeier, 2016; Muhie, 2022; Bless *et* al., 2023). However, its adoption and application in South Africa are still in its developmental stages, with limited empirical studies that explicitly address the challenges, opportunities, and contextual nuances unique to the South African agricultural landscape. Moreover, the definition of regenerative agriculture is heavily debated, and practitioners and scholars are unable to reach a consensus on a definition. The current general understanding of regenerative agriculture is a set of practices that include integrating livestock, minimizing soil disturbance, covering of the soil and an overall reduction of fertilisers (Newton *et al*., 2020; Sands *et al*., 2023). These practices aim to achieve principles, which are to restore the health and fertility of the soil, enhance biodiversity, and sequester carbon (Newton *et al*., 2020; Schreefel *et al*., 2020; Bless *et al*., 2023; Khangura *et al*., 2023; Sands *et al*., 2023). It is seen as a potential climate adaptive solution to mitigate climate change and an improvement in food sovereignty. Food sovereignty is intrinsically linked to regenerative agriculture as it empowers farmers, including peasant farmers, seed savers, and local food producers, to cultivate food in a manner that is culturally appropriate and promotes health through sustainable farming methods (Weiler *et al*., 2015; Sampson *et al*., 2021). This concept is particularly relevant in South Africa, where land reform issues, historical injustices, and socio-economic inequalities continue to shape agricultural practices and access to resources.

Smallholder farmers who play a crucial role in global food production often face a lack of resources, and access to knowledge and technologies (Fan and Rue, 2020). Regenerative agriculture offers a practical and accessible approach for smallholder farmers to improve their livelihoods and agricultural productivity (Schreefel *et al*., 2020). Regenerative agriculture practices are often low-cost and require minimal inputs, making them suitable for resource-constrained farmers (LaCanne and Lundgren, 2018; Newton *et al*., 2020). Hereby, this study contributes to the larger understanding of the application of regenerative agriculture by helping to identify the barriers and opportunities for both men and women to participate in and benefit from regenerative agriculture.

For regenerative agriculture to be successful in South Africa, there is a need for localized research that identifies specific barriers and opportunities for both men and women to participate in and benefit from regenerative practices. Gender dynamics in agriculture often lead to disparities in access to resources, decision-making power, and opportunities for women farmers (Huyer, 2016; Quisumbing *et al*., 2023). Local gender dynamics play a crucial role in determining who has access to and control over agricultural resources, such as

land, inputs, information, and markets, as well as who benefits from agricultural production and income (Azumah *et al*., 2022; FAO, 2023; Quisumbing *et al*., 2023). Previous studies have focused on the agriculture gender gap from a quantitative perspective, highlighting disproportionate access to assets, land and extension services (Olumba and Alimba, 2022; Quisumbing *et al*., 2023). The scarcity of qualitative research on this subject hinders a deeper comprehension of the cultural norms and local dynamics that contribute to the gender disparity in agriculture. A more nuanced investigation is necessary to illuminate the underlying factors perpetuating this gap and develop strategies to address these specific challenges. Hence, the use of a gender lens was used to highlight the current strategies followed by women – providing insight to improve agricultural productivity, economic development, human well-being, and environmental sustainability.

Additionally, regenerative agriculture is garnering interest as a potentially transformative food systems approach. Current literature highlighting the role of women in regenerative agriculture is limited. Hence, this study looks at understanding the potential of regenerative agriculture in rural communities, considering the importance of local gender dynamics and how it may address key challenges and opportunities that rural communities face in terms of agriculture and climate change. A gender lens will be used to examine how regenerative agriculture considers the local gender dynamic, furthermore, generating evidence-based recommendations that can inform policies that are more sustainable, equitable, and inclusive.

CHAPTER THREE

RESEARCH METHODS AND METHODOLOGY

3.1 INTRODUCTION

This research aimed to explore the current agriculture practices and knowledge around regenerative agriculture applied by smallholder farmers in the rural communities of Bushbuckridge, Mpumalanga. Ethical approval was granted by the University of the Witwatersrand (Protocol number: H22/10/10). An explorative study approach was used to collect data for this study. Key informant interviews were held with academics, local agricultural department researchers, farmers, and different organizations that are involved with the implementation of regenerative agriculture across South Africa. These interviews were used to define regenerative agriculture in the South African context and, in a Mpumalanga context. Thereafter, individual interviews and focus group discussions were conducted in three villages of Bushbuckridge, Mpumalanga to assess the knowledge and practice of regenerative agriculture. A gender lens was used to identify if regenerative agriculture considers gender, and ultimately if regenerative agriculture could contribute to gender-equitable food systems. This chapter outlines the theoretical framework, research methods and methodology, research design, sample size, sampling, and data collection analysis.

3.2 CONCEPTUAL FRAMEWORK

According to O'Brien *et al*., (2007), climate change exposes a group of people to conditions that result in vulnerability. However, contextual vulnerability means that contextual conditions determine the level of vulnerability a group of people may face as a result of climate. Vulnerability can be viewed via three distinct pathways. Firstly, these include the exposure to climate change impacting factors like temperature and precipitation that impact agricultural outputs. Secondly, vulnerability can be explored through sensitivity, where the availability of resources is the viewpoint of this framework. And, thirdly, vulnerability can be viewed through the adaptive capacity of participants through factors such as health, wealth, knowledge, technology and external factors such as corruption (Figure 3.2.1). Addressing these vulnerabilities adds to the adaptation plans for future climate disasters (Kelly and Adger, 2000). The initial stage of adapting to vulnerability includes an integrative approach

that addresses climate change with equity and justice to help policymakers determine action plans (O'Brien et al., 2007).

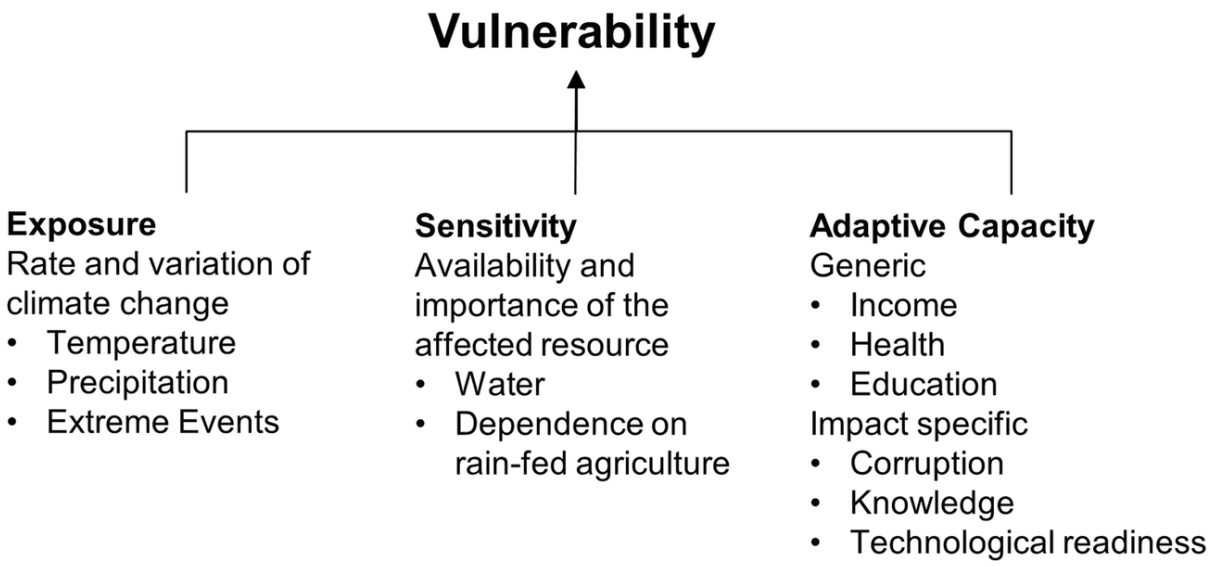

Figure 3.2.1: Vulnerability framework (Source Schiling *et al*. (2020) – based on IPCC (2007).

Schiling et al. (2012) define vulnerability as the combination of exposure, sensitivity, and adaptive capacity providing an approach to understanding the impacts of climate change applied in a North African case study. While this framework has not explicitly been applied to regenerative agriculture, it has been applied to agriculture and its effects on water resources and the subsequent effects of localized climate change on agriculture. By applying this framework to regenerative agriculture, one can evaluate the regenerative agricultural practices and how these might reduce exposure to climate risks, decrease sensitivity by improving soil health and water retention, and increase adaptive capacity through enhanced biodiversity and ecosystem services.

While this framework encompasses the socio-ecological circumstances of participants – a key concept of this thesis is the gender aspect which is not included as a factor in the adaptivity capacity branch of this framework. For this reason, a gender lens will be applied to answer the overall arching research question.

This thesis draws inspiration from the feminist political ecology theory, which is a field of political ecology useful in identifying and understanding different relationships between the environment, political structures, policies and influencing factors that result in increased

gendered vulnerabilities. However, for the scope of this thesis, gender is used as a lens to unpack vulnerability and the potential of regenerative agriculture to tackle challenges relating to gender inequalities and climate change.

3.2.1 Gender lens

Feminist political ecology is an element of feminism that is intersectional, with gender and the environment used to inform discussions around change in politics (Sato and Alorcon, 2019). Feminist political ecology emphasises the gendered division of responsibilities for women and argues that the environmental risks faced by women are far greater than those of men. The feminist political ecological approach is important as it facilitates discussions around men and women having different access to resources in different areas, from different races or social classes (Sato and Alorcon, 2019). This thesis draws from this field of political ecology, which focuses on the political structures that dictate the partitioning of environmental resources.

> "Capitalism, patriarchy, race and ethnicity shape a woman's oppression and vice versa" (Folbre, 2021).

Studies have consistently indicated that women possess unequal access to resources in agriculture – including access to ownership of assets, knowledge, and seeds (Quisumbing and Doss, 2021; Vercillo, 2022). Gender biases as a result of patriarchy and social norms restrict the ability of women to engage with agriculture independently (Doss, 2001). There have been reports of disparities in credit, knowledge and extension services- where women face financial challenges in conducting agriculture activities (Quisumbing *et al*., 2015). Additionally, there may not be a gender difference in the impacts of climate change., however, the adaption responses are different as a direct result of access to resources and gender norms of the community (Kawarazuka *et al*., 2017).

In addition to women's agricultural responsibilities, traditional gender roles often dictate specific tasks and responsibilities within the household, with women typically responsible for unpaid care work, such as childcare and household chores. Subsequently, women's multiple roles within the household can hinder their participation in decision-making in agriculture further limiting their access to resources (Agarwal, 1997).

Decision-making power within agricultural households is often gendered, with men typically wielding greater authority over key decisions related to land use, crop selection, and marketing. Research by Meinzen-Dick *et al*. (2019) highlights the importance of recognizing

and challenging unequal power dynamics in decision-making processes to promote gender-equitable outcomes in agriculture. Increasing women's involvement in decision-making and encouraging gendered collaboration on decisions can improve social welfare, sustainability, and agricultural output.

Additionally, current gender studies emphasize the need for intersectional analysis within agriculture and rural structures, especially in an African context (Thompson-Hall *et al*., 2016; Fehr and Moseley, 2019; Lawson *et al*., 2020). In rural African agriculture, there are large gender disparities that are often exhibited, visible through the difference in crops produced and access to farming equipment between men and women of the same area (Huyer *et al*., 2016). Women are unable to improve their agricultural production due to cultural norms that limit their education, inheritance, resource access, and inclusion in discussions (Vercillo, 2021). Drawing from a well-recognized feature of the feminist political ecology lens is the ability to consider the micro-politics surrounding resource access, positioning in the community, household roles, and the influences of globalization (Vercillo, 2021).

This gender lens challenges patriarchal notions in a manner that promotes transformation in light of women and their roles in agriculture (Elmhirst, 2015). It seeks to empower women as agents of change, rather than victims of environmental problems, and to foster more equitable and sustainable forms of development that respect the diversity and complexity of human-nature relations. Applying a gender lens in this research is essential for understanding and addressing the complex ways in which gender influences agricultural practices, policies, and outcomes. By uncovering gender disparities and inequalities, researchers can contribute to the development of gender-sensitive policies that promote equity, sustainability, and social justice in the agricultural sector.

Hereby, to assess the overarching research question, a gender lens was used to understand the challenges facing women in different villages and what system change could be implemented to allow for gender equality in food production. This includes investigating the potential of regenerative agriculture as a means of providing women with access to resources in the community and their experiences within their community if there have been any injustices due to the effects of climate change.

3.3 RESEARCH METHODS AND METHODOLOGY

3.3.1 Research methods

This thesis follows an explorative research design to explore the research questions (Mbaka and Isiramen, 2021). The purpose of this study design was to comprehend regenerative agriculture within the context of South Africa and to explore the lived experiences of farmers including women in rural communities of Mpumalanga. This method has been used in similar studies that have looked into gender inclusivity, Africa's utilisation of natural resources and agriculture in a changing climate (Phiri *et al*., 2020; Maake and Antwi, 2022). Hence, an explorative research design is appropriate for this study. Applying a qualitative research strategy to this study is appropriate as this method involves the research participants providing context and their perspective to understand experiences with regard to a phenomenon (Mohajan, 2020). As indicated previously, this study intends to explore if regenerative agriculture has the potential to create climate-adaptive and gender-inclusive food systems in rural communities of Mpumalanga. To answer the overarching research question, this study design intended to generate qualitative data through the use of semi-structured interviews, surveys, focus group discussions and observations.

A qualitative research methodology was selected as the primary research methodology for this study. However, data in this thesis is represented quantitatively in the form of various pie charts and histograms. This method is selected when the phenomenon that is being studied is unknown and the aim is to explore the study topic with varying levels of depth (Mbaka and Isiramen, 2021). Observations, focus groups, semi-structured interviews, and other qualitative research techniques enable the integration of many theories and facts, and aid in answering questions about experience, understanding and perspective in the view of the participant (Richey *et al*., 2014; Hammarberg *et al*., 2015; Aspers and Corte 2019).

When examining a theory or phenomenon in its natural environment, qualitative case studies are appropriate (Sultan and Yin Wong, 2013). Simons (2009) expands on this, indicating that case studies explore different angles of a specific project – this can be explored through different policies, institutions and actors. Additionally, adopting a qualitative case study research strategy provides key informants with a platform, through surveys, interviews or focus group discussions, to vocalise their knowledge, thus, providing in-depth contextual insight into the research problem (Gioia *et al*., 2013; Sultan and Yin Wong, 2013). This is especially true with this thesis where the concept of regenerative agriculture is being studied using different perspectives, i.e., through the understanding of organizations and the reality of

agriculture in rural communities. Although there is a prevailing scepticism about the generalizability of case study results, due to the unique and in-depth nature of each study, there is evidence to suggest that these findings can indeed be relevant and applicable in contexts that share comparable conditions (Yin, 2013). This implies that while each case study is tailored to a specific scenario, the insights gained can provide valuable guidance and inform practices in similar environments. The transferability of case study outcomes is particularly useful in fields where controlled variables are difficult to isolate, allowing practitioners to draw parallels and adopt strategies that have been effective in analogous situations (Schoch, 2020). Hence, despite the individualized focus of case studies, their contributions can extend beyond their immediate scope, offering broader applicability under the right circumstances. This is particularly relevant when devising adaptation strategies for comparable regions or across various municipalities within South Africa, where such tailored approaches can significantly influence local outcomes.

This qualitative research is employed in line with the ontological and epistemological views of this study. Ontology is the study of existence; assumptions include what makes reality (Al-Saadi, 2014; Yucel, 2018). The study of knowledge, or epistemology surrounds ideas the creation or acquirement of knowledge and how it is communicated (Al-Saadi, 2014; Yucel, 2018). The ontological and epistemological stance of this research assumes critical realism.

Ontologically, critical realism is divided into three different levels: empirical, actual and real. At the empirical level, events are explained through empirical evidence but are filtered through human experiences (Groff, 2004). The actual level is not filtered through human experiences, rather, these events are the true occurrences that are different from an empirical level. The real level indicates the causal events that act as a force for a specific event to occur, thus explaining the empirical level. Critical realism serves to explain social occurrences through casual events, this is termed the ‘three-layered iceberg of reality’ (Fletcher, 2014; Singh, 2019). The ‘three-layered iceberg of reality’ is used to depict the ontology and epistemology of critical realism by creating links from knowledge to reality (Fletcher, 2014). Regarding the smallholder farmers, assuming critical realism assists in understanding the surroundings and the preferences for certain farming practices over others according to the changes over time. As this research is guided by critical realism as an ontological and epistemological stance marries well with the gender lens as it allows the exploration of women’s experiences and knowledge.

3.3.2 STUDY SITE

With the aid of Wits Rural Research Facility, this research was conducted in the district of Bushbuckridge, Mpumalanga (Figure 3.3.2.1). The villages located in Bushbuckridge where this research was conducted were New Forest, Allandale A and Athole. Mpumalanga province is approximately 6,4% of the total area of South Africa and is 7 942 744 hectares in size. There are approximately 4 million people living in this province accounting for 7% of the total population (Ebhuoma *et al*., 2020). The population of Mpumalanga reflects a higher percentage of females than males living in this province, with a ratio of males to females at 47:53 (Stats SA, 2016).

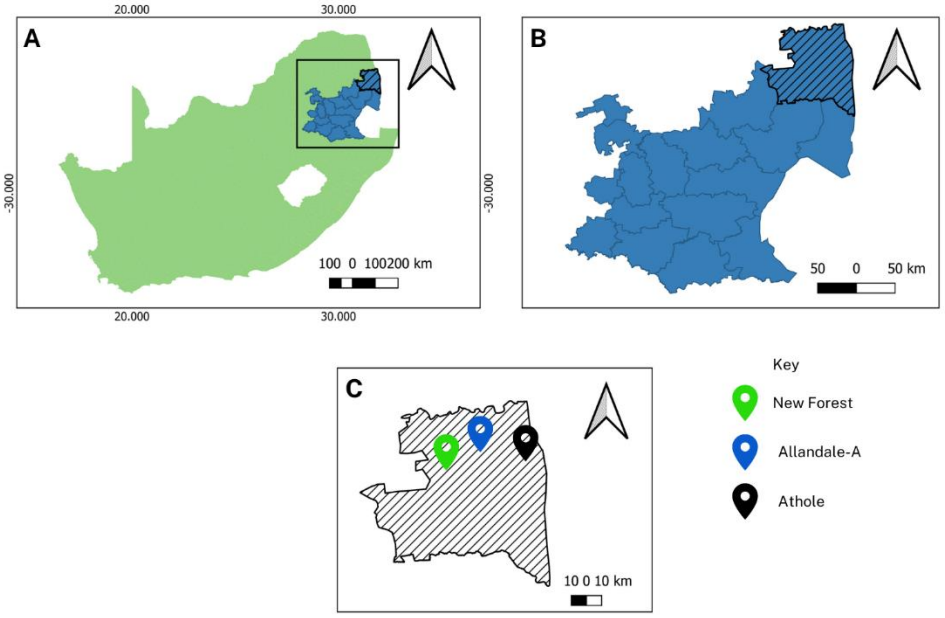

Figure 3.3.2.1: The study site for this study in which the villages are part of the Bushbuckridge municipality in Mpumalanga, South Africa.

A represents the villages highlighted in the municipality of Bushbuckridge in Mpumalanga in South Africa. B is used to highlight Bushbuckridge in Mpumalanga. C is Bushbuckridge.

Bushbuckridge

Data collection occurred in Bushbuckridge, which is located in the Bushbuckridge Local Municipality in Mpumalanga. The climate of Mpumalanga is diverse with summer rainfall, cold winters and subtropical climate experienced in the Lowveld, where the average yearly rainfall amounts to approximately 867mm. A variety of crops are available in this province including citrus fruits and subtropical fruits (Ebhuoma *et al*., 2020). This area of Bushbuckridge is a savanna biome with an undulating landscape, a mean annual temperature

of 22℃ and a mean annual rainfall ranging from 580-800mm (Ragie, 2020). Villages in this area are scattered through the landscape and form large settlements around communal rangelands (Ragie, 2020). A typical homestead in this area features dwellings, small animal pens and home gardens, where residents grow crops such as maize, squash and ground nuts (Ragie, 2020).

3.3.2.1. Traditional authorities

For this study, permission had to be obtained from the Amashangana traditional council before having individual interviews and focus group discussions with participants. The research questions were explained to the village heads and their council. Once the research was well understood and accepted by the council, the village heads contacted prominent members of the community and asked them to pass the information of this research on. The sample of this research was purposively selected under the Amashangana traditional council as villages in this council actively practice agriculture.

3.3.3. Sampling and sample size

Purposive sampling is the method used in this study. According to Kelly (2010), to ensure the "sampling of respondents that are most likely to yield appropriate information," the purposive sampling technique is employed. Additionally, the purposive sampling technique following the overarching research question, assumes that specific participants hold different and important views about a set subject (Danieffe, 2020). This study looked to define regenerative agriculture in a South African context, experts who are knowledgeable in the field were invited to partake in interviews. Hence, the purposive sampling technique was selected for this aspect of the study.

To answer the first research question, a total of 10 interviews were held with different experts in regenerative agriculture, these included academic researchers, agriculture training officers and farmers (Table 3.3.1).

Table 3.3.1: Participant code names and types of participants explained

Participant code abbreviation	Sector	Date of interview
E001	Academic	01/02/2023
E002	Government official	06/02/2023
E003	Academic	08/02/2023
E004	Academic	08/02/2023
E005	Non-governmental organization (NGO)	13/02/2023

E006	NGO	16/02/2023
E007	Non-profit organization (NPO)	17/02/2023
E008	Farmer	22/02/2023
E009	Academic	24/02/2023
E0010	Farmer	21/08/2023

While some research designs require a large number of expert interviews, some do not. Bernard (2013) suggests that a group of six key participants is typically sufficient to explore a research objective thoroughly. However, it's important to note that the adequacy of this number can significantly depend on the specific context of the study. Factors such as the complexity of the research question, the diversity of the participant pool, and the depth of information required can all influence the optimal number of participants needed to achieve comprehensive insights. Therefore, while six participants may be adequate in some cases, other scenarios may necessitate a larger or more diverse group to fully understand the research topic. Regenerative agriculture is a relatively new concept and there is not much expertise in the area - hence, to address this an initial group of key experts was identified through a comprehensive review of South African literature and an extensive internet search to ascertain organizations actively involved in regenerative agriculture. Subsequently, snowball sampling was used to find more experts to participate in this study. Snowball sampling is applied when the target participants are not easily accessible and require networking and referral to other participants who are knowledgeable on the topic (Naderifar *et al*., 2017; Parker *et al*., 2019). In the context of this research, various experts were identified through their experience in regenerative agriculture through an internet search. These experts were contacted, interviewed and asked for their expert opinion on who should be interviewed for this study. Experts that were identified and interviewed are actively involved in the field of regenerative agriculture and provide education through workshopping, working with farmers that practice regenerative agriculture or are farmers that are actively implementing regenerative agriculture practices in their farms.

To answer research questions 2 and 3, Purposive sampling was used to select smallholder farmers for both the survey and focus group discussion. The inclusion criteria were households that grow crops, these individuals were pinpointed during the initial meeting with the local traditional authorities of the respective villages, ensuring a representative sample. There were 31 individual surveys were conducted across all three villages (11 interviews in Athole, 10 in Allandale-A and 10 in New Forest). Thereafter, six focus group discussions

were held with farmers and women that are either directly involved with agriculture or not, 2 focus groups per village and 10 people at a time were invited for focus group discussions around their experiences with regenerative agriculture (See summary in Table 3.3.5.1).

3.3.4 Data collection

Individual interviews

Individual interviews occur when two people partake in a semi-formal/formal conversation, which is initiated by the researcher (Saarijärvi and Bratt, 2021). This interview aimed to gather information about the objectives of this study and ultimately answer the research question. Interviews are the best opportunity to allow the interviewee to make their attitudes and beliefs visible to the interviewer with complete respect (Tuckman, 1978). For this study, a semi-structured interview was used (Komba, 2014). This was to ensure that experts could freely express their expertise with regenerative agriculture and could answer any follow-up questions if the interview sparked any.

To answer research objective 1, a literature review was undertaken to investigate where regenerative agriculture has been implemented and what potential this has for the future of agriculture systems in South Africa. In addition to this, a review of potential mitigation and adaptation of climate change was discussed with regard to regenerative agriculture. Through individual interviews, organisations and field experts that work on implementing regenerative agriculture were contacted and interviewed to define regenerative agriculture from a South African perspective. As noted above, these experts included those who have experience in regenerative agriculture as academics or researchers, farmers practicing regenerative agriculture and various government officials working on aspects of regenerative agriculture implementation. Recruitment of participants was done through researching different academics and organizations implementing regenerative agriculture. Additionally, different forms of social media were used to inform participants of this research and to invite them for the interview. Interviews were conducted via Zoom, where with the permission of participants, the interview was recorded. Interviews with participants took approximately 45-60 minutes.

Surveys

To answer objective 2, with the assistance of an interpreter, a combination of surveys and focus groups were conducted with smallholder farmers in the communities of Bushbuckridge. Here, a survey questionnaire was used to collect data. Survey research is especially important

to the investigations of socioeconomic information and is an important tool that assists in collecting information about programs and shaping national policy (Lakshman *et al*., 2000). Surveys are often complimented for their quick design and standardization that can be replicated and compared to various parts of the world (Braun *et al.*, 2021). The wording of survey questions is crucial. For standardized survey questions, there is a set of established questions that cannot be elaborated upon or explored in more detail (Smyth, 2016). According to Braun *et al*., (2020), there are two types of questions in surveys: demographic questions and topic-based questions.

i). In order to understand what information can be captured from the survey, background information surrounding the concept studied, demographic questions are crucial for the researcher to know and analyse.
ii) Topic-based questions are important for seeking answers to lived experiences on the topic at hand, in this case, the participants lived experiences with climate change and regenerative agriculture.

Both types of questions were present in this survey. The demographic information obtained included information about participants' age, gender, income, education and employment. Topic-based questions included obtaining information about participants' farming practices, lived experience around climate change and their overall knowledge about regenerative agriculture. An extensive review of the literature, and a series of interviews held with experts in the field were instrumental in formulating the survey questions aimed at evaluating the understanding of regenerative agriculture. Eleven categories were identified to determine if regenerative agriculture was being practiced. These included: crop rotation, mulching, cover crop retention, organic matter, no-tillage, cash crops, drought-resistant crops, polyculture, livestock farming, intercropping, and cover cropping. While cash crops are not necessarily recognised as a regenerative agriculture practice by all researchers. Regenerative agriculture fits under this category since it is defined as a strategy for beneficiaries to receive financial uplift (Dent and Boincean, 2021). A cash crop is grown for monetary value, it is not consumed by the household but is sold for monetary value and is used as inputs for the household to grow more crops that can be sold. The purpose of these survey questions was to determine the extent to which regenerative agriculture is being implemented within these villages. Additionally, the questions for the focus group discussions, as well as the subsequent follow-up inquiries, were refined based on this information. Surveys were conducted with smallholder farmer participants and took approximately 15-20 minutes each. Additionally,

survey participants were invited to continue the discussion in the form of focus group discussions.

Focus group discussion can be confused with interviews, especially in the context of a group interview (Hennik, 2013). These techniques aim to uncover the perceptions of the participant, there is one key difference between these two techniques. In an interview or survey, the researcher plays a vital role in driving the discussion with specific questions (Nyumba *et al*., 2018). In contrast, the researcher facilitates focus group discussions by acting as a "moderator," giving members the freedom to steer the conversation and provide a forum for their opinions to be heard. (Hohenthal *et al*., 2015). Additionally, in the format of a focus group discussion, the researcher will ask follow-up questions in response to participants' responses – here there is no rigid structure (Escalada and Heong, 2014; Nyumba *et al*., 2018).

Focus group discussion

To answer research objective 2, focus group discussions were held with smallholder farmers. To allow for this, 20 men who identified themselves as having a direct role in local agriculture were invited to participate. The traditional authorities of each village played a crucial role in the recruitment process by facilitating the identification and engagement of participants who could provide valuable insights into the study. A focus group consisting of a group of 5-7 participants at a time was used in this study to collect data. Each focus group discussion took approximately 60 minutes each. As the name implies, a focus group discussion is a group interview or discussion about a specific topic under the guidance of the researcher and in some cases an interpreter (Sim and Waterfield, 2019).

For this focus group, questions about the current perceptions of regenerative agriculture and barriers around regenerative agriculture were the focus of the discussion. In addition to this, participants were asked about current farming practices to understand the potential of regenerative agriculture in a rural context. Knowledge about regenerative agriculture was assessed by first giving a brief description of regenerative agriculture practices and then asking the farmers if they had any pre-existing knowledge about regenerative agriculture and what that knowledge was. Thereafter, farmers were asked if they practice regenerative agriculture, and the total number for various practices was recorded to obtain a percentage of participants that practice regenerative agriculture in these communities. Farmers that do not practice regenerative agriculture and that were willing to practice regenerative agriculture were asked about barriers that inhibit them from practicing it and furthermore, what can be

done to facilitate the move to regenerative agriculture. Farmers who were circumspect about regenerative agriculture were asked to explain their views of regenerative agriculture. A SWOT analysis (Ncube and Washburn, 2010; Kurmanalina *et al*., 2020) discussing regenerative agriculture was generated from the discussions with the farmers practicing regenerative agriculture. Previous agricultural studies make use of a SWOT analysis (Kurmanalina *et al*., 2020; Abid and Jie, 2021; Ali *et al*., 2021). Here, a SWOT analysis enables the analysis of strengths, weaknesses, opportunities and threats within the practices of regenerative agriculture and, the longevity of agricultural extension services.

To answer objective 3, a series of focus group discussions were held with participants in the different villages. To allow for this, women of the community regardless of whether they play a direct or indirect role in agriculture were invited to share their experiences in the focus group, a total of 36 participants were recorded. The discussion focused on whether they were recognized for their contributions to agriculture, the effects of climate change on the women of the community, and different interventions were discussed. To ensure a comfortable and open dialogue, the focus groups were organized by gender and village, with two separate sessions conducted for each village. Additionally, a desk-based study on the potential of regenerative to improve gender dynamics and climate vulnerability in rural communities was conducted.

3.3.5 DATA ANALYSIS

Thematic analysis is the primary method of analysis of data in this study. Guided by Braun and Clark (2006), the following steps were undertaken: 1) Data familiarization, which is the initial transcribing process from audio to text, 2) Generating initial codes from the dataset, this includes reading the text and finding the initial codes, 3) searching for common themes in the dataset, if codes were similar, they were classified as one theme, 4) reviewing themes that have been recorded and creating new themes if necessary, 5) characterizing themes and 6) producing the report. Furthermore, through this study design, the coding analysis allows for new codes, ideas or themes to be explored (Gioia *et al*., 2013).

The data analysis process involved several steps to ensure the validity and reliability of the findings. A literature review was conducted to understand the different views of regenerative agriculture in a general context, this was further used to understand regenerative agriculture in a South African context, and this was further substantiated by the expert interviews.

Similarly, responses from all participants, who took part in the expert interviews, surveys, and focus group discussions were collected via audio recordings. Second, the audio recordings were separated into interviews and focus group discussions, focus groups were then translated and transcribed verbatim, and the transcripts were checked for accuracy. Third, the transcripts were coded using a thematic analysis approach, which involved identifying and labelling patterns and themes in the data. The codes were then organized into categories and subcategories and interpreted in relation to the research questions. (Table 3.3.5.1). Responses from the surveys were analysed through Excel and R Studio and were visually presented.

Table 3.3.5.1: Summary table of data collection and analysis for each objective in this thesis

Objective	**Tool of data collection**	**Participants**	**Sample size**	**Method of analysis**
Defining regenerative agriculture in a South African context	Literature review Expert interviews	Regenerative agriculture experts	10	Thematic analysis
Knowledge about regenerative agriculture	Survey Focus group discussion	Smallholder farmers	31	Thematic analysis
The potential of regenerative agriculture in Mpumalanga?	Focus group discussion	Smallholder farmers	20	SWOT analysis
Opportunities for women in regenerative agriculture in Bushbuckridge	Focus group discussion	Women	36	Thematic analysis

How does regenerative agriculture support climate mitigation and climate adaptation in a local context?	Focus group discussion	Smallholder farmers	20	Thematic analysis

3.4 ETHICS AND INFORMED CONSENT

The observance of ethics is especially important in research that involves human participation. For this research, the researcher needed to treat the participants with the respect and dignity they deserve as well as respect the wishes of participants regarding their identity and response. Thus, for all interviews, surveys and focus group discussions, the procedures surrounding ethical clearance were explained and consent was obtained from all participants before beginning the data collection process. Participants were informed that participation is of their own volition and have a right to refuse to answer any of the questions asked. Additionally, participants were informed of their right to pull out of the study at any given moment. With the assistance of an interpreter, participants were informed of their rights as participants and verbal consent was obtained before proceeding with data collection. Permission was obtained from participants before taking any photographs of their farms and were informed that no identifiable information would be visible in these pictures and would be used for the report. A short mini-report will be sent to the respective traditional authorities for their record and for participants to receive feedback.

3.5 CONFIDENTIALITY AND ANONYMITY

During the surveys, participants were informed that the information revealed would remain confidential. Participants were informed that in the report, there would be no identifiable information made available and quotes would be reported in an anonymised manner. All participants agreed to this arrangement. All responses to the data collection methods were stored safely. Additionally, for the focus group discussions, confidentiality and anonymity could not be guaranteed, as other participants were present during the focus group. However, participants were alerted to this and informed that confidentiality and anonymity outside of the workshop process would be ensured by reporting participants in anonymized manner in the report.

3.6 LIMITATIONS

This study faced several challenges, starting with the recruitment of RA experts, as the term ‘regenerative agriculture’ is a relatively new concept in South Africa, which was limited due to their availability and willingness. To address this, the research team extended invitations to a broader pool to ensure a diverse and robust sample.

In Bushbuckridge, where the research was concentrated, the study did not encompass the entire province of Mpumalanga, presenting challenges in generalizing the findings. Group discussions were sometimes overshadowed by more dominant voices; however, this was mitigated through structured facilitation to promote fair participation. A significant language barrier was also navigated by a local interpreter, adept in both the regional dialect and agricultural terminology, enhancing communication and ensuring participants' perspectives were accurately documented.

Tensions arose during discussions in New Forest when participants expressed dissatisfaction with the local agriculture department's services. The situation escalated to the point of disrupting the focus group, with participants insisting on the presence of a department official. This issue was temporarily set aside to be addressed post-discussion. Throughout the data collection phase, the interpreter played a crucial role in easing tensions by clarifying the researcher's independence from the agricultural department.

CHAPTER 4

REVIEW OF REGENERATIVE AGRICULTURE IN SOUTH AFRICA

4.1 INTRODUCTION

The purpose of this study was to explore the potential of regenerative farming systems in rural communities of Bushbuckridge. To achieve this, experts in the field of regenerative agriculture were first interviewed to clearly define regenerative agriculture and to define what this means in a South African context. This is in response to gaps identified in current literature suggesting that regenerative agriculture is not clearly defined, therefore making this concept difficult to study (Lal, 2020; Newton *et al*., 2020), more so, in a South African context (Bilgnaut *et al*., 2015). To answer the overarching research question around the potential of regenerative agriculture in the rural communities of Bushbuckridge, regenerative agriculture in a South African context first had to be defined. This chapter addresses the following research question: What is the current understanding of regenerative agriculture in a South African context? Here, a literature review was conducted in attempts to define regenerative agriculture in a South African context, to further supplement this, expert interviews were conducted.

4.2 REGENERATIVE AGRICULTURE IN SOUTH AFRICA

Ten experts were interviewed. The experts of regenerative agriculture included farmers, academics and other researchers that are involved in regenerative agriculture in South Africa. A thematic analysis on their responses identified 4 core themes and 11 sub-themes encompassing the experts' insights on regenerative agriculture (Figure 4.2.1). Each sub-theme is discussed below with coded texts. The sub-themes discuss the barriers and opportunities of regenerative agriculture, with the ultimate aim to suggest a definition of regenerative agriculture in a South African context backed up by the literature (Table 4.2.1). According to experts, one first needs to understand regenerative agriculture in a global context before applying what this means in a South African context.

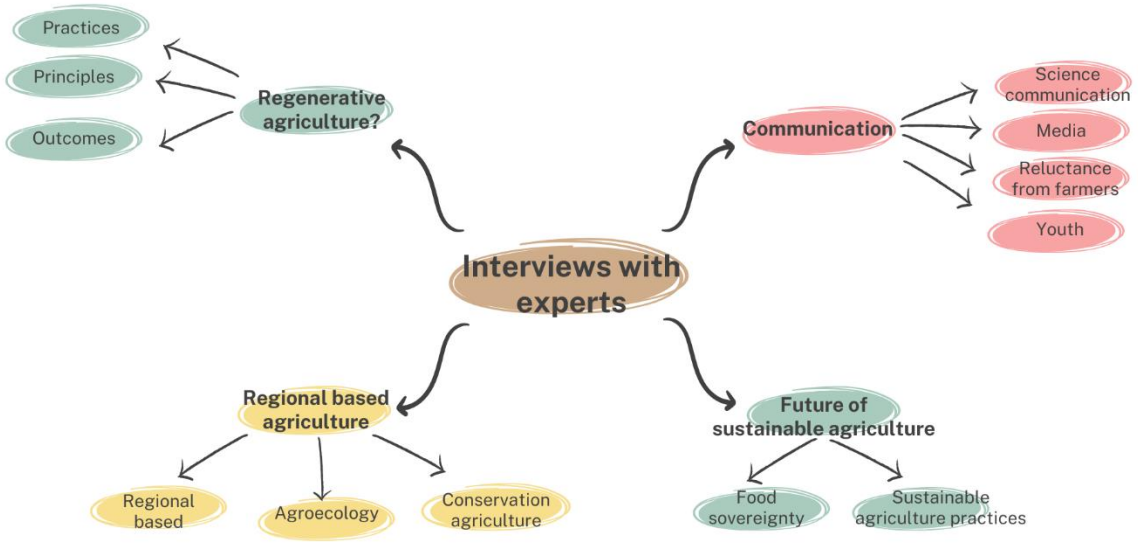

Figure 4.2.1: Conceptional mind map of different themes discussed from the interviews with the experts of regenerative agriculture.

To define regenerative agriculture in a South African context, a summary of regenerative agriculture in the global literature was reviewed – thereafter, to define regenerative agriculture in a South African context, expert interviews and a literature review were conducted and summarised (Table 4.2.1.). Experts included farmers, academics, government officials and corporations that have experience in the regenerative agriculture space. According to experts and further supported by literature – current understandings used to define regenerative agriculture are practices, principles and outcomes.

Table 4.2.1: Summary table of the definition of regenerative agriculture according to experts.

Theme 1: Regenerative Agriculture	Practices	It is a set of sustainable practices that aim to focus on less artificial inputs and maximize outputs over time" (E005)	No tillage, crop rotation, intercropping, cover crops, livestock integration, the use of organic matter and composting (Gosnell *et al.*, 2019; Schreefel *et al.*, 2020;).

	Outcomes	"I define it in terms of its outcomes instead of practices cause - so in terms of the outcomes that we are talking about the improvement of soil, specifically the increase in soil organic carbon and then the increase in soil microbes, which are the two primary indicators of soil health." (E001)	Better soil health, mitigation of climate change through carbon sequestration, increased diversity, increased yield, better roots and water infiltration system and profit (Brown, 2018; LaCanne and Lundgren, 2018).
	Principles	"Regenerative agriculture follows principles that essentially sequesters carbon from the atmosphere into the soil as opposed to conventional agriculture which is degenerative" (E007)	No-tillage, no bare soil, keep living roots in the soil, integration of livestock and eliminating fertilizers (LaCanne and Lundgren, 2018).

4.4. WHAT IS REGENERATIVE AGRICULTURE IN SOUTH AFRICA?

South Africa's vast diversity of agro-climatic conditions and ecological zones are reflected in the country's diversified agricultural landscape (Strauss *et al*., 2021). It includes both smaller, subsistence-based agriculture systems and larger, commercial agriculture. This diversity is evidence of the nation's long history of agricultural production and its farmers' ability to adapt to environmental challenges. In the pursuit of a more resilient agricultural system, South Africa has witnessed the growing emergence of conservation and regenerative agriculture practices. These approaches are vital in addressing issues related to soil erosion, water scarcity and overall improvement of environmental sustainability. According to the experts, there are similarities between regenerative agriculture, conservation agriculture and agroecology (Table 4.4.1).

Table 4.4.1: Summary table of Regenerative Agriculture in the South African Context according to expert interviews, illustrating that there is no real consensus on what it means

Regional specific conditions	"South Africa is a semi-arid country, with different landscapes, different seasons and hence, different crops and different practices of regenerative agriculture favoured." (E005).
Agroecology	"Regenerative agriculture is closer to agroecology as a practice." (E001)
Conservation agriculture	Regenerative agriculture is currently practiced under 'conservation agriculture.' (E007)

In South Africa, agroecology is practiced by various actors, such as smallholder farmers, civil society organisations, researchers and activists (Pereira *et al*., 2018). Agroecology practitioners are motivated by varied reasons, these include improving food security, economic benefits, biodiversity conservation, climate change adaptation and social transformation. According to Wynberg et al. (2012), traditional small-scale farmers in South Africa possess a strong understanding of agroecological techniques, such as managing water and pests and breeding plants and seeds.

Reiterated by a participant: "When you try to compare different forms of agriculture production to each other- regenerative agriculture is the most aligned to agroecology, which is part of this broader movement that is trying to find more equality and empowerment for women in the agricultural space" (E001).

There are various ongoing agroecological projects by different organizations in parts of the country. These projects place emphasis on the smallholder farmers that produce food based on their own indigenous knowledge systems.

For example, Biowatch in South Africa advocates for agroecology for smallholder farmers to improve their household food security using agroecological practices and the crops in their homestead (Williams *et al*., 2018; Greenberg and Drimie, 2021). Accordingly, the agroecological practices most emphasised in a South African context include: 1. No synthetic fertilisers, 2. No genetically modified organisms, 3. No pesticides or herbicides, 4. Composting, 5. Recycling water (use of grey water), 6. Saving seeds, 7. Mulching and 8. The use of fertility beds (Williams *et al*., 2018). Here, smallholder farmers have access to local markets to sell their produce. These practices can be applied differently depending on the context (Mncwabe, 2018). Regenerative agriculture is distinct from agroecology in that it potentially includes the use of genetically modified crops to advance its practices, as suggested by the literature (Giller *et al*., 2021). This holds significance because in a South African context there are provisions for trading genetically modified crops, which thus far has been illustrated through soybeans (Thompson, 2016). Soybeans are commonly cultivated by commercial farmers rather than by smallholders, who may lack the resources for such a crop. This trend is due to the significant investment and infrastructure required for soybean production, which can be a barrier for smaller farms. As a result, soybean cultivation is often not an option for smallholder farmers who manage smaller plots (Siamabele, 2021).

In areas of KwaZulu-Natal, agroecology functions with the training of rural women in various agroecological practices such as crop-livestock integrations and the importance of various crops (Wynberg et al., 2012). Biowatch South Africa supports smallholder farmers, particularly women, by promoting agroecology practices that include composting, mulching, and seed saving (Williams *et al*., 2018). There are various educational workshops held for farmers, students, and tourists interested in learning more about agroecology (Wynberg et al., 2012). These workshops, coupled with Biowatch's advocacy efforts, aim to ensure biodiversity, food sovereignty, and social justice (Williams *et al*., 2018).

Similarly, the commonly used agriculture approach in South Africa is conservation agriculture according to the interviews, which can be recognized as another form of regenerative agriculture (Valbuena, 2012; Thierfelder *et al*., 2018). Similarly, according to

literature regenerative agriculture is a form of conservation agriculture (Landers *et* al., 2021). One participant indicated:

> "There are many commonalities between conservation agriculture and regenerative agriculture, such as the principles of reducing pesticides and fertilizer, polyculture, no-tillage, etc. It is not far-fetched to say that South Africa has always been practicing regenerative agriculture, however under the name of conservation agriculture. As these concepts are similar" (E009).

It appears that Conservation Agriculture (CA) shares three fundamental principles with regenerative agriculture, which are also increasingly adopted by industrial farms (Figure 4.4.1). These include: 1) crop rotation and diversity - where farmers plant various types of crops in rotation to reduce pests or diseases and to improve soil health; 2) minimal soil disturbance – similar to regenerative agriculture, conservation agriculture encourages minimal or no-tillage which reduces soil disturbance and enhances the overall soil moisture and soil structure; and 3) permanent soil cover - through the use of cover crops, organic matter through crop residues or cover crops – this protects the soil from intense temperatures and soil erosion (Blignaut *et al*., 2015; FAO, 2016).

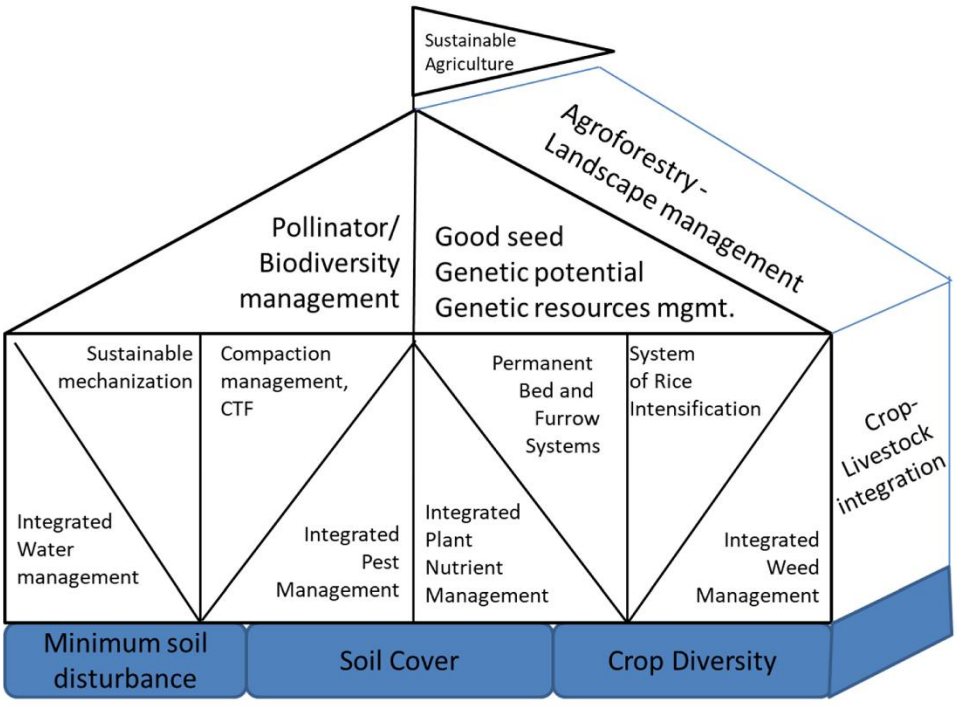

Figure 4.4.1: The principles that form the basis for conservation agriculture (Adapted from: Kassam *et al*. 2022).

The primary goal of conservation agriculture, in line with one of the tenets of regenerative agriculture, is to enhance overall soil health by preserving soil moisture, enhancing soil structure, and protecting soil microbes (Strass et al., 2021). Furthermore, the adoption of conservation agriculture aligns with regenerative agriculture outcomes including promoting carbon sequestration, resilience and water conservation in agricultural systems. However, this is where conservation agriculture differs from the adoption of regenerative agriculture - conservation agriculture promotes water management over other principles (Stagnari *et al*., 2009; Kassam *et al.,*2022), while regenerative agriculture promotes soil health and biodiversity (LaCanne and Lundgren, 2018; Schreefel *et al*., 2020; Tittonell *et al*., 2022).

In a South African context, regenerative agriculture highlights different outcomes and practices over others in various provinces. In water-stressed and soil-degraded communities, such as those in South Africa, the promotion of water conservation and promotion of soil health is the priority over all other outcomes and practices (Swanepoel, 2021). This is especially important in semi-arid and water-stressed communities.

The literature indicates that many South African communities have successfully adopted conservation agriculture (Thierfelder *et al*., 2015; Von Loeper *et al*., 2016; Swanepoel *et al*., 2018; Findlater et al., 2019; Strauss *et al.*, 2021). According to a survey evaluating grain farmers' use of CA, 14% of them have done so fully, however, this is in contrast to the perception of a 40-80% adoption rate with smallholder farmers (Findlater *et al*., 2019). Notably, the integration of livestock and seasonal pastures was not included as part of conservation agriculture. According to studies, livestock farming is integral to rural farming communities, with many implementing crop-livestock integration (Chaminuka *et al*., 2014; Marandure, 2015;). According to Strauss *et al.* (2021), these principles have since been included in a South African context. However, this indicates that like regenerative agriculture, conservation agriculture principles are not clear to all practitioners, and an evolving definition creates confusion for the full adoption of conservation agriculture.

In their review of CA research done in South Africa, Swanepoel *et al.* (2017) noted the lack of noteworthy outcomes and emphasised the need for more research on a range of agroecosystems properties, such as carbon, soil cover, cover crops, soil biology, soil water, livestock integration, economics, and greenhouse gas emissions. A study looking at the adoption of CA in Asia indicated challenge in its adoption with major problems including the lack of a suitable farm for smallholder farmers, low technological reach to rural farmers, and

a conventional mindset that is yet to be convinced (Somasundaram *et al*., 2020). On the other hand, industrialised parts of Europe, South America, and North America—which include Canada, the United States, Australia, Spain, Finland, Ukraine, and Russia—have seen a rise in the use of CA (Derpsch et al., 2010; Kassam et al., 2015; Kassam et al., 2019).

While South Africa is diverse in its landscape, 3% of the land has agricultural potential and 91% is classified as arid, semi-arid or dry (Strass *et al*., 2021). Water scarcity is a problem in South Africa, with poorly distributed rainfall further impacting soil health, leading to increased stress for crops and livestock impacting agricultural productivity (Blignaut *et al*., 2015; Thierfelder *et al*., 2018). The majority of smallholder farmers in South Africa practice rainfed agriculture. Irrigated land makes up 8.5% of all arable land, yet this only makes up 30% of all agriculture in South Africa (Meza *et al*., 2021). Of this, only 3% of the total irrigation is for smallholder farmers –schemes upheld by the government and private companies for economically upliftment and to improve their livelihoods (Sinyolo *et al*., 2014; Findlater *et al*., 2019; Mkuna and Wale, 2023).

Water-saving techniques are both practiced in agroecology and conservation agriculture (Wezel *et al*., 2014; Lal, 2015), however, literature on this specific technique is limited with regards to regenerative agriculture. Since regenerative agriculture draws inspiration from agroecology and conservation agriculture – in a South African context, water-saving techniques should be considered, including techniques like seed saving and drought-resistant crops. Global literature indicates that regenerative agriculture in principle and practice is an overlap of various sustainable agriculture narratives (Bless *et* al., 2023). Based on the literature and the expert opinion interviews of this study - regenerative agriculture in a South African context can be defined as a combination of conservation agriculture and agroecology practices (Figure 4.4.2).

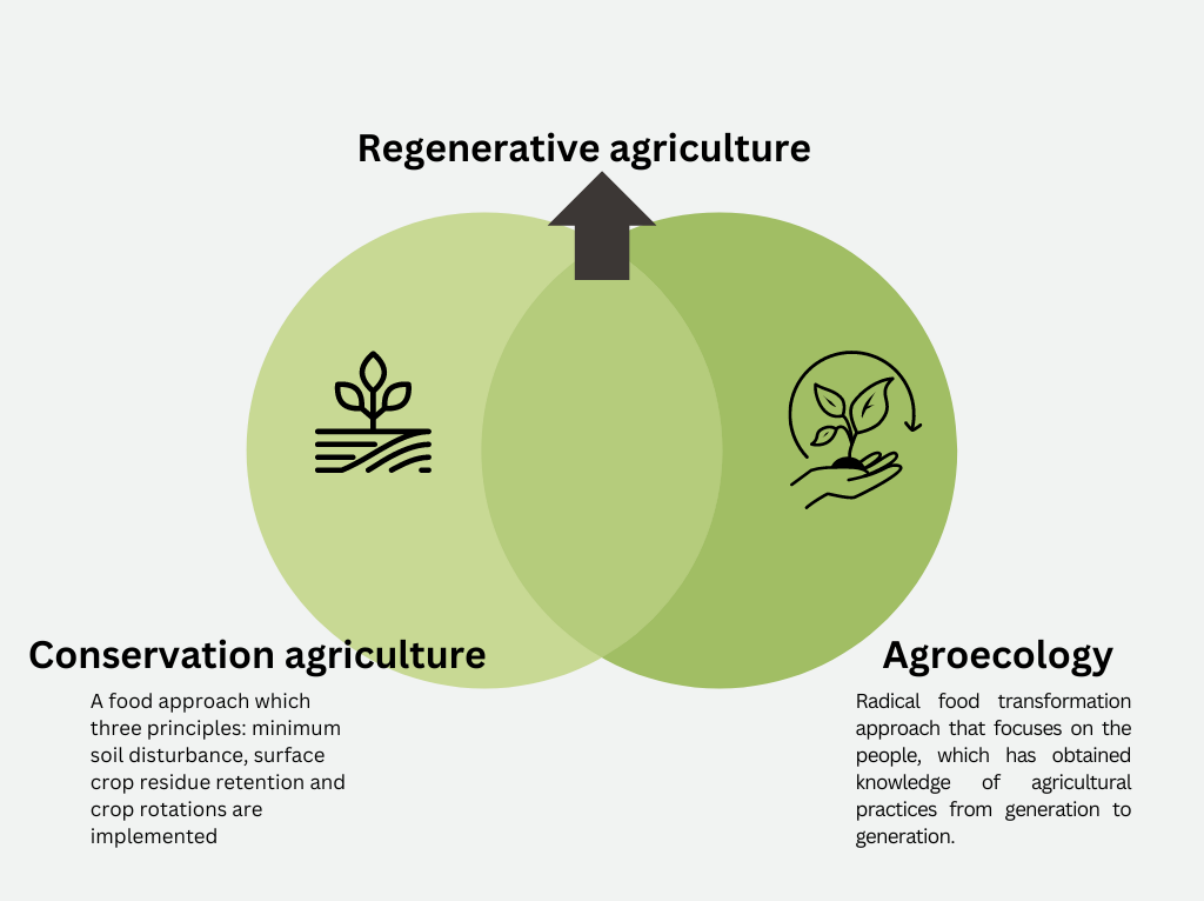

Figure 4.4.2: Summary diagram of regenerative agriculture in a South African context based on interviews – a combination of conservation agriculture and agroecology. (Own)

4.4.1 Gender considerations in regenerative agriculture

Drawing on agroecology, there have been reports that this approach of agriculture is embedded in feminism and gender equity. In their paper, Zaremba *et al*. (2021), reviewed the 13 agroecological principles through a gender lens indicating that gender equity is at the centre of the agroecology movement. It has been argued that agroecological practices are based on the feminist movements – highlighting women's role in food systems.

However, the literature on gender implications in regenerative agriculture is limited. Interestingly, an expert added:

> "Regenerative agriculture has nothing inherent with gender equity, however, the skills could be cultivated to support gender equity. For example, if one is to support women in regenerative agriculture skills training, that has nothing to do with regenerative agriculture. Rather who is in charge and doing the training" (E001).

Other approaches to agriculture have explored a gender aspect. Approaches such as agroecology, organic farming and climate-smart agriculture indicate there is a scope for gender considerations (Khoza *et al*., 2019; Ogisi and Begho, 2023; Obossou *et al*., 2023). Especially in climate-smart agriculture, there is evidence suggesting that women can only fully benefit from agricultural services when they are included in the decision-making, training and resource partitioning (Grillos, 2018). This research objective will be further explored in the following chapter with the use of the gender lens.

4.5. ADOPTION AND THE FUTURE OF REGENERATIVE AGRICULTURE

4.5.1. Catalysts of the adoption of regenerative agriculture

The successful adoption of regenerative agriculture relies on a multitude of factors. These include cultural, social, and in some cases political considerations (Eckberg and Rosenzweig, 2020). The shift to regenerative agriculture is highly influenced by the media, academics and perceptions of regenerative agriculture (Burns, 2020; Burns, 2021). As regenerative agriculture requires a paradigm shift, which is highly knowledge-intensive, academics indicate that the science has been done, but there is no mechanism to carry this information to the people. This indicates that the media and other players have a large role to play in influencing the outcomes of adoption – including catalysts like the youth (Polidori and Pavoncello, 2021).

According to multiple experts:

> "Regenerative agriculture has only been gaining interest for the past 10 years". (E001, E004, E009).

The growing interest in regenerative agriculture can be brought on by several factors, and the media plays an influential role in this communication (Olper and Swinnen, 2013). Moreover, experts indicate that scientific communication to the broader public is vital for the longevity of regenerative agriculture. A consensus among experts is that an increase in research and science communication of regenerative agriculture would enable communication to the general public. A similar study found that effective science communication and mass media improves conservation agriculture uptake through information sharing especially in rural areas (Achora *et al*., 2019). One expert indicated that:

> "Government needs to implement a procurement standard that incentivises regenerative agriculture. I would say you need civil societies to start pushing too for

> it. You would need academics writing about it, you need the benefits to be pushed out into popular media, you need proper monitoring and evaluation of the benefits, and demonstration of its merits being popularised in tracked responsibly and scientifically" (E002).

A multifaceted approach to exploring the communication around regenerative agriculture would result in a better adoption rate (Eckberg and Rosenzweig, 2020). Other approaches may include involving the media, consumers and the youth in training sessions and information dissemination sessions.

An expert emphasised:

> "The youth are the future catalysts, involving them in regenerative agriculture would help immensely with involving farmers and the larger public with regenerative agriculture." (E006).

Experts spoke reverently about regenerative agriculture and conservation agriculture, and methods to increase adoption were discussed. When asked about the gaps in regenerative agriculture leading to the lack of adoption during the expert interviews, the negatives to this approach were not discussed – including the additional costs of regenerative agriculture were not explored by any of the experts.

4.5.2. Food sovereignty and the future of regenerative agriculture

Ultimately, the goal of regenerative agriculture is to restore the ecosystem and have resilient food systems. Research indicates that the overall long-term benefits of regenerative agriculture take longer to observe and are arguably difficult to adapt to a local context. According to experts, the future of agriculture has to focus on food security for all, especially in rural communities that rely on growing their food, furthermore, highlighting the importance of local food sovereignty. With the increasing unpredictability of climate patterns, marked by erratic temperature fluctuations and precipitation levels, it becomes imperative to embrace non-traditional methods of adaptation in agriculture. Various countries around the globe have been implementing adaptation methods towards sustainable agriculture – these include methods of soil health conservation and water conservation (Cárceles Rodríguez *et al*., 2022; Diop *et al*., 2022).

> "There is no way forward besides regenerative agriculture and other sustainable agricultural practices. If we are not sustainable about food sovereignty, there is no doubt about it, we will be left without food" (E008).

A study showed that smallholder farmers would not adopt conservation agriculture as benefits can only be observed in the long term, while the short-term goals are to feed their families (Ngoma *et al*., 2021). The long-term benefits include the overall increase in yield, accumulation of soil carbon or shifts in the interactions between the overall ecosystem and the farm (Eckberg and Rosenzweig, 2020). A previous study indicated that the implementation of regenerative agriculture would decrease yields before there is an increase due to the rehabilitation of the soil and an increase in soil organic carbon (LaCanne and Lundgren, 2018; Jordon *et al*., 2022). Overall, there is a long-term benefit of food sovereignty resulting from this implementation. Local food sovereignty, according to Bernstein (2015), is the right of people to produce healthy and culturally relevant food that is produced using sustainable practices, while providing freedom to design their food systems. However, the ability to produce and sell food sustainably is reliant on economic growth. Higher prices are usually a deterrent to consumers and therefore, deter smallholder farmers from producing food regeneratively (Carlisle, 2016). Additionally, difficulties in maintaining the practices of conservation agriculture and lack of storage facilities and equipment are often overlooked within the adoption of conservation and regenerative agriculture (Dhar *et al*., 2018).

4.5.3 Future of regenerative agriculture

Like agroecology, regenerative agriculture has an ecological-backed narrative. It, however, lacks the political and social prominence of agroecology. Furthermore, with an ambiguous definition, regenerative agriculture runs the risk of undermining the transformation potential possessed by agroecology (Gliessman *et al*., 2022). Hence in their review, Sands *et al*. (2023) proposed "an anti-colonial definition of regenerative agriculture" that prevents the coopting of regenerative agriculture to not exclude minorities and ignore traditional knowledge and promote the separate transformation potential possessed by regenerative agriculture – creating an opportunity for women to be recognized in regenerative agriculture.

According to one expert that posed an important question:

> “Why should regenerative agriculture be defined? Regenerative agriculture is essentially a collective of traditional and indigenous practices – to define regenerative agriculture in itself is colonial” (E0010).

Thus far, the framings of a definition surrounding that of regenerative agriculture are western-centric definitions. It is important to note that regenerative agricultural practices, although popular today, have historically been practiced for millennia by indigenous communities around the world. To better capture the true essence of regenerative agriculture, an anti-colonial approach is needed, whereby the socio-environmental and socio-cultural values of regenerative agriculture can be valued.

While the future of regenerative agriculture may seem bright, it is also questionable. Large international corporations such as Unilever, Syngenta, Cargill and H&M have reaffirmed their support for regeneration agriculture. This growing interest in regenerative agriculture by large agri-corporations, other large corporations, small businesses, government and even some farmers has not been further probed into in literature. Though, one expert remains sceptical of regenerative agriculture, indicating that “greenwashing may be a potential threat to regenerative agriculture” (E007). With the lack of a definition, various actors could provide their definitions of regenerative agriculture, creating a space in which it could be co-opted to suit an entirely different agenda (Tittonell *et al*., 2022).

The practice of misleading the public about the environmental benefits of methods, goods, or services is known as "greenwashing."(de Freitas Netto *et al*., 2020). In this context, greenwashing in regenerative agriculture could involve selling technologies and outputs that could be used for carbon offsetting and improved soil health (Sharma *et al*., 2021). These corporations must establish clear, measurable goals and transparent reporting mechanisms to avoid greenwashing accusations. This includes providing evidence of improved soil health, biodiversity, and reduced reliance on chemical inputs, as well as the economic viability of farmers. Additionally, concerns have been raised that regenerative agriculture “lacks system transformation and social justice considerations” and hence, there should be an all-encompassing definition of regenerative agriculture, one that can be used to prevent the greenwashing of regenerative agriculture (Tittonell *et al*., 2022).

Similar to regenerative agriculture, agroecology faces similar challenges of co-optation, with concerns that agroecological practices could be co-opted by Global North stakeholders. Co-optation is the practice of diluting or reinterpreting a specific subject for one's gain (De Jong

and Kimm, 2017). However, the agroecological movement has made pushbacks over the years against attempts to co-opt the movement, providing an emphasis on the Global South peasant movements and indigenous practices (Bless *et al.*, 2023). According to Tittonell et al. (2022), the pushback from agroecology against the influence of co-optation in the Global North could have led to the rise of regenerative agriculture.

In contrast, no other expert raised this point of greenwashing concerning regenerative agriculture, however, they indicated that ineffective science communications with farmers could be a potential barrier to regenerative agriculture.

A stronger preference for regenerative food systems and the connection of farmers to the markets may lead to the better adoption of regenerative agriculture (Nelson *et al*., 2014; Ewert *et* al., 2023). Additionally, more discussions around the role and economics of regenerative agriculture, especially in South Africa, are yet to be held resulting in knowledge sharing and, a better adoption rate (Eckberg and Rosenzweig, 2020).

Another challenge faced by smallholder farmers is access to tools to adopt regenerative agriculture (Castilla-Rho and Kenny, 2022). Therefore, it has been proposed that funds be allocated to encourage the adoption of regenerative agriculture practices. Financial incentives could play a significant role in supporting farmers who choose to implement these sustainable methods (Kenny and Castilla-Rho, 2022).

CHAPTER 5

REGENERATIVE AGRICULTURE IN BUSHBUCKRIDGE

5.1 INTRODUCTION

This study aimed to explore the potential of regenerative farming systems in rural communities of Bushbuckridge. To achieve this, experts in the field of regenerative agriculture were first interviewed to clearly define regenerative agriculture and what it means in a South African context, which was discussed in the previous chapter. Thereafter, in the municipality of Bushbuckridge, smallholder farmers were invited to participate in individual interviews and focus group discussions. The aim was to investigate whether smallholder farmers in the area were aware of regenerative agriculture and if they practiced it in any capacity. Furthermore, investigates the role women play a role in regenerative agriculture and if they are recognized for it. Additionally, climate change in Bushbuckridge was also investigated. To answer the overarching research question, the following questions are answered in this chapter:

i). Is regenerative agriculture currently being practiced in rural communities of Bushbuckridge and if so, what is the current understanding of regenerative agriculture?

ii) Does regenerative agriculture enable provisions towards a gender-equitable and climate-adaptive community?

The results and the discussion of these research questions are presented in this chapter. The discussion aspects are linked to previous studies and other contrasting studies to align this study with the existing literature.

RESULTS

5.2 DEMOGRAPHIC INFORMATION

5.2.1 Villages of this study

As elaborated in the methods chapter, three villages falling under the Amashangana Tribal Authority were selected to participate in this study (Table 5.2.1). A total of 31 respondents participated in the individual interviews and were thereafter invited along with other smallholder farmers to attend a focus group discussion.

5.2.2 Household head and gender

The majority (83.9%) of the interviews were conducted with the household head, and 16.1% of the participants were household dependents (Table 5.2.1). More women than men participated in this study (Figure 5.2.1).

5.2.3. Age

The sampled farmers were grouped into four age categories (Table 5.2.1). The majority (29%) of the farmers fell in the age range of 36-50 (Figure 5.2.3.1). This statistic indicates that farming in Bushbuckridge is conducted by those in middle age, followed closely by the youth of the area.

5.2.4 Education

Results of smallholder farmer's education indicates that just over half of the participants (58%) have obtained a secondary education, while 22.6% received a primary education and no participants obtained a tertiary education (Table 5.2.1). This proves advantageous as farmers in this area are literate, with the ability to write and read the resources provided to them. However, most resources are provided in English, thus, proving disadvantageous to the farmers as not all participants had a full understanding of English. The home language of the participants was used to conduct interviews.

5.2.5 Source of income

Results indicated that 58.1% of the participants rely on government grants and food from their homestead farm to support themselves in the forms of food and income. While 19.4% participants rely on the farm and other business to support their income and supplement food security (Table 5.2.1.). Additionally, 12.9% of participants rely on selling produce for the farm and employment elsewhere to obtain an income. 3.2 % of participants relied on selling produce from their farm for income. While a 6.5% of participants indicated that they rely on a family member's income to support themselves economically.

Table 5.2.1: Summary demographic information of individual interviews participants

Characteristic	**Number of participants**	**Percentage of total participants**
Village		
Allandale A	10	32.3%
Athole	11	35.5%

New forest	10	32.3%
Household head		
Head of house	26	83.9%
Dependent	5	16.1%
Gender		
Male	8	25.8%
Female	23	74.2%
Age		
18-35	8	25.8%
36-50	9	29%
51-65	7	22.6%
65>	7	22.6%
Education		
No formal education	6	19.4%
Primary education	7	22.6%
Secondary education	18	58%
Tertiary education	0	0
Source of income		
Solely on farm	1	3.2%
Farm and employment	4	12.9%
Farm and business	6	19.4%
Farm and family members	2	6.5%
Farm and government support	18	58.1%

5.3 AGRICULTURE IN BUSHBUCKRIDGE IN MPUMALANGA, SOUTH AFRICA.

Agriculture is a key sector in South African socio-economic development and reduction of poverty, especially in areas of Mpumalanga that are reliant on agriculture (Manyanga *et al*., 2023). Mpumalanga's agricultural sector is a cornerstone of its economy, with a large portion of the province's land dedicated to natural grazing, supporting livestock such as cattle and sheep. The Lowveld region, Mbombela, is renowned for producing citrus fruits, making it South Africa's second-largest citrus producer. Additionally, the Highveld areas are known for their extensive soya bean cultivation, contributing over half of South Africa's soya bean crop

(Manyanga *et al*., 2023). These agricultural activities not only bolster the local economy but also play a vital role in the socio-economic development of the region (DAFF, 2010). However, the livelihoods of local farmers are at risk because agriculture is similarly susceptible to the effects of climate change (Kurukulsuriya and Rosenthal, 2013).

According to the Department of Agriculture, Forestry and Fisheries (2010), Mpumalanga has four main agroecological zones: the Highveld Grassland, the Eastern Moist Grassland, the Lowveld Savannah and the Escarpment Forest. Each zone has different climatic conditions, soil types, vegetation and crop suitability. Bushbuckridge is located in the semi-arid Lowveld Savannah zone, which experiences hot summers and moderate winters. The average annual rainfall is about 500 mm, with most of it falling between October and March. The average annual temperature is about 23°C, with a maximum of 35°C in January and a minimum of 11°C in July (DAFF, 2010). This area is highly exposed to the impacts of climate change with variations in temperature and rainfall making local agriculture more sensitive to these climatic events (Manyanga *et al*., 2023).

Specifically with smallholder farmers in Mpumalanga, maize and wheat are common in regional food systems (Olabanji *et al*., 2021). While these crops have contributed to food security and economic stability, they have also led to a decline in the cultivation of indigenous crops such as sorghum and millets, which are more resilient to local climatic conditions and hold significant cultural value (Mavengahama *et al*., 2013). Maize and wheat crops have been reported to be sensitive to changes in temperature with a reduction in yield resulting from these conditions (Olabanji *et al*., 2021). Furthermore, the effects of climate change in this region affect soil health immensely. The province of Mpumalanga reports lower soil quality and lower water quality as a result of mining activities in the area (Simpson *et al*., 2019).

The adoption and effects of regenerative or conservation agriculture in Mpumalanga are not well documented in the literature. However, some studies conducted on conservation agriculture and regenerative agriculture have shown positive results in soil quality, water efficiency, yields and economic gain. For example, Mabuza *et al.* (2023) evaluated the effects of conservation agriculture on maize production in Mpumalanga, specifically in Bushbuckridge, and found that no-tillage agriculture increased soil organic carbon, soil moisture content, and maize yield compared to tillage. The potential of regenerative agriculture in the Global North has been explored, findings include that regenerative

agriculture improves soil fertility and crop diversity (Rhodes, 2017; Fulton, 2022; LaCanne and Lungdren, 2018). Although limited, research from the Global South, including countries like Kenya and Nepal, indicates that regenerative agriculture not only mirrors the benefits found in other studies, but also enhances food security and improves livelihoods beyond what is achievable with conventional farming methods (McLennon *et al*., 2021; Tittonell *et al*., 2022; Adhikari and Timisina 2022; Otara, 2023).

Agriculture in Bushbuckridge faces many challenges due to climate change and land degradation. However, there are opportunities for adaptation in agriculture – one of these discussed extensively in the global North is regenerative agriculture. While literature indicates that this specific practice of agriculture could be a sustainable alternative that enhances soil health, crop productivity and resilience, reduces greenhouse gas emissions, and conserves biodiversity, it also requires careful implementation and management to ensure that these benefits are fully realized and sustainable over the long term.

5.3.1 ASSESSING KNOWLEDGE OF REGENERATIVE AGRICULTURE PRACTICES

Objective two of this study sought out to assess the understanding of regenerative agriculture among smallholder farmers in Bushbuckridge. According to the conducted interviews smallholder farmers of Bushbuckridge are knowledgeable about various regenerative agriculture practices, and they are currently being practiced in all three villages (Figure 5.3.1). Eleven practices were identified as regenerative agriculture practices - of these, smallholder farmers respondents indicated that polyculture is the most commonly employed regenerative agriculture practice. Additionally, these practices are carried out differently with varying adoption rates in the three study sites (Figure 5.4.3).

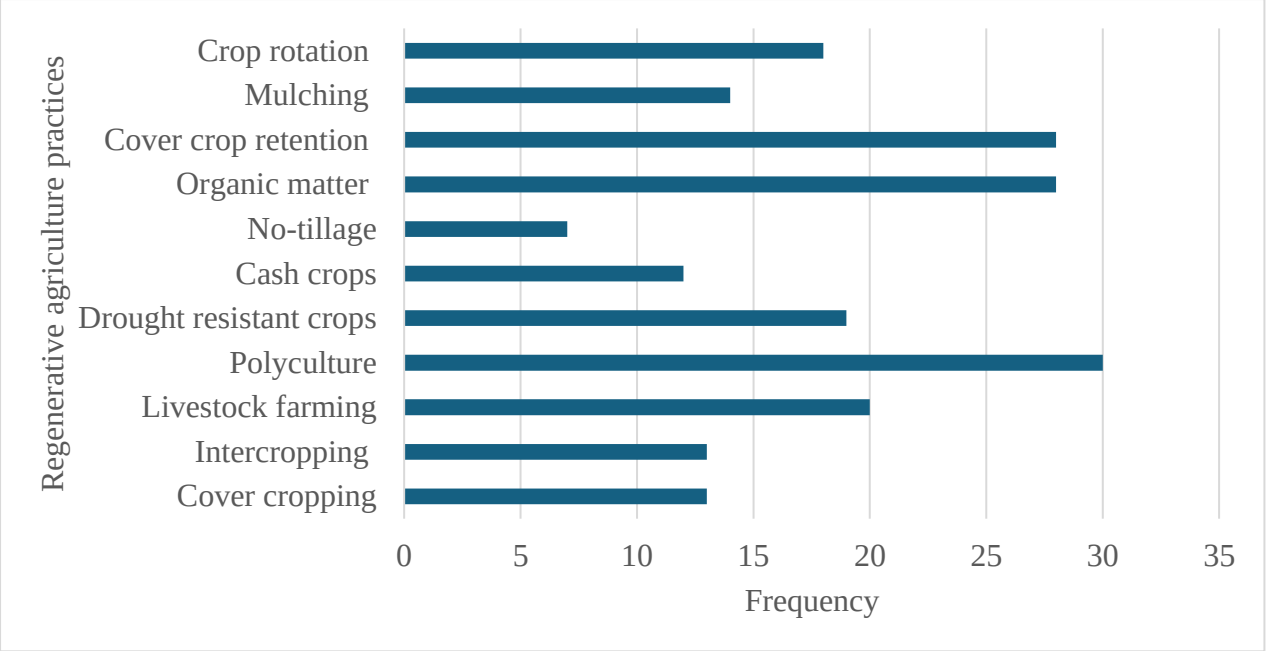

Figure 5.3.1: Overall regenerative agriculture practices in the municipality of Bushbuckridge.

Interview results indicated that participants are knowledgeable of different regenerative agriculture practices (Table 5.3.1). Overall polyculture was the most common practice followed by cover crop retention and application of organic matter. One participant indicated that "We plant multiple types of crops and when we harvest, whatever is left over is applied back to the ground." (FGD 002 AA, FGD A 007, FGD NF 009).

Table 5.3.1: Assessment of participants knowledge of regenerative agriculture practices (n=54)

Regenerative agriculture practice	**Knowledge of practice and practices (%)**	**Knowledge of practice and does not practice (%)**	**No knowledge of practices and does not practice (%)**
Crop rotation	87	7	6
Crop Livestock integration	56	42	2
Intercropping	56	9	35
Cover cropping	58	7	35
Crop residue retention	58	35	7

No-tillage agriculture	35	23	42

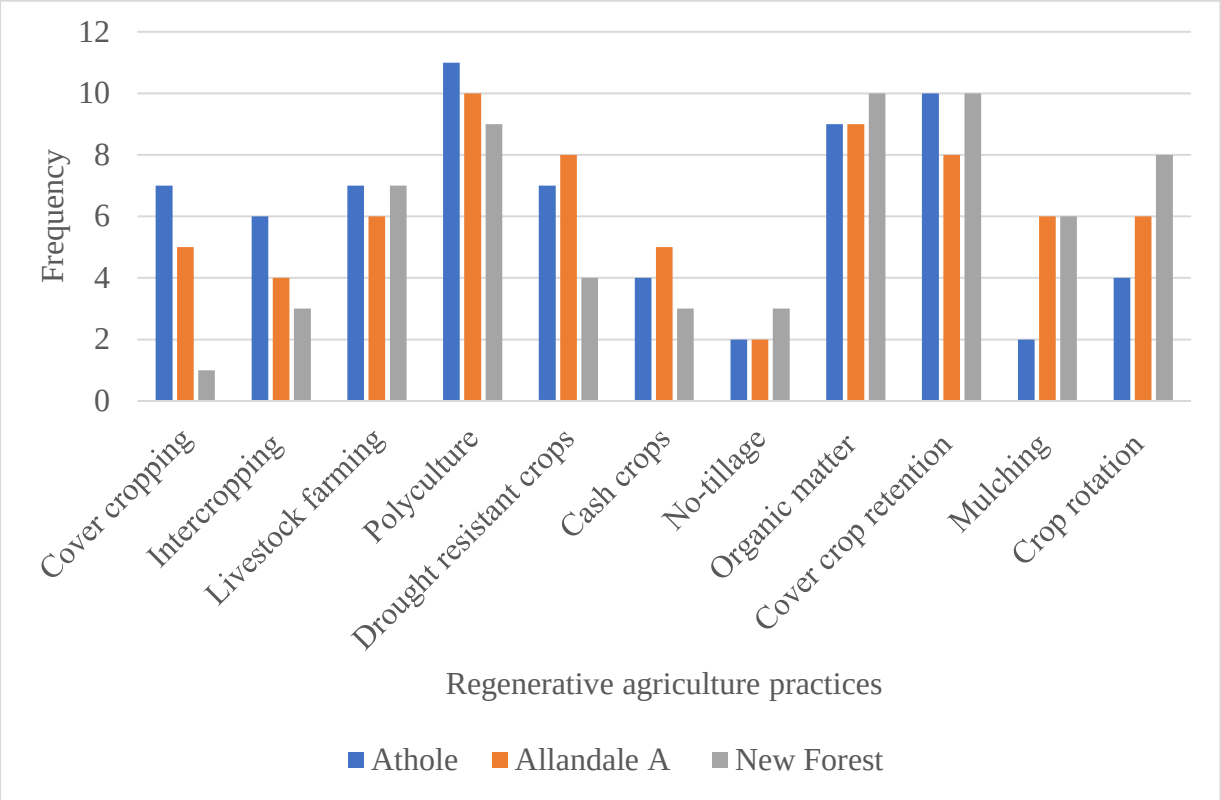

Figure 5.3.2: Regenerative agriculture practices in the respective study site villages in Bushbuckridge.

According to the focus discussion groups, practices of regenerative agriculture are carried out and are known by the smallholder farmer participants. The regenerative agriculture practice that has a lower adoption as a result of limited knowledge with regards to the practice is no-tillage agriculture (Table 5.3.1). According to smallholder farmer participants of Bushbuckridge, the most practiced regenerative agriculture practice is polyculture (Figure 5.3.2). According to participants, these practices have been passed down to smallholder farmers from family members that were previously involved with agriculture. This observation aligns with the conclusion of other studies, indicating that knowledge of agricultural practices is inherited across generations (White, 2012; Wójcik *et al*., 2019; Conway *et al*., 2021). Additionally, other practices that are mostly conducted in the region of Bushbuckridge include intercropping and livestock integration. This is indicative of the high potential for future adoption of other regenerative agricultural practices in the municipality.

According to all participants, the reasoning behind knowing different practices and being unable to carry them out is due to limited access to resources and funding. According to participants, no-tillage agriculture was the most misunderstood practice. Participants have indicated that “we have been taught by other farmers to turn the topsoil occasionally or attach an instrument to livestock as to assist with tillage” (FGD 001 AA, FGD NF 003, FGD NF 005).

5.4. TRAINING FARMERS OF BUSHBUCKRIDGE

A common theme emerging in the focus group discussions are that smallholder farmers are looking for training to improve their current agricultural practices. A focus group in Athole revealed that private extension officers from an organization in Cape Town educated farmers in the area about regenerative agriculture during a workshop in September 2022. As a result of this workshop, a group of six participants congregated to create a communal farm for a local school (Figure 5.4.1.). All produce grown in the school are used to cook meals for students that are not able to afford bringing lunch to school.



Figure 5.4.1: A regenerative agriculture farm newly implemented in a local school in Athole.

While some participants benefited from the regenerative agriculture workshop, other participants indicated that they could not fully benefit. One participant indicated:

> "I did not benefit from the workshop like the others did; I learnt new information about regenerative agriculture, but I could not practice it. After the workshop, Sabie Sand provided seeds to some individuals, but because they ran out of seeds, I did not receive seeds, and I could not benefit like others that received seeds." (FGD A 01)

In addition to this, some members from the workshop indicated that they were not made aware of this workshop opportunity and felt robbed for not learning the necessary skills needed to implement regenerative agriculture on their land.

While the village of Athole had the opportunity to be educated in regenerative agriculture systems, the other villages were not so fortunate. Focus groups from Allandale A and New Forest revealed that they received no training from private or public extension officers. Participants from Allandale A and New Forest both reaffirmed their readiness to learn about different forms of agriculture. One participant indicated:

> "I want to learn from different workshops about agriculture, but there is no one to teach us, no private or public officers have come to our village to provide us with resources or information before this. I rely on the knowledge I have been taught growing up." (FGD NF 01)

Another participant further reiterated:

> "I want to attend but the private sector and public sector do not visit us or listen to our concerns about agriculture. In the last 20 years, no government official or private official has come to speak to us about agriculture." (FGD AA 01).

As mentioned previously, some Athole participants have received training in regenerative agriculture practices. The same number of participants in New Forest and Athole have heard of the term 'regenerative agriculture.' Allandale A has the least amount of participants aware of the term (Figure 5.4.2). Participants from Athole have indicated that they had previously received training from Sabie Sands, which could be an indication as to why participants were aware of regenerative agriculture. However, participants from Allandale A and New Forest were not formally trained, but indicated that to stay updated they use the internet.

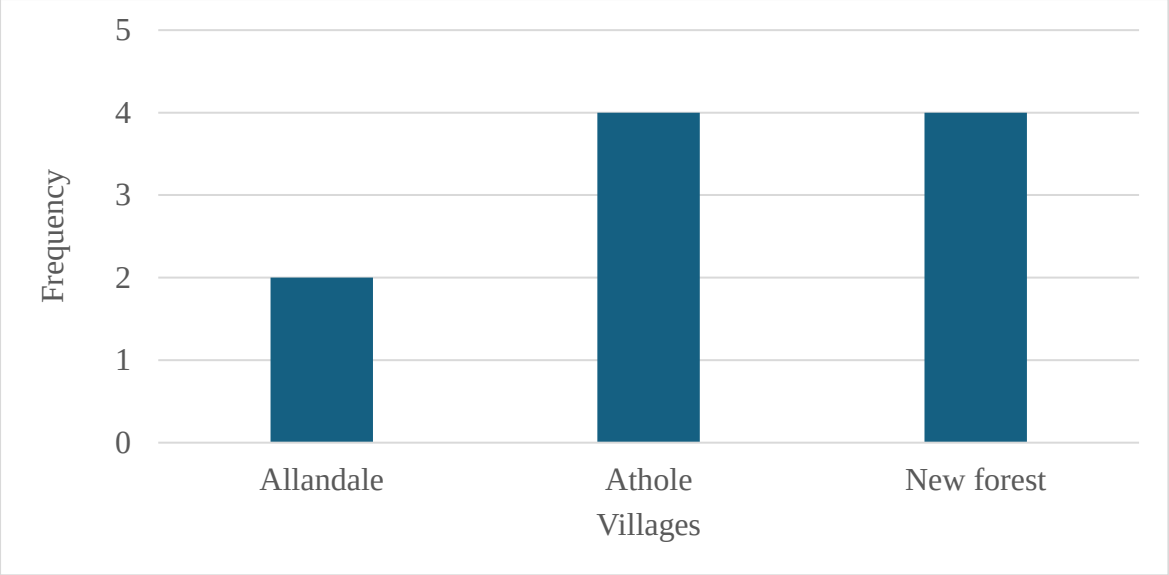

Figure 5.4.2: Knowledge of the term regenerative agriculture in different villages of Bushbuckridge.

The information indicates that participants who are older, ages 65 and above (Figure 5.4.3.), a plethora of knowledge and insight, probably because they have been involved in traditional farming methods for a longer amount of time. This knowledge is essential because it is the foundation of sustainable agriculture; it ensures that important discoveries are not lost but rather shared, building resilience in the face of shifting agricultural paradigms and landscapes.

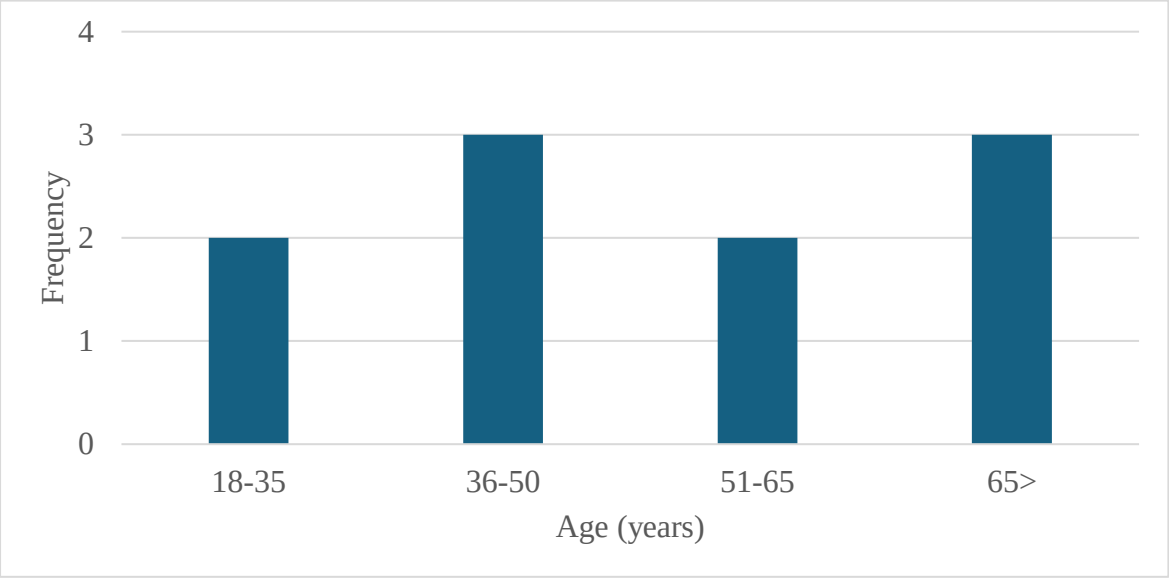

Figure 5.4.3: Smallholder farmer participants having heard of the term regenerative agriculture.

According to the data collected, participant age groups have spent different years farming. However, with regard to knowledge of regenerative agriculture, participants who have been farming for 10-20 years have a better understanding of regenerative agriculture practices (Figure 5.4.4). According to smallholder farmers who have been in the field for less than ten years and those who have been in the field for more than fifty years, the term "regenerative agriculture" is unfamiliar to them. According to the data collected from participants, local practices were carried out by participants and were defined as agroecological practices . These include polyculture, cover-cropping, and mulching (Figure 5.4.1).

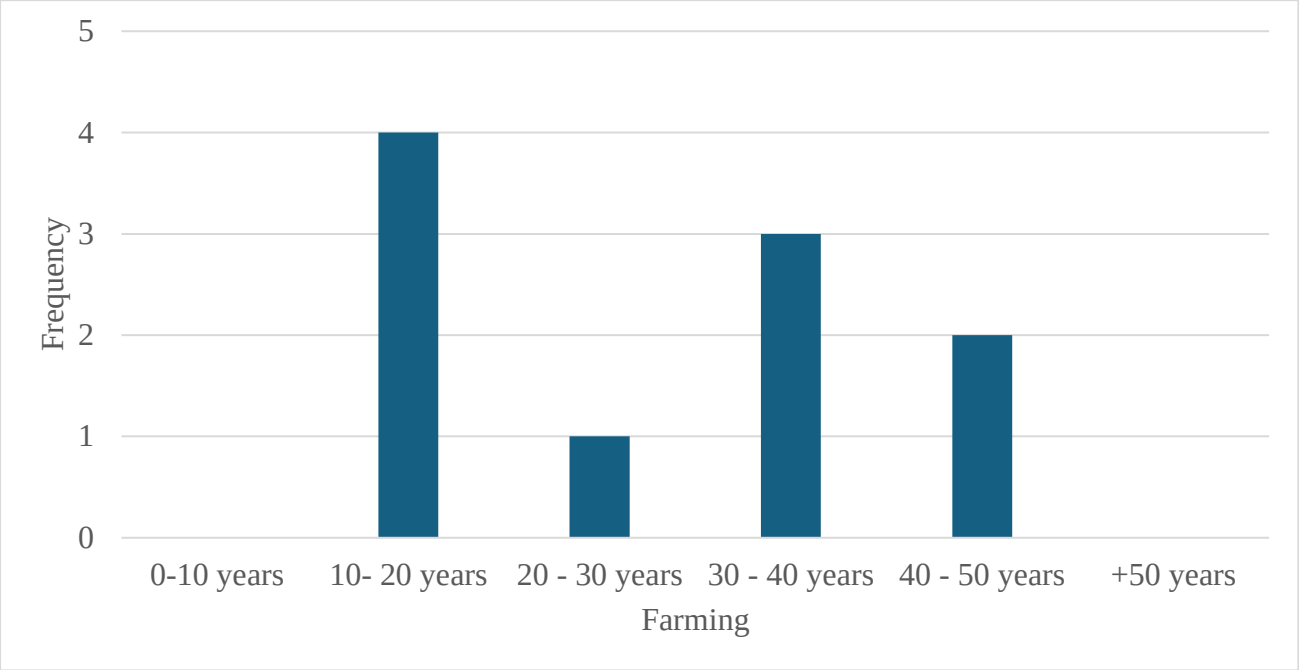

Figure 5.4.4: Number of years of farming and having heard the term regenerative agriculture.

5.5 SWOT ANALYSIS

Based on the focus discussion groups and their knowledge of regenerative agriculture, participants discussed the strengths, weaknesses, opportunities and threats (SWOT) of the practices that can be associated with regenerative agriculture (Table 5.5.1). The form of analysis has been previously used in different studies indicating that the SWOT can be used to identify strategies for the development of agriculture and can influence policies in this space (Ramaloo *et al*., 2018; Benzagtha *et al*., 2021).

Table 5.5.1: SWOT analysis based on the responses of participants from focus groups.

STRENGTHS	WEAKNESSES

• Longer lasting soil health. • Intercropping allows for growing more crops (increasing agricultural diversity). • Growing drought-resistant crops (i.e., sweet potato). • Making compost from harvest crops. • Animal manure as organic fertiliser for the soil. • Less pests are found on crops. • Local knowledge	• Gaps of knowledge, thus, unable to practice regenerative agriculture according to the landscape and climate. • Lack of access to resources due to corruption in local government and agricultural department • No market access. • No targeted interventions.
OPPORTUNITIES • Increase of funding for agriculture from the local government. • Organizations providing education to different villages. • Inclusion of the irrigation scheme that other villages are running. • Networking or seed sharing programme amongst smallholder farmers. • Providing workshops to smallholder farmers. • Education on climate change: planting late according to the temperature change. • Involvement of technology • Irrigation	THREATS • Climate change: extreme temperatures are affecting the yield of crops grown. • Lack of water due to lack or irrigation: Not enough water to grow crops thus, decreasing the overall yield grown. • Lack of seeds from the previous season or poor seeds sold at the market – including local varieties.

5.5.1 STRENGTHS

A theme explored by participants was their local knowledge with regards to a changing climate and changing environment. Understanding and addressing climate change requires a deep grasp of local knowledge, and farmer collective conduct is influenced by perceptions.

For example, according to focus group participants, based on the lack of rain or diseases found on crops, various responses would be portrayed. For instance, participants indicated that:

> "If there are diseases found in the crops, we burn the crops and sprinkle it over the living crops." (FGD AA 007, FGD AA 008, FGD A 006, and FGD A 009).

Additionally, one participant indicated that climate change could be seen as an opportunity:

> "Climate change could hold an opportunity for us (smallholder farmers) to learn about using drought-resistant crops during periods of less water" (FGD AA 009).

5.5.2 WEAKNESSES

Weaknesses include higher initial costs, gaps in knowledge, corruption, and lack of market access. Smallholder farmers' access to markets was extensively discussed as a weakness in agriculture. Some smallholder farmers who grow cash crops, however, are excluded from the formal market and street vending, indicating there should be a better system in place to allow for the inclusion of smallholder farmers in the marketplace. One participant stated:

> "We (smallholder farmers) do not have any access to the marketplace, when we grow enough produce for the household and we have enough to sell to others, there is no place we can go to sell our crops." (FGD AA 003).

As indicated in the previous chapter, regenerative agriculture has been cited as a potential solution for local food sovereignty. Additionally, smallholder farmers indicated that local corruption plays a role that limits the adoption of regenerative agriculture. In New Forest, the provincial agricultural department is located here, however, access to information and grant applications are not easily available to them. According to one of the participants:

> "When we (smallholder farmers) go to the agricultural office to find out about grant applications or extension services offered, we have no assistance. If there are applications we receive them the day or two before applications close. They also give application forms to their family members" (NF 008).

Seemingly, these factors play a role in the adoption of regenerative agriculture in the community.

5.5.3 OPPORTUNITIES

While one of the main principles of regenerative agriculture is to increase biodiversity (Sands *et al*., 2023), results indicated that this proved challenging for smallholder farmers of Bushbuckridge. Most participants, if not all, indicated they grew maize. Smallholder farmers with an income and who could afford to buy other seeds reported that they grew other fruits and vegetables for household consumption and if any extra to sell to obtain an extra income. These fruits and vegetables included tomatoes, onions, peanuts, potatoes and sweet potatoes (Figure 5.5.1).

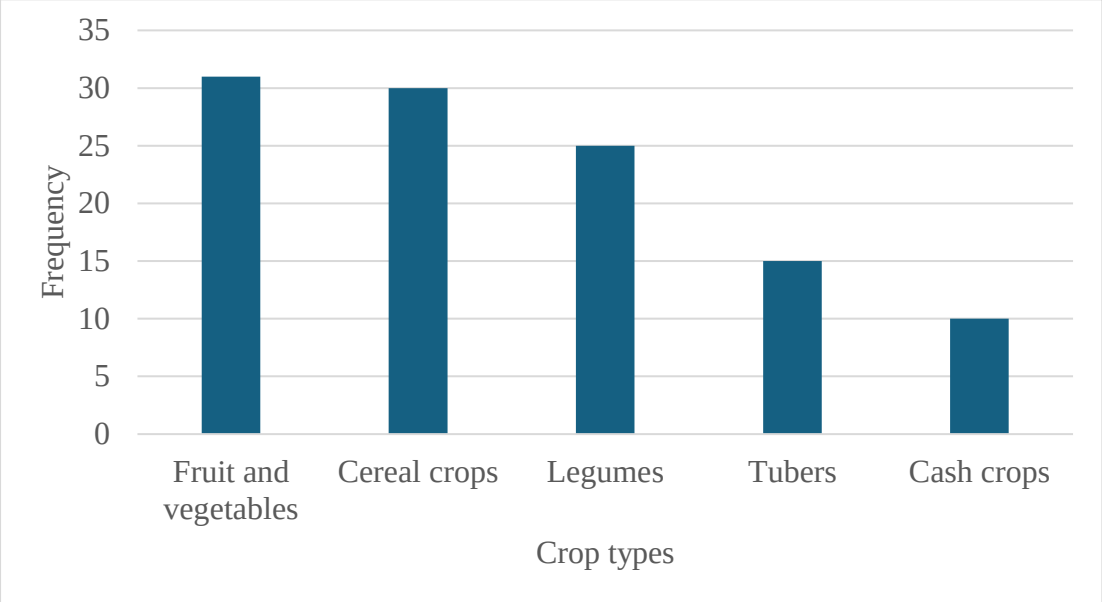

Figure 5.5.1: Crops grown in Bushbuckridge.

In some rare cases, crops grown also included sugarcane and chilies. According to the SWOT analysis (Table 5.5.1), smallholder farmers have indicated that a barrier to the uptake of different agriculture practices but also an opportunity is the limited access to seed varieties. Participants expressed that this could provide an opportunity for smallholder farmers of the community to share seeds and create networks for other educational workshops.

Another opportunity is training. According to participants in New Forest village and Allandale-A that heard about other villages such as Athole getting benefits from attending agricultural workshops were left disgruntled.

> "We also want education in agriculture so we can better understand our crops, their growth and how it is affected by the environment" (FGD NF 002, FGD AA 003).

Participants were eager to discuss opportunities indicating that with a changing world and the introduction of cell phones, there could be more opportunities in how information is communicated. One participant indicated:

> "Farmers could use phones to communicate various information with each other around agriculture – this could include climate information or practices in agriculture." (NF005).

Similarly, other technological advancements can be made with regards to resource availability such as irrigation schemes. Athole and Allandale A were not on any water scheme, but, in the village of New Forest, smallholder farmers were part of an irrigation scheme.

One participant who is a beneficiary indicated:

> "This is a small irrigation scheme that helps farmers with access to water, it is not a big water scheme, and it does not work sometimes." (FGD NF 008).

Opportunities therefore include an increase of educational workshops, an integration of technology and the building of smallholder farmer networks for knowledge.

5.5.4 THREATS

Most if not all smallholder farmers indicated that there has been a reduction in crops produced and have indicated that this is a direct result of changing temperature, however, the impacts of climate change were varied in the different study sites. Participants in Athole reported extreme heat, which would result in diseases and pests in the crops grown. An emerging theme from the focus groups was the changing climate and the effect this has on both crops and smallholder farmers. According to a participant:

> "Our plants cannot survive the heat, we (smallholder farmers) have to plant crops that can better handle the heat or change the crops planted. For example, sometimes I plant maize and because of the heat it cannot grow, I would plant peanuts because the soil is cooler, and it can survive." (FGD NF 007).

A participant reiterated:

> "The extreme heat as a result of climate change kills all our crops, the 2022-2023 season is the worst I have ever seen, this heat has killed all my maize, when I harvest

> my maize it is black and full of disease and insects. I have to cut all my maize down and start from scratch." (FGD A 003).

In Mpumalanga, participants have indicated there were extreme weather events, these include the February 2023 rains, the emergence of cyclone Freddy, and thereafter, a rapid increase in rising temperatures.

According to participants, coupled with the effects of climate change, the lack of water is a huge challenge for smallholder farmers. Two villages (Athole and Allandale A) were not on any water schemes and had to rely on rainfed agriculture and in times of need on their household water conservation to carry out agricultural activities.

One participant indicated:

> "Because of the heat, I have to water the crops twice a day, but I cannot work with this heat, I water the crops once a day and it dies because there is not enough water. But because I am old I find this hard to do every day" (FGD AA 005).

According to participants, climate change also affects agricultural productivity with the ability to collect viable seeds to cultivate for the next season. One participant indicated:

> "Because of how climate change has affected us this season, we (community smallholder farmers) will not be able to save seeds for the next season." (FGD A 002).

Another participant reiterated:

> "This is not the first time we are not without seeds for different fruits and vegetables, there have been other times that all we can grow is maize and nothing else, we borrow from our neighbours and family members. we need assistance for obtaining seeds from different organizations and government." (FGD AA 002).

As a savanna region, the municipality of Bushbuckridge is dry and requires crops that can withstand elevated temperatures and lack of water (Incoom *et al*., 2022). A lack of diversity in seeds hinders the uptake of regenerative agriculture in the area, as there are not enough crops to carry out the various practices in regenerative agriculture – such as crop rotations, intercropping and polyculture. As mentioned above, the implementation of local varieties could be viewed as a potential opportunity for adaptation to climate change.

5.6 GENDER AND REGENERATIVE AGRICULTURE

Objective three sought to assess how regenerative agriculture considers the local gender dynamic. As indicated previously, more women than men participated in this study and are more involved in smallholder agriculture in the selected villages of Bushbuckridge (Table 5.2.1). While they are more involved in agriculture, the training and resources often go to men, as evidenced below.

One participant indicated:

> "As women of the community, we are not given any resources or any aid from the government, we have no one to turn to if we have questions about climate change or agriculture. – however, the men get more access to resources than women" (FGD NF 002)."

> "We do not receive training or resources from any government official in our village, when the local government has resources or funding available for us, those resources go to the men or youth of the community." (FGD NF 003).

There appears to be disproportionality with regards to women's access to resources and adaptiveness to climate-related disasters.

With regards to regenerative agriculture, despite women not being formally trained, they are more likely to know about different agriculture practices and even regenerative agriculture (Figure 5.6.1). However, this does not necessarily translate to their agricultural contribution being recognised. One participant stating:

> "90% of the agriculture in this municipality of Bushbuckridge is completed my women, yet we are not recognized for this role." (FGD NF004).

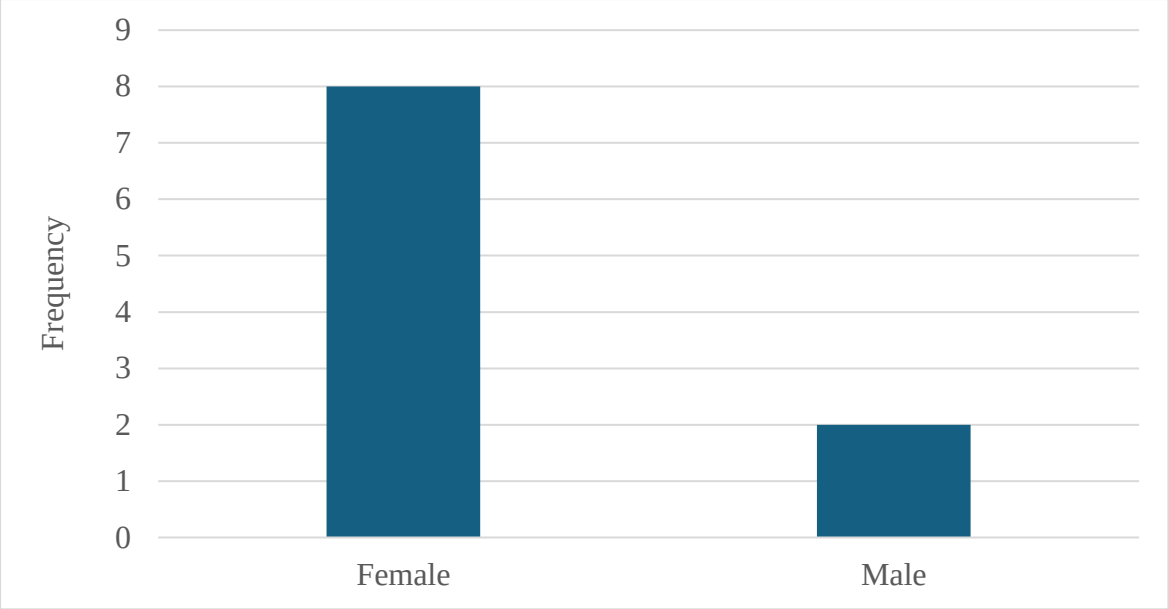

Figure 5.6.1: Genders of the different participants and them having heard about RA.

When women participants were asked about the source of information around different agricultural practices and more specifically, regenerative agriculture, one participant indicated that it was "through reading agricultural information on the internet" (FGD A008). Another participant indicated that "women farmers speak to other women farmers to enquire about their practices" (FGD NF006).

Here, women have been reported to share information about their involvement and practices with regards to regenerative agriculture, with one participant sharing:

> "We (women in the village of New Forest) do not get any assistance from extension officers, but we have a group that collects our monthly grant together, during this time we discuss agriculture, resources, irrigation or climate-related adaption strategies" (NF004).

This study found that women have different access to resources including information about regenerative agriculture practices, but that they are key role-players in agriculture in the region and have a particular role in the sharing of information on different agricultural practices, although they feel that this is not recognised . The findings with regards to question three were, however, inconclusive, in terms of how regenerative agriculture could help address these concerns.

CHAPTER 6

DISCUSSION AND CONCLUSION

6.1. DISCUSSION

6.1.1 WHAT ARE SMALLHOLDER FARMERS PRACTICING?

The term "regenerative agriculture" may not be widely recognized, but experts note that smallholder farmers often engage in these practices under the broader umbrella of conservation agriculture. This suggests that what is termed 'agriculture' could, in essence, encompass a variety of regenerative techniques. Indeed, it is questionable whether a single category can adequately capture the diverse methods and principles that farmers apply in their stewardship of the land. This finding was previously reported in another paper, which was used to define regenerative agriculture (Tittonell *et al*., 2022). Further backed by Landers *et al*. (2021), corporate regenerative agriculture lacks a scientific definition but adopts conservation agriculture. However, indicating that CA should embrace this forming a new practice of CA and RA known as “Combined Regenerative Agriculture” (Landers *et al*., 2021), while this is a noble attempt for CA and RA practitioners to get ahead of co-optation – the combination remains not scientifically defined and not well understood. According to Landers *et al*. (2021), an advantage of this combination of approaches to agriculture is through a multistakeholder approach, the potential of a standardization of certification. This method involves integrating the strengths of both CA and RA by applying them together.

Additionally, according to the definition of conservation agriculture, there are 3 core principles including no-tillage, permanent soil cover and diversification of crops - of which crop-livestock integration is not included (Pittelkow *et al*., 2015). However, farmers in Bushbuckridge are practicing crop-livestock integration and according to the literature, this practice is key to agroecology and sometimes the regenerative agriculture approach (Ryschawy *et al*., 2017; Peuch and Stark, 2023). Participants are engaging with regenerative agricultural practices, not just conservation agriculture as mentioned by some of the experts, however, they do not necessarily recognize it by name.

6.2 GENDER AND REGENERATIVE AGRICULTURE – GENDER LENS

More women than men smallholder farmers participated in this study and are household heads (Figure 5.2.1). According to the FAO (2011), women are the primary producers in smallholder farmer communities, which is reflected in the study participants. Evidence

suggests that culturally, women in developing nations who stay in villages often stay at home, while the men are expected to look for formal employment (Rietveld *et al*., 2020; Jayachandran, 2021). According to the women in this study, they run the household including looking after the children and cooking meals for the household – which is a similar result found in another study (Ngomane and Sebola, 2019). Thus, as a result, are more likely to farm in comparison to the men of rural areas. However, when men do engage in agriculture, the main goal is not food security for the household, but rather generating additional income by selling crops in the market (Raney *et al*., 2011; Peralta, 2022).

Gender inequalities and social norms affect how women and men experience and respond to climate change. Women in Sub-Saharan African rural villages frequently bear more risks and duties as a result of climate change, particularly due to their economic backing and responsibilities in their homes and communities. Agriculture is one method that both men and women may adapt to the consequences of climate change (Perez *et al*., 2015; Assan *et al*., 2018; Rao *et al*., 2019). Agriculture can provide food security, income and livelihood opportunities for both genders. However, there are also gender differences in access to and control over agricultural resources, such as land, water, seeds and credit (Croppenstedt *et* al., 2013). These differences might influence how men and women use and adopt various agricultural technologies and practices (Porter, 2011; Van Aelst and Holvoelt, 2016; Petesch et al., 2018). Moreover, it has been proposed that the reasons why men and women enter agriculture vary. A case study in Benin found that men practice agriculture to secure capital and government grants, whereas women practice agriculture to satisfy hunger in the household (Dah-Gbeto and Villamor, 2016). As women and men play different roles in agriculture, have different access to resources, and have different responses to climate change, it is necessary to evaluate regenerative agriculture using a gender lens.

According to the women smallholder farmers in this study, most agricultural efforts are carried out by women, however, they do not receive any assistance in the form of agricultural grants, workshops, or knowledge. Similarly, literature indicates that men in Africa have easier access to information than women do (Nyasimi *et al*., 2018). This is usually due to their access to higher capital, education and freedom of mobility (Maulidi and Kasiya, 2019). In addition, because men have easier access to markets than women do, they are more likely to grow crops for the market (Croppenstedt *et al*., 2013; Peterman *et al*., 2014; Olaosebikan *et al*., 2019; Aberman and Roopnaraine, 2020). Men are more likely to engage with the market and have higher production levels due to better access to resources (Olaosebikan *et al*., 2019).

An example of this is cassava production in Nigeria, where men have better market access than women in the area. Similarly, banana production in Kenya is shown to have equivalent results (Fisher and Qaim, 2012). In contrast, gender was shown to not correlate to agricultural performance in Bushbuckridge (Belete and Ledwaba, 2021) perhaps because market access was a limiting factor for both genders.

Despite all women's contributions to agriculture, their labour often goes unacknowledged (Hansda, 2017). Societal norms and cultural norms prohibit women from being acknowledged and included in the very conversations that determine their livelihoods (Grabe, 2010). This lack of inclusion in decision-making in agriculture often translates to a lack of policy around women in agriculture and a continuous lack of resources (Mohammed *et al*., 2023). Indicating the future of regenerative agriculture is dependent on tailoring practices to different rural communities. According to gender studies, there is a power imbalance due to multiple factors including race, class, ethnicity and socio-economic status and women (Vercillo, 2022). Addressing these imbalances are crucial for the inclusivity of women and dismantling the associated barriers to women's involvement in agriculture (Chandra *et al*., 2017; Vercillo, 2022).

According to this study, there is a difference in how many women and men practice regenerative agriculture with a higher proportion of women carrying out these practices than men (Figure 5.6.1). In contrast to what was found in this study, gendered patterns in Uganda found that women were found to practice less soil fertility methods such as composting and mulching due to their tight limits with resources and cash – these restrains resulted in a lower soil fertility and ultimately lower crop yields (Goldman and Heldenbrand, 2002). Additionally, adoption other regenerative agriculture practices were found to be lower indicating limited uptake minimum tillage and livestock integration systems in women than men in parts of Ghana (Ndiritu *et al*., 2014). Decision-making is influenced by various factors, including limited access to resources, land, and governance about land use (Croppenstedt *et al*., 2013). It is important to note that each case study is different and it is therefore important not to make generalisations.

Inn addressing these challenges, social capital is a climate adaptation and agriculture involvement strategy for women in villages of Kenya (Jiri *et al*., 2017). Notably, women organizations have been reported to improve women's access to resources, livestock production, market access, agricultural extension services and participation in decision

making in their communities (Buehren *et al*., 2019; Raghunathan *et al*., 2019). Organizations form critical forms of household food security and the overall wellbeing of women in rural communities (Das and Singh, 2020; Jenderedjian and Bellows, 2021). In the Bushbuckridge municipality, women's agricultural organizations have emerged as a significant force. These groups, originating from various villages, have united to exchange agricultural knowledge and strategies, enhancing their collective expertise. This collaboration has become a cornerstone of their social capital, holding discussions on enhancing agricultural productivity and efficiency. However, these women have voiced a concern: the broader agricultural sector, including both regenerative and conventional farming, fails to recognize their role. Consequently, there is a lack of gender-inclusive food systems that accommodate their needs and contributions, forcing them to create and rely on their own agencies.

Making provisions for women in regenerative agriculture goes beyond acknowledging their contributions to agriculture overall, but includes disabling barriers that seek to exclude them (Nyanga *et al*., 2012; Wekesah *et al*., 2019). This potentially includes transformative change through creating programs that look to train women in agriculture, access to equal resources and opportunities and creating policies that actively challenge rural societal norms that perpetuate gender inequalities in villages. Hence, regenerative agriculture requires a holistic view that considers the intersectionality of gender dynamics, climate change and agriculture and aims for a shift towards an inclusive food system (Frobrich *et al*., 2023). While currently, regenerative agriculture is not enabling a more gender-inclusive food system in the study sites, provisions through programmes catered towards gearing women with the skills necessary could result in a more gender equitable food system (Newton *et al*., 2020; Frobrich *et al*., 2023).

6.3 VULNERABILITY

A prominent theme emerging from the data collection is that there is a lack of access to information and education about resources influencing participants' responses to the climate crisis impacting their vulnerability to climate change. According to Schilling *et al*. (2020), this can be classified as vulnerability, further sub-categorized into exposure, sensitivity and adaptive capacity. Building on the identified theme of vulnerability due to inadequate access to information and education, the subsequent section will delve into regenerative agriculture as a pivotal strategy to address vulnerability. This approach addresses exposure, sensitivity, and adaptive capacity aspects of vulnerability and also discusses a proactive pathway to enhance the resilience of communities against the climate crisis.

6.3.1 Exposure to climate change

According to Juana *et al*. (2013), Sub-Saharan Africa is amongst the most vulnerable regions to climate change impacts as a result of highly dense populations living in poverty and high reliance on agriculture for their sustenance. An emerging theme from the individual interviews and focus group discussion is the effect of climate change on smallholder farmers' crops. Participants have indicated that there has been variation in rainfall and temperature that is detrimental to smallholder livelihoods. This is further substantiated by the Juana *et* al. (2013) – indicating that variation in temperature and rainfall not only affects agriculture, but the economic and social factors reliant on agriculture. Temperature data across the continent reflects an increase in the number of extreme temperature events, with more hotter days to come (Niang *et al*., 2014). The most significant warming has been reported in sub-Saharan Africa and current models indicate further increases in temperature for the rest of the century (Engelbrecht *et al*., 2015). Temperature is considered an important factor affecting the distribution and abundance of various crops, affecting the overall growth and development of crops (Skendžić *et* al., 2021). Similarly, the development of various pests and diseases is affected by volatile temperature (Hakala *et al*., 2011; Munawar *et al*., 2020). Other studies indicate that during a season with variable temperatures, crops are compromised (Newton *et al*., 2020; Sharma and Dhillon 2020).

In response to these challenges, regenerative agriculture emerges as a potential approach that can revitalize ecosystems and enhance the resilience of smallholder farms against climate-induced stressors. According to participants, the impacts of climate change were varied in the different study sites. A similar finding was reported with smallholder farmers indicating varied individual climate change impacts on their crops and livelihoods (Kom *et al*., 2020). All the participants indicated there has been a change in crops planted from the time they started farming and that climate change is the biggest contributor to the change of crops being planted in different seasons or not planted at all (Table 5.5.1). Participants either plant another type of crop or plant various crops. This finding has been found in similar studies indicating that the change in crops grown, and farming practices is due to smallholder farmers and their perceptions of climate change (Gandure *et al*., 2013; Kom *et al*., 2020).

Various findings have been reported indicating that changes in local climate results drive adaptation methods – such as changing practices to better suit reduced water inputs as an impact of climate change or adopting high-yielding plant varieties (Lal, 2011; Kalele *et al*., 2021). For example, in Burkina Faso, smallholder farmers have an interest in cultivating

traditional sorghum landraces due to their ability to produce stable yields in the face of a changing climate (Vom Brocke *et al*., 2014). Another study found that local farmers have also been reported to change from traditional crops to modern high-yielding crops as a result of climate change (Alteri and Koohafkan, 2008; Alteri *et al*., 2015). Whereas other reports have indicated that smallholder farmers are swapping out high-yielding crops for the traditional crops that were previously grown due to their resilience to the heat – including maize (Jarvis *et al*., 2008).

Most participants indicated that they grow maize. Maize is a staple crop in Mpumalanga, but it is not very tolerant to climate change (Juana *et al*., 2013). In assessing the viability of maize as a staple crop within Mpumalanga's diverse agroecological zones, it is important to consider the critiques surrounding its cultivation under the region's climatic constraints (Mabhaudhi *et al*., 2017). While maize exhibits adaptability to varying weather patterns, its resilience is not absolute. The environmental repercussions of monoculture maize farming, particularly soil depletion and subsequent yield reduction, pose significant threats to long-term food security. This necessitates the critical examination of sustainable agricultural practices, such as crop diversification with legumes like soybeans, which can enhance soil fertility and promote ecological balance (Mugiyo *et al*., 2021). Furthermore, the socio-economic aspects of growing maize need to be taken into consideration, particularly for small-scale farmers who are struggling with declining soil health (Jouzi *et al*., 2017). By incorporating digital agriculture technologies, maize productivity could be strengthened against environmental stresses. An examination of these variables will help develop a more complex understanding of maize's place in Southern Africa's agricultural system.

Reports indicate that warmer and drier conditions with reduced precipitation could impact maize yields making this crop susceptible to attacks from diseases and pests (Juana *et al*., 2013). According to Sabagh *et al*. (2020), the growth of maize is sensitive to temperature fluctuations. Extreme heat events and climate variability are unprecedented. El Niño is one of these events – according to literature an unprecedented El Niño affected the 2022-2023 season (Aderinto, 2023). The main crop season in Southern Africa is from November to April of the following year and El Niño affects Southern Africa with drier conditions and reduced rainfall (Brugnara *et al*., 2023). Similar findings were reported in South Africa were reported in 1992 and 2016 (Rembold *et al*., 2016). The effects of El Niño have been reported to affect maize production in South Africa (Brugnara *et al*., 2023). In addition to the effects of El

Niño, the 2023 summer season was affected by Cyclone Freddy, indicating the increased exposure to weather related extremes that communities will suffer under climate change.

6.3.2 Sensitivity

In South Africa, there is a semi-arid rainfall, with variability of less than 100mm/year in the western region and 1500mm/year in the eastern region (Thomas, 2021). To put it into perspective, the global average rainfall is 860mm, in South Africa it is 497mm, ranking in the top 30 driest countries globally. Climate predictions indicate that due to the unpredictability of rainfall – some areas of the country are expected to be drier than others. Rainfed agriculture in arid regions like South Africa relies on rainfall for crop yields (Strauss *et al*., 2021) – impacting RA practices and their adoption. Additionally, water resources are unevenly distributed, this is either spatially or temporally (Knight, 2019). Such holds in the context of Bushbuckridge – a study done by (Ndlovu *et al*., 2021) found that water conservation practices or water-smart agriculture are essential for production, especially in the case of Bushbuckridge municipality.

Rainfed agriculture is the primary means of production, without sufficient water, these crops are unviable and susceptible to diseases and pests. Additionally, the lack of water results in soil erosion whereby the overall agricultural productivity is compromised. Furthermore, affecting the smallholder farmers that rely heavily on rain – the livelihoods of farmers are threatened as farmers are unable to produce viable crops for household consumption or as cash crops. Farmers collect water from their households and recycle this water in their farms to conserve water, water crops and prevent soil erosion. Irrigation and other water saving techniques were mentioned as an opportunity to be harnessed by the spread of regenerative agriculture by the participants, addressing this critical aspect of agricultural production.

6.3.3 Adaptive Capacity

Adaptive capacity is the ability to adjust to potential damage, take advantage of opportunities, or respond to consequences either at the system, community or individual level (Schiling *et al*., 2020). Under adaptive capacity, there are two main headings: generic and impact-specific. Generic adaptive capacity refers to education, income and health. Impact-specific adaptive capacity is related to a specific impact and its relation to technology, governance, and technological advancements (Adger *et al*., 2007).

6.3.4 Income

In South Africa, social grants benefit approximately 16 million people every month (SASSA, 2014). According to the results, 58.1% of participants rely on social grants obtained from the government and economic benefits from their smallholder farms (Table 5.2.1). Likewise, studies in other rural communities indicate that participants rely on grant money and crops grown on their homesteads (Sinyolo *et al*., 2016; Gutura and Tanga, 2017; Hendrickson *et al*., 2020). This finding is similar to the data collected in a study which indicated that social grants and smallholder farming play an important role in the livelihoods in rural areas, showing that social grants are available to over 90% of participants, with an average of three beneficiaries per home (Chipfupa and Wale, 2020). There have been negative reports that indicate that smallholder farmers' reliance on social grants undermines farming entrepreneurship and opportunities associated with this (Chipfa and Wale, 2020; Chipfa and Tagwi, 2021). In contrast to this, a study indicated that money obtained from the grants and agriculture in the household was used to improve crop varieties or buying seeds (Bezner *et al.*, 2024).

In addition to this, participants indicated that they would only sell crops if they were fortunate enough to have a good season and extra produce – hence income is limited from homestead farms. This finding is similar to another study done in Ghana – which found that 77% of participants did not sell any of their crops produced indicating that their farm is profitable in sustaining the household (Mansson, 2011).

Regenerative agriculture may hold the key to converting smallholder farming to a business model that is more lucrative and sustainable. Farmers may be able to increase the resilience and productivity of their land by directing social grants toward regenerative measures, which would eventually lessen their reliance on government support (Koswana, 2019; Spratt *et al*., 2021). A positive feedback loop might be started by this change, in which increased agricultural productivity reduces the need for social grants, which could then be redirected to promote agricultural development even more, as indicated in these studies (Sinyolo *et* al., 2016; Koswana, 2019).

This shift is supported by groups like the Regenerative Agricultural Association of Southern Africa (RegenAg SA), which emphasizes the wider ecological advantages of healthy soils, such as enhanced water retention and carbon sequestration. Recognizing the financial obstacles that farmers face, programs such as the Restore Africa Funds are in place to assist

them in making the switch from conventional to regenerative agriculture. The Climate Neutral Group goes on to highlight the financial rewards for farmers who implement regenerative farming methods, suggesting that this approach can lead to both financial and environmental sustainability.

6.3.5 Health

The intersection of human health, labour, and agriculture is becoming increasingly significant in the context of climate change and demographic shifts. Regenerative agriculture emerges as a pivotal strategy in this nexus, offering a sustainable approach that can mitigate the adverse health impacts of conventional farming practices. The literature underscores the rise in heat-stress events that affect labourers in agriculture, particularly those in the vulnerable age bracket of 36-50, and even more so for those above 65, who find agricultural tasks physically demanding (Lima *et al.,* 2021; Ebi *et al.,* 2021). These age groups are prone to fatigue and other health issues due to prolonged exposure to heat while tending to crops, a concern corroborated by multiple studies (Olutumise *et al.,* 2021).

Regenerative agriculture can play a crucial role in addressing these challenges. By adopting practices such as cover cropping, crop rotation, and reduced tillage, regenerative agriculture can create a cooler microclimate in the fields, potentially reducing heat-stress for farmers (Newton *et al*., 2020; Tittonell *et al*., 2022). Moreover, these practices contribute to carbon sequestration, which can help combat the broader effects of climate change that exacerbate health risks for agricultural workers (Al-Kaisi and Lal, 2020; Giller *et al*., 2021).

Incentivizing youth participation in regenerative agriculture could be a multifaceted solution. Due to the lesser appeal of agriculture to younger generations, there are more likely more of the older generation involved in agriculture (Żmija *et* al., 2020). Younger individuals may be more resilient to heat and physically capable of implementing the labour-intensive practices of regenerative farming. However, studies indicate a disinterest among the youth in pursuing agricultural careers (Pienaar and Traub, 2015; Geza *et al.,* 2021; Rocque *et al.,* 2021). Therefore, creating attractive incentives is crucial to draw the younger generation into agriculture, ensuring the sustainability of the workforce and the adoption of regenerative practices.

Furthermore, transitioning to regenerative agriculture can provide economic benefits that extend beyond environmental and health improvements. Early studies suggest that while there may be an initial decrease in yields, farmers can experience increased profit margins

over time due to improved soil conditions and reduced input costs (LaCanne and Lundgren, 2018). This economic incentive can be a compelling argument for both aging farmers and the youth, aligning their efforts towards a regenerative model that promises long-term viability and resilience.

Integrating regenerative agriculture into the current discourse on labour and health in the agricultural sector offers a holistic solution that addresses the well-being of workers, the engagement of youth, and the health of the ecosystem. As such, it is imperative to explore policies and programs that support this transition, providing the necessary education, resources, and incentives to facilitate a shift toward a more regenerative and sustainable agricultural future.

6.3.6 Education

According to this study, most participants have received a formal secondary education (Table 5.2.1). However, participants have indicated that they could benefit from educational workshop programs around agricultural practices and climate change. Other studies indicate that resources that resources provided in a language that is not their home language are disadvantageous to farmers (Paul and Gĩthĩnji, 2018; Simpson *et al*., 2021). According to studies, education is an important dissemination tool for smallholder farmers to either adopt or abandon various practices in agriculture (Makate, 2020; Autio *et al*., 2021). It is also an important tool for farmers to further their understanding with the effects of climate change so they can better prepare for its impacts (Asare-Nuamah and Amungwa, 2021).

A majority of participants have completed secondary education, as shown in Table 5.2.1. Despite this, there is a clear indication from the participants that they would benefit from educational workshops focused on agricultural practices and the implications of climate change. This need for targeted education is underscored by other research, which suggests that providing resources in a language not native to the farmers hinders their ability to effectively utilize such materials (Paul and Gĩthĩnji, 2018; Simpson et al., 2021). Education emerges as a pivotal tool for smallholder farmers, influencing their decision-making process regarding the adoption or rejection of various agricultural methods (Makate, 2020; Autio *et al.,* 2021). Moreover, education serves as a crucial instrument for farmers to deepen their comprehension of climate change impacts, thereby enhancing their preparedness (Asare-Nuamah and Amungwa, 2021). Education is not only important in disseminating information about climate change but also in regenerative agriculture.

Incorporating regenerative agriculture into this context, education can serve as a transformative agent, equipping farmers with the knowledge and skills necessary to implement regenerative practices (Autio *et al.,* 2021). By integrating regenerative agriculture into educational programs, farmers can learn to create more resilient and sustainable farming systems. This approach not only aligns with the immediate educational needs expressed by the participants, but also addresses the broader challenge of climate change adaptation and mitigation in agriculture.

6.3.7 Governance

In this context, corruption is any illegal activity that a person of authority, usually in public office commits, which affects public service and is for public gain (Gardiner, 2017). The literature states that "political stability, accountability, government efficacy, low levels of corruption, and improved rule of law have a positive influence on efficiency in agricultural development." (Liu, 2008). Participants have indicated that corruption that was visible at the local government level prevented their elevation within agriculture.

Poor governance at the municipality and departmental level impacts the level of functionality of agriculture. Here participants have indicated that the officers of local office commit nepotism – indicating that priority was given to family members and friends of public officials. Similarly, this has been previously reported in other studies which have indicated that family members are favoured (Ganda, 2020). Addressing these governance challenges would be core to the successful implementation of any agriculture programme designed to achieve sustainability, adaptation and livelihood benefits.

6.3.8 Knowledge

Knowledge ingrained in farmers' experiences and customs is crucial to increasing their understanding of the hazards posed by climate change and their options for adaptation (Makondo and Thomas, 2018). Empirical data validates the significance of Indigenous knowledge as a source of inspiration for regionally appropriate activities and behaviours (Brondízio *et al*., 2021). Farmers' perceptions of climatic fluctuation and change are often the basis for adaptation (Karki et al., 2020).

According to multiple participants, many of the regenerative agriculture practices that they employ have been traditionally practiced for many generations. Literature, however, suggests that because adaptations react to perceived threats rather than anticipated changes, they may have limited applicability, be ineffective over time, or even result in maladaptation

(Akinyemi, 2017). Furthermore, according to Derbile *et al.* (2016), knowledge based on local practices might not be enough to drive more revolutionary measures that take intergenerational equity into consideration or to take on riskier endeavours like altering crop varieties or irrigation programmes (Etana *et al*., 2020).

In their review of the relationships between humans and ecosystems, Silici *et al*., (2021) show that: 1) in the context of climate adaptation, not much evidence looks into specifically the connections between smallholder agriculture and the ecosystem and there are limited publications on this subject, indicative of the continued tendency for environmental, climate change, and agriculture policies to be developed independently with little interaction across various practices and disciplines. Secondly, there is a need for a transdisciplinary strategy that integrates possible solutions at several levels and spans the economic, social, and environmental domains (Silici et al 2021). They also point to collective action as another crucial component of social capital. Farmers' social networks, particularly those comprised of knowledgeable individuals or sustainability advocates, can often aid in achieving targeted environmental results on a local level (Soto *et al*., 2021). Last but not least, for an activity to be transformational, it must find a place and coherence in a higher-level framework that eventually resolves the trade-offs and obstacles for more long-term solutions. This offers a chance for outside entities, including governments and international organisations, to help provide the required legal and regulatory framework in addition to supporting the integration of the three levels of intervention: household, community, and landscape. (such as land tenure and access rights for natural resources) (Abegunde *et al.*, 2022). More importantly, though, is that they can offer smallholders the appropriate financial incentives to make investments in regenerative agriculture.

An example of this was that participants indicated that a seed-saving program could be initiated in the community between friends, family and neighbours focusing on knowledge sharing (Table 5.5.1). Seed-saving programs have been implemented in various parts of the world – with one study indicating that seed-saving programs improve social cohesion, which creates a community where participants can rely on each other (Sthapit *et al*., 2012).

Due to the unpredictability of climate change, whether it be heat or unprecedented storms, post-harvest drying may result in various seasons or pests that may prey on the seed and destroy its viability. Similarly, other studies have also reported that a lack of seed varieties acts as a deterrent to agriculture and various agriculture practices (Walters, 2016). The uptake

of local seed varieties has been promoted in various parts of the world, these local crop varieties have been reported to experience less environmental stress, including droughts and by far make better use of water resources – especially important in water-stressed South Africa (Nicholls and Alteri, 2019). A potential solution to the lack of seed varieties could be the implementation of a local seed variety system that provides smallholder farmers with local seeds and networks (De Jong *et al*., 2015). However, seed saving is not without challenges, participants have indicated that seeds on the market are hard to access because unviable seeds are being sold and it is hard to tell the good seeds from the bad seeds – the only way of knowing is to plant them. This finding was similar to another study that indicated that due to failed harvests, seeds that are saved may not be favourable (Ncube *et al*., 2023).

Many scholars concur that the success of smallholder farming is based on the viability of seeds (Wynberg and Hilbeck, 2024), sufficient water (Agholor and Nkosi, 2020), market access (Cusworth *et al*., 2022) and climate change (Thinda *et al*., 2020). In some cases, farmers produce, save, sell and exchange seeds to their fellow farmers in a system that is known as a farmer-led systems. Additionally, it has been indicated that coupled with the effects of climate change – farmer-led systems are what leads smallholder farmers to success. Scholars have indicated that the formal market may not always provide viable seeds or are not compatible with smallholder farmers (Sperling *et al*., 2020; Hlatshwayo *et al*., 2021; Wynberg and Hilbeck, 2024). Hence, farmer-led systems prove important here. Furthermore, government subsidies or tax incentives for participating in regenerative markets could further encourage farmers (Buck and Palumbo-Compton, 2022).

6.3.9 Technological readiness

Growing populations and climate change threaten adequate supply; significant technology advancements are needed to boost production with constrained resources as a result of climate change. (Gomez-Zavaglia *et al*., 2020; Kogo *et al*., 2021). Some technologies have the potential to enhance productivity especially during growth stages and harvesting (Ciccullo *et al*., 2021), including weeders, automatic sensors and harvesting technology. Since the 19th century, there have been various agricultural technological advances (Khan *et al*., 2021). One of these methods are greenhouse agriculture – this method of involves growing crops in a controlled environment, which would require minimum inputs after the initial investment – reducing the risks of diseases and pests. Other advanced methods are hydroponics, where crops are grown in water without soil, 95% of water resources are reduced with this method (Velazquez-Gonzalez *et* al., 2022). A controversial tool for the

advancement of crop productivity is the use of biotechnology and genetically modified organisms (GMOs). Literature indicates that South Africa is one of the only countries in Africa that openly support the use of GMOs, however, this is not applicable in a South African smallholder context, as findings suggest this agricultural adaptation method impacts inputs required for agriculture (Muzhinji and Ntuli, 2021).

The biggest criticism of technological advancements in agriculture is that traditionally, these technologies are applied to conventional agriculture. Additionally, the affordability of these methods is often questioned in a smallholder context – while some studies indicate that technological advancements are inexpensive to smallholder farmers (Alteri *et al*., 2012), in some cases the opposite holds (Dhillon and Moncur, 2023). Farmers suggest that there are opportunities for technological advancements in their villages and this could include dissemination of climate information and agricultural services, indicating this is where technology could come into play (Table 5.5.1).

Communication via cell phones or smartphones is the primary communication for smallholder farmers especially in rural areas (Khan *et al*., 2021). This has been observed in various developing countries in Africa including Ghana, Kenya and Nigeria (Wyche and Steinfield, 2016; Barnett *et al*., 2017). The proliferation of mobile technology in rural areas, as evidenced by the increased use of cell phones and smartphones for communication among smallholder farmers, underscores the potential for technological integration in agricultural practices. This trend towards technological readiness not only facilitates information dissemination but also complements initiatives like the New Forest irrigation scheme, which aims to enhance living conditions through improved agricultural productivity.

The New Forest irrigation scheme is 1000 ha in extent; however, 160 ha is being fully utilized. This scheme was developed in the 1960s with a purpose of providing households with water to ensure substantial living conditions – most households have smallholder farms, in which they grow various crops, which are sold informally to make a living. However, according to Ncube (2017), the New Forest irrigation system does not operate as a functioning system with various irrigators not functioning correctly and a lack of extension officers to obtain aid. According to studies, the use of a fully functional irrigation system provides benefits to smallholder farmers (Fanadzo and Ncube, 2018). Results were reported in other studies whereby the lack of water affects the agricultural productivity of smallholder farmers (Muzari *et al*., 2012). For example, a study in Oman indicated that smallholder

farmers plant their crops with assistance from irrigation schemes before the rainy season begins and are rewarded with good produce (Choudri *et al*., 2013). Additionally, limited water resources from the irrigation scheme often break out into fights between smallholder farmers. Hence more effective infrastructure and effective governance over water resources and technologies is critical to address if regenerative agriculture is to be a success for smallholder farmers.

6.4 CONCLUSION

This study indicates that regenerative agriculture practices are currently being carried out in the study sites of Bushbuckridge – however, few participants recognize this as the specific term, regenerative agriculture. Smallholder farmers carry out both regenerative agriculture and agroecological practices. The main practice carried out by smallholder farmers is polyculture with various crops being grown. Furthermore, according to participants they are affected by changes in temperature and precipitation. Factors such as corruption, lack of resources and training have also had an impact on agriculture in the municipality. Smallholder farmers have formed networks and collectives as a form of support to achieve agricultural yields, including a gender network – where women share knowledge about agriculture and practices.

Regenerative agriculture does not consider the gender aspect; while this may be remedied through an increase of skills training and extension officers that provide opportunities to women specifically. There are pre-existing agricultural approaches such as agroecology that have always considered women as part of the movement. While some academics support gendered knowledge and participatory agriculture, the women of the study sites have found a means to move forward by using their collectives to support and share knowledge with smallholder farmers in their community. Improvements are encouraged by the government and private extension officers – however, the women of the community indicated that their practices are currently working for them, and they will continue to support each other for this to continue. Finally, technological advances could also provide opportunities to smallholder farmers and their adaption plans to climate change and water scarcity.

RECOMMENDATIONS AND CONCLUSION

6.5 SUMMARY OF RESEARCH

This study sought to find out the potential of regenerative agriculture systems in creating more climate-adaptive and gender-inclusive food systems in rural communities in Bushbuckridge, Mpumalanga. The literature around the definition of regenerative agriculture in a South African context is unexplored. This study intended to define regenerative agriculture in a South African context. This was done by interviewing experts in regenerative agriculture – these experts included government officials, researchers, corporations, and NGOs. Once an understanding of what regenerative agriculture is in a South African context was achieved, farmers from villages that fall under the Amashangana tribal were selected and surveys were done to understand their understanding of regenerative agriculture. Data were collected through surveys and thereafter, focus group discussions. Specifically, women of the study sites were invited for focus group discussions to identify if regenerative agriculture considers gender angle and if not, what could be done to provide provisions for women. The results were presented in response to the overarching research question and the following conclusions were made.

6.6 CONCLUSIONS

To conclude, the review of regenerative agriculture provided a multifaceted understanding of regenerative agriculture, drawing from different sources as established from the interviews with experts and the literature. Regenerative agriculture is seen as a holistic system that transcends conventional systems is rooted in the fundamentals of indigenous farming knowledge and has been tailored to different landscapes (Sands *et al*., 2023; Seymour and Connelly, 2023). According to the expert participants, conservation agriculture is an approach that aligns closely with regenerative agriculture in South Africa and is practiced under this guise. However, regenerative agriculture is also associated with agroecology and can be defined as a combination of the two approaches. Regional adaptation of regenerative agriculture in South Africa is highlighted through various practices such as polyculture, cover crop, minimal disturbance, crop rotation, and livestock rotation (Strauss *et al.,* 2021). Furthermore, there is a large emphasis that is placed on water conservation in a South African context.

The interviews with experts revealed that the role of various stakeholders plays a pivotal role in the dissemination, understanding and promotion of regenerative agriculture. An array of

more discussions with stakeholders is necessary to facilitate dialogue for the wider adoption of regenerative agriculture. While regenerative agriculture may hold the potential to be a transformative approach to agriculture – it is not without concerns. The lack of a clear definition provides the biggest hinderance to the adoption and understanding – it is either confused for conservation agriculture or interpreted as agroecology. This opens regenerative agriculture to greenwashing by various actors, destroying the good that this approach seeks to do.

Literature indicates that a paradigm shift is required in the regenerative agriculture approach towards more socially and ecologically conscious methods. It was suggested that using a systems research approach, in which farmers have a major role in helping various agro-ecosystem regions, would assist in the nation adopting CA (Swanepoel *et al*., 2017) – similarly, this approach can be applied to regenerative agriculture. In conclusion, the adoption of regenerative agriculture allows for flexibility in adopting approaches as seen fit per context – for the betterment of smallholder farmers as opposed to large-scale commercial farmers, this approach holds potential towards a more resilient, equitable and sustainable food system.

The findings revealed from the expert interviews indicate that regenerative agriculture in a South African context is the overlap of conservation agriculture practices and agroecological practice – aspects from both are embraced in this approach to agriculture. Smallholder farmers practice regenerative agriculture practices without necessarily identifying them by this term– however, some participants were aware of this name and have indicated it was through surfing the internet they were able to identify this concept. All practices of regenerative agriculture were carried out to some extent at the different study sites with polyculture being the most practiced. The least practiced was no-tillage agriculture, which is vital to the regenerative agricultural stance. Although a wide range of crops are cultivated, smallholder farmers have voiced their concern about how climate change may harm those crops. An El Nino event and the arrival of Cyclone Freddy in February and March of 2022 have already had an impact on the crops' viability.

According to the women of the community, there are no provisions to allow for regenerative agriculture to be a gender-inclusive food system as they are not awarded opportunities in their community. Women mentioned the lack of importance given to them in their community and little recognition by the municipality. However, to combat this the women have formed their own collective through which they share knowledge. Additionally, knowledge, education and

corruption play a large role in smallholder farmer's adaptive capacity to better opportunities in regenerative agriculture and their overall response to climate change, exacerbating their vulnerability to climate shocks.

6.7 RECOMMENDATIONS BASED ON FINDINGS

Smallholder farmers need to develop better strategies with dealing with climate-related issues – including rises in temperature and decreased precipitation that affect their crop production. To assist with this matter, the Department of Agriculture, Forestry and Fisheries could locate government officials that are knowledgeable in this matter to provide educational workshops to farmers or employ various technological devices that would assist farmers understand climate-related information that affects crops. Additionally, these workshops and information booklets could be provided in the home language to better assist with dissemination. Processes such as formal markets that formalize around sustainable methods of agriculture could be put in place to promote the adoption of agroecological practices such as regenerative agriculture. Knowledge systems based on the knowledge of smallholder farmers and women in the area could be supported and discussed openly in community forums to encourage social capital amongst participants can be promoted. Furthermore, measures to end local municipality corruption that inhibit the betterment of agriculture in the communities could be taken forward. Lastly, encouraging training programs in regenerative agriculture for women could potentially promote regenerative agriculture as a gender-equitable food system – like that of agroecology.

6.8 RECOMMENDATIONS FOR FUTURE STUDIES

To ensure reliability, a larger number of participants could be compared across various other study sites to get a holistic view of regenerative agriculture across the province. For the improvement of this study, a mixed-methods approach of quantitative and qualitative data collection is encouraged, where soil analysis could be conducted over different seasons and trials to understand how regenerative agriculture varies over time. This could also include important crops across South Africa. Additionally, one study province was selected in this study whereas any further study could incorporate other provinces to get a better indication of the potential of regenerative agriculture in South Africa.

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APPENDICES

Appendix 1: Ethics clearance

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Govender

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H22/10/10**
PROJECT TITLE	The potential of Regenerative Agriculture in creating climate adaptive and gender inclusive food systems: A study of rural communities in Mpumalanga, South Africa
INVESTIGATOR(S)	Ms Y Govender
SCHOOL/DEPARTMENT	Animal, Plant and Environmental Science/
DATE CONSIDERED	21 October 2022
DECISION OF THE COMMITTEE	Approved Risk Level: Minimal
EXPIRY DATE	20 November 2025

DATE 21 November 2022 **CHAIRPERSON** _____
(Professor J Watermeyer)

cc: Supervisor : Prof L Pereira and Dr M Kabisa

Appendix 2: Letter of permission

1/11/2022

Amaxangana Traditional Authority
P/Bag X1303 Thulamahashe1365

To whom it may concern

Permission to do research: The potential of regenerative agriculture systems in creating more climate adaptive and gender inclusive food systems in rural communities in Mpumalanga Province, South Africa.

This letter serves to confirm that the Amaxangana Traditional Council gives permission to Miss Yashila Govender to conducti her research in selected villages that fall under the Amaxangana Traditional Authority.

Yours sincerely

Secretary: Amaxangana Traditional Authority

RECEIVED BY MBILI LOUIS
ON THE 03RD NOV. 2022

AMASHANGANA TRADITIONAL COUNCIL
2022 -11- 03
PRIVATE BAG X 1303
THULAMAHASHE 1365

Appendix 3: Organisation questions

Background information:

1. What organization are you associated with or what role do you play in the agricultural space – more specifically, regenerative agriculture?
2. Could you please provide me with your background in regenerative agriculture and what types of projects you have conducted?

Regenerative agriculture:

1. With no clear definition, scientists have found this phenomenon difficult to study. From your perspective and experience, what is regenerative agriculture?
2. How does this definition differ from a South African context?
3. Are there any specific aspects of regenerative agriculture that should be given more attention? Why and what are they?
4. Are there any specific crops that should be given attention in this space?
5. From when has regenerative agriculture garnered attention in South Africa?
6. What barriers are there when trying to implement regenerative agriculture?
7. What opportunities are there when trying to implement regenerative agriculture?
8. What can be done to better implement or promote regenerative agriculture?
9. From your experience, does regenerative agriculture make provisions for gender equality?
10. Are there any gaps in regenerative agriculture?

Appendix 4: Farmer survey and focus group discussion

Revised farmer survey questions:

Household Interview Identifiers

Province	
District	
Village/ Section	
Is the Respondent the Household Head 1 = Yes 2 = No	

1.Demographic Information

1.1	Gender Male = 1 Female = 2	
1.2	Year of birth/ Age	
1.3	Highest level of formal education attainted. No education = 1 Primary education = 2 Secondary education = 3 Tertiary education = 4	
1.4	Source of income Solely on the farm = 1 Farm and employment = 2 Farm and other business = 3 Farm and remittances from family/friends = 4 Farm and government support = 5	

2. Farmland and use

2.1	How long have you been farming (years)?	
2.2	How long have you been farming on this land (years)?	
2.3	What is the ownership status of this land? Purchased = 1 Inherited = 2 Borrowed = 3 Rented = 4 Other = 5	
2.4	What main crop(s) do you grow on your land? Cereal crops = 1 Tubers = 2 Fruits and vegetables = 3 Legumes = 4 Cash crops = 5	
2.5	Has there been a change of crops planted from the time you have started farming?	

	Yes = 1 No =2 ***(Instruction: If response is 2, skip to question 2.6)***	
2.5.1	What has caused this change?	
2.6	Where did you learn your current farming practices? Self-taught = 1 Family = 2 Fellow farmers = 3 Public (government) extension officers = 4 Private sector extension officers = 5 Church based groups = 6 Other = 7	
2.7	Have the farming practices you use changed with time? Yes = 1 No = 2 ***(Instruction: If response is 2, skip to question 2.8)***	
2.7.1	How have they changed?	
2.8	Have you heard the term 'Regenerative Agriculture' before? Yes = 1 No = 2	

Notes:

2. Regenerative agriculture practice

This section will assess if smallholder farmers practice regenerative agriculture:

Instruction: Indicate which practices you use and how often these apply to you: **Agriculture practices**	**Yes**	**No**	**Additional information**
Cover cropping			
Practice intercropping			
Livestock rotation			
Planting one crop			
Planting of two or more crops			
Reusing seeds			
Buying seeds			
Applying fertilizers			
Applying pesticide			
Applying herbicide			
Planting drought resistant crops			
Planting cash crops			
No-tillage			
Organic matter applied to the farm			
Cover crop retention			
Mulching			
Crop rotation			

Sources of information key: Self-taught = 1, Family = 2, Fellow farmers = 3, Public (government) extension officers = 4, Private sector extension officers = 5, Church based groups = 6, Other = 7. (SOURCE OF INFORMATION IS THE SAME THROUGHOUT, ADDITIONAL INFORMATION WILL BE USED TO RECORD IF THIS DIFFERS AND OTHER INTERESTING FACTS).

FOCUS GROUP QUESTIONS

1. What farming practices are currently used in the area? *(List them with the farmers)*

- Have they been influenced over time? Who has influenced these practices?

2. What knowledge do farmers have on the following agricultural practices? (*Here farmers will be asked about different regenerative agriculture practices and where they get information from.*

- Crop rotation
- Livestock farming
- Intercropping
- Cover cropping
- Crop residue retention
- No-tillage agriculture.

Ask who among the participants:

- *Have at least used that practice and record the number.*
- *Are still using the practice and record the number.*
- *Have never used the practice and record the number*

3. Are there any challenges in adopting these practices*? (The discussion should be challenges per practice identified in Q2 and any other practice that may emerge during the discussion)*

Find out how their experience was:

- *For those that at least adopted some practices, what were the challenges?*
- *For those that have not used it, what has stopped them from using it?*

Remember to take note of interesting things being discussed as this is going on (quotes and examples, socio-cultural as well as economic and technical issues)

4. What would help with the adoption of regenerative agriculture in the community? *(The opportunities for uptake should be per practice discussed)*

- *For those that at least adopted some practices, what were the benefits?*
- *For those that are still using the practice, what has kept them using it?*
- *For those that have not used them, what can be done to incentivise them to use the practices?*

Remember to take note of interesting things being discussed as this is going on (quotes and examples, socio-cultural as well as economic and technical issues)

5. Has climate change affected any farming activities and livelihoods in this area? Please explain this further.
    a. What climatic changes have been observed, if any?
    b. How has this impacted the farming practices?
    c. Has there been any impacts on livelihoods?
    d. Has there been climate migration in your community?

6. Based on your knowledge, is there anything being done to address climate change?
    a. What do you think is likely to happen if climate change continues with the current state of responses, if any?

7. Has there been government intervention for the previously mentioned practices?

8. Do you think there are differences in practice and access to information of identified regenerative agriculture practices in the community?

- Men
- Women
- Youth
- Old

Appendix 5: Women of the community

Questions for focus group: women

Introduction: This discussion with you today is part of wider effort to understand farming practices in your community/village. Your area has been selected to represent other villages as it is not possible to visit all the villages. Therefore, you would be doing a good service to the whole farming sector in Mpumalanga by being open and truthful in this discussion giving us as much information as you can so that together we can chart a better and sustainable way forward.

Focus group questions will be translated in the home language of participants.

1. In this area, who typically makes the decisions on the farming practices and crops to be grown within a household?
    a. What is the reason behind why the identified person makes the decisions?

2. What roles do women typically play in farming in this area?
    a. Are they recognised for the role they play in agriculture?
    b. What can be done to improve their conditions in agriculture?

3. What are your current roles in agriculture?

4. What role do you play a role in any of the following agricultural practices? Crop rotation, Livestock farming, Intercropping, Cover cropping, Crop residue retention, No-tillage agriculture.

5.Are there any specific challenges faced with any of the previously mentioned practices? What are these challenges?

6. What can be done to make allow for these practices to be better implemented?

7. Are there any target interventions from government or local organizations to aid in women's involvement in agriculture? What about regenerative agriculture?

Appendix 6: Key of respondents

Table 6.1: Participant code names in Bushbuckridge explained

Code name abbreviation	Code name explained
FGD A	Focus Group Discussion Athole
FGD AA	Focus Group Discussion Allandale-A
FGD NF	Focus Group Discussion New Forest