



**Exploring the Role of Local Indigenous Knowledge and Community  
Engagement in Soil Conservation and Management in Rural South Africa.**

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**A thesis submitted to the School of Agriculture, Earth and Environmental Sciences,  
College of Agriculture, Engineering and Science, at the University of KwaZulu-Natal,  
in fulfilment of the academic requirements for the degree of  
Master of Science in Environmental Sciences**

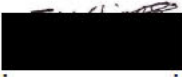
**Supervisor  
Dr S'phumelele Lucky Nkomo**

**February 2025**

## DECLARATION

The research work described in this dissertation was carried out in the School of Agriculture, Earth and Environmental Sciences, University of KwaZulu-Natal, Howard College Campus, Durban, from June 2019 to July 2024 under the supervision of Dr S'phumelele Lucky Nkomo.

By submitting this dissertation, I hereby declare that all contents within this paper are my own original work. I would like to declare that this dissertation has not been previously submitted in any form to any other university. I am the sole author of this dissertation and where applicable, the work and ideas of others have been correctly acknowledged and referenced in accordance with the departmental requirements.

Thabiso Vincent Shinga signed..........Date: 03 February 2025.....

As the candidate's supervisor, I certify the above statement to be correct to my knowledge and have approved this thesis/dissertation for submission.

Dr S'phumelele Lucky Nkomo: ..........Date: 03 February 2025.....

## DECLARATION 1-PLAGIARISM

I, Thabiso Vincent Shinga, declare that:

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Signed:  \_\_\_\_\_

Thabiso Vincent Shinga

February 2025

## DECLARATION 2- MANUSCRIPTS

- **Shinga, T.V. and Nkomo, S.L.** (In preparation). “The role of local indigenous knowledge systems and community involvement in managing soil erosion in Sub-Saharan Africa: A Review”. *Geoderma*.
- **Shinga, T.V., Nkomo, S.L., and Khoza G.M.** (In preparation). “The Legacy Effects of the Bantu Authorities Act (No. 68) of 1951 on the Abandoned Agricultural Land in Eastern Cape Province: Implications on Food Security and Sustainable Land Management”. *Land*.
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## ABSTRACT

Soil erosion remains a widespread environmental challenge that threatens sustainability, food security, agricultural production, and human habitats in developing countries. It particularly affects rural areas, where communities rely heavily on agriculture for their livelihoods. To address this issue, it is essential to consider local and indigenous knowledge systems (IKS) in rural communities as part of soil conservation and erosion prevention strategies. Ensuring the value of IKS in agricultural development must remain a key priority for policymakers.

This study aimed to assess the role of IKS and community involvement in soil conservation efforts in rural areas, focusing on the effectiveness of local knowledge in managing soil erosion problems in the Eastern Cape Province. Research was conducted in selected rural villages across four local municipalities within the Alfred Nzo District Municipality (ANDM). A mixed-methods approach, including unstructured face-to-face interviews, questionnaires, field observations, and Google Earth imagery, was used to collect data on IKS, agricultural land abandonment, and their role in soil erosion and conservation management.

Findings indicate that agricultural land abandonment is prevalent in the majority of rural areas within ANDM, contributing significantly to soil erosion. Many farmers attribute land abandonment and soil erosion to the historical injustices caused by the Natives Land Act No. 27 of 1913 (NLA) and the Bantu Authorities Act No. 68 of 1951 (BAA). In summary, farmers argued that these laws facilitated (intentionally or unintentionally) conditions that (1) led to infrastructure and property vandalism, (2) displaced black farmers from agricultural activities, and (3) confined black rural villages to institutional poverty. This legacy has made it particularly challenging for small-scale black rural farmers to adopt sustainable agricultural practices, exacerbating soil erosion and threatening food security.

The majority of farmers still rely on indigenous techniques for soil conservation and land management, such as contour intervals, tree and grass planting, stone walls, terrace cultivation, fallow/ridge planting, mulching, and crop rotation. While farmers generally praised these conservation methods, they expressed frustration that the lingering effects of the BAA continue to hinder their ability to live sustainably. Furthermore, the community spirit that once supported conservation initiatives has been eroded due to the NLA and BAA.

Farmers also noted minimal involvement from youth—both men and women—in agriculture, with the ageing of the farming population being a significant concern. The study suggests that local knowledge and IKS practices, such as contouring, crop rotation, mulching, intercropping, and the use of vegetation cover and organic matter, remain relevant for soil conservation, food production, and security in the rural villages of ANDM. However, some farmers are unaware of the critical importance of these practices.

Overall, the study highlights that rural communities possess valuable knowledge for preventing soil erosion and promoting soil conservation, which, if integrated with scientific knowledge, can help address soil erosion challenges in these areas.

## **PREFACE**

This thesis adheres to the "publication model", where the different chapters focus on articles written by the author throughout the study. Thus, each chapter is anticipated to be read as a definite article that will address the research objectives, creating a mass of knowledge for the subject of the thesis. Also, selective reiteration or duplication among articles is inevitable. This dissertation consists of 5 chapters:

Chapter 1 (Introduction) - serves as an introductory foundation for this study, offering context and background information to frame the study. It outlines the primary aims and objectives, research questions, and rationale behind the investigation. This chapter also provides an overview of the subsequent chapters, highlighting the fundamental issues addressed within each one.

Chapter 2 (The Role of Local Indigenous Knowledge Systems and Community Involvement in Managing Soil Erosion in Sub-Saharan Africa: A Review) provides a detailed literature review of the role of local indigenous knowledge systems and community involvement in managing soil erosion within sub-Saharan Africa.

Chapter 3 (The Legacy Effects of the Bantu Authorities Act (No. 68) of 1951 on the Abandoned Agricultural Land in Eastern Cape Province: Implications on Food Security and Sustainable Land Management) - investigate the effects of the Bantu Authorities Act (No. 68) of 1951 on abandoned agricultural lands and soil erosion at Alfred Nzo District Municipality.

Chapter 4 (Indigenous Knowledge Systems: Rural Farmers' Perspectives on Soil Management Strategies in the Alfred Nzo District Municipality) - comprehend rural farmers' perspectives on soil management and evaluate the contribution of indigenous knowledge systems and community engagement in addressing soil erosion in the Alfred Nzo District Municipality.

Chapter 5 (Synthesis) - Conclusively, the synthesis of the research work is provided in this final chapter which serves as the culmination of the dissertation, offering a succinct summary of the study's significant findings.

## LIST OF ACRONYMS AND ABBREVIATIONS

|        |                                                              |
|--------|--------------------------------------------------------------|
| AFS    | Agroforestry Systems                                         |
| ANDM   | Alfred Nzo District Municipality                             |
| BAA    | Bantu Authorities Act No. 68 of 1951                         |
| COGTA  | Department of Cooperative Governance and Traditional Affairs |
| CSA    | Conservation South Africa                                    |
| DALRRD | Department of Agriculture, Land Reform and Rural Development |
| DRC    | Democratic Republic of Congo                                 |
| EC     | Eastern Cape                                                 |
| GDP    | Gross Domestic Product                                       |
| GIS    | Geographic Information Systems                               |
| IDP    | Integrated Development Plan                                  |
| IK     | Indigenous Knowledge                                         |
| IKS    | Indigenous Knowledge Systems                                 |
| LM     | Local Municipality                                           |
| LULC   | Land use land cover                                          |
| MP     | megapixel                                                    |
| NGI    | National Geo-spatial Information                             |
| NLA    | Natives Land Act No. 27 of 1913                              |
| PRA    | Participatory Rural Appraisal                                |
| RUSLE  | Revised Universal Soil Loss Equation                         |
| SA     | South Africa                                                 |
| SAHO   | South African History Online                                 |
| SANBI  | South African National Biodiversity Institute                |
| SPSS   | Statistical Package for Social Sciences                      |
| SSA    | sub-Saharan-Africa                                           |
| SSI    | Semi-structured interviews                                   |
| UNEP   | United Nations Environment Programme                         |
| WWF    | World Wildlife Fund                                          |

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## **CHAPTER 1**

### **GENERAL INTRODUCTION**

### 1.1 Background: Soil Erosion, Local Knowledge, and Soil Conservation

Soil erosion is a process in which a significant amount of topsoil is gradually removed from the Earth's surface and occurs when the impact of water or wind detaches and removes soil particles, causing the soil to deteriorate (Ajibade, 2008; Blanco and Lal, 2023). The process involves three key stages: detachment, transport, and deposition of soil particles, often resulting in the degradation of the land. Soil erosion is a serious environmental problem with severe implications for sustainability, food production, and human settlements, especially in developing regions like Southeast Asia, South America, and sub-Saharan Africa (SSA) (Hamann and Tuinder, 2012; Borrelli *et al.*, 2017; Blair *et al.*, 2018; Sartori *et al.*, 2019; Xionga *et al.*, 2019; Moyo and Ravhuhali, 2022; Materechera, 2022). According to Yang *et al.* (2003), approximately 30% of the global arable land has undergone erosion over the last four decades, averaging around 10 million hectares annually. These statistics have possibly increased in recent years as the dynamic process of soil erosion continues.

Erosion results from unsustainable farming practices, climate change, land abandonment (Blair *et al.*, 2018; Moyo and Ravhuhali, 2022), and insufficient local awareness about soil erosion, among other factors. Effective soil conservation strategies are critical to mitigating the negative effects of soil erosion. This study specifically addresses the role of local indigenous knowledge systems (IKS), with a particular emphasis on the Eastern Cape (EC) province in South Africa (SA), one of the country's nine provinces. The purpose is to identify solutions to combat soil erosion at the local level by integrating the knowledge of local communities with techniques employed by successful farmers. In this context, Indigenous Knowledge Systems (IKS) can play a crucial role in addressing soil erosion (Mulat, 2013; Sithole, 2020; Chuma *et al.*, 2022; Materechera, 2022) in the EC and contributing to regional or global efforts to mitigate this issue through soil conservation practices.

Borrelli *et al.* (2017), in a study conducted at the continental level, revealed that South America, Africa, and Asia demonstrated the highest forecast for average soil erosion rates, estimated at 3.53 Mg ha<sup>-1</sup> yr<sup>-1</sup>, 3.51 Mg ha<sup>-1</sup> yr<sup>-1</sup>, and 3.47 Mg ha<sup>-1</sup> yr<sup>-1</sup>, respectively. Borrelli *et al.* (2017) indicate an average predicted annual soil loss rate of 1260 t km<sup>-2</sup> yr<sup>-1</sup> due to sheet and rill erosion on arable land in SA, reaffirmed in subsequent research (Borrelli *et al.*, 2017, 2020). This assessment employed advanced techniques such as remote sensing, spatial analysis, and statistical data within the framework of the Revised Universal Soil Loss Equation (RUSLE) model (Borrelli *et al.*, 2017; Sartori *et al.*, 2019). Kiage (2013) emphasised that in SSA, soil

erosion and land degradation are widely seen as serious problems. A study by Chen *et al.* (2019) affirmed that soil erosion by water in Southern China remains a major issue in the red soil region. Soil erosion by water occurs when a large amount of topsoil is gradually removed from the surface of the earth's crust through transport, detachment, and deposition (Ajibade, 2008; Blanco and Lal, 2023). These mechanisms are intrinsically linked to various factors, including land use, slope, precipitation, soil erodibility, erosivity, and land cover, collectively shaping the magnitude and pace of soil erosion (Blanco and Lal, 2023).

Worldwide, soil erosion is a serious issue that occurs in different forms, mostly when soil is left exposed to raindrops or wind energy (Pimentel and Burgess, 2003) and has far-reaching consequences that affect various aspects of the environment, society, and the economy. There are several reasons why soil erosion is a significant problem, namely, food security due to the loss of arable land, environmental degradation, biodiversity loss, and economic implications, among others. Soil erosion can occur in a natural form because of the loss or removal of the top layer of soil due to rain, surface runoff, wind, deforestation, or any other human activity. However, a plethora of studies have argued that anthropogenic activities seem to be the main factors that accelerate soil erosion (Le Roux *et al.*, 2007; Kiage, 2013; Borrelli *et al.*, 2017). Human activities, including unsustainable farming practices, the removal of vegetation (deforestation), overgrazing, and soil depletion, are some of the key drivers for accelerated soil erosion. These human-induced actions have led to increasing soil degradation, reducing the ability of soil to perform its essential functions, which is where soil conservation measures can provide a mitigating role. Natural factors, such as rainfall intensity, also interact with these human activities, leading to varying degrees of soil erosion in different regions.

In SSA, soil erosion predominantly results from the interplay of severe climates with high erosivity, vulnerable soils with high erodibility, steep slopes, and inadequate natural resource management (Kiage, 2013). Soil conservation techniques are vital to restore and maintain the fertility of the land, ensuring the sustainability of agricultural production. Through practices such as contour plowing, agroforestry, and the restoration of vegetative cover, local communities can actively contribute to reducing soil erosion and promoting healthier land management.

Soil erosion has significant off-site impacts, primarily involving the mobilisation of sediment into rivers and dams. It also leads to the loss of fertile soil, diminishing overall soil productivity (Parwada and Van Tol, 2016). This is a substantial concern, as highlighted by Pimentel and

Burgess (2013), who contended that soil erosion poses a significant threat to global food production. Each year, approximately 10 million hectares of cropland are lost due to soil erosion, reducing the available cropland for worldwide food production (Sartori *et al.*, 2019). The decline in soil productivity resulting from soil erosion and associated degradation directly jeopardizes food production and livelihoods. As Gomiero (2016) argues, soil degradation is a significant threat to food security because it leads to lower yields, compels farmers to use more resources, and may eventually result in the abandonment of soil. Consequently, soil erosion is recognised as a part of land degradation, as soil loss constitutes a major environmental issue that contributes to poor living conditions. Soil conservation measures, such as organic farming and sustainable land management techniques, can mitigate these negative effects.

Soil erosion has been identified as one of the factors that reduce the living standard of communities. Studies indicate that approximately 80% of the world's agricultural land faces moderate to severe erosion, with 10% experiencing a slight soil erosion rate (Pimentel and Burgess, 2013; Gomiero, 2016). A study done in the rural karst mountainous areas of Guizhou Province, southwestern China, indicates that soil loss destroys surface vegetation and increases the likelihood of soil loss due to exposed swallow holes (Zhao and Hou, 2019). A two-year study on China's ongoing soil loss rate indicates that if this trend persists over the next 50 years, there will be a 40% decline in food production (Jie, 2010; Pimentel and Burgess, 2013). Such a decline in food production can lead to increased hunger in rural areas, where farming is a primary source of food and income for many communities. Soil conservation strategies such as sustainable land management and reforestation are essential to reversing these trends and securing long-term food security.

Baade (2024) states that poverty leads to land degradation, and in turn, perpetuates poverty, creating a vicious cycle. Hence, the consequences of soil erosion extend beyond food production, causing stress on rural livelihoods and contributing to poverty. Soil loss from agricultural areas is occurring at a rate of 10 to 40 times faster than the natural process of soil formation, posing a serious threat to global food security (Pimentel and Burgess, 2013). Soil erosion's pervasive impact on agricultural land not only decreases food production but also places immense pressure on the livelihoods of those who rely on farming, ultimately leading to increased poverty and food insecurity. Soil conservation methods such as conservation tillage, terracing, and agroecological practices offer a path forward in mitigating these challenges.

Soil erosion is a global issue, especially affecting rural areas heavily reliant on agriculture. SA, located within the African continent, is no exception and faces significant challenges related to soil erosion, particularly in its rural communities (Le Roux *et al.*, 2007). Predictions indicate that the average rate of soil loss in SA is 12.6 tons per hectare per year, with even higher rates of 13 tons per hectare per year in annual cropland (such as grain crops) (Le Roux *et al.*, 2007; Le Roux and Smith, 2014). These rates far exceed the natural soil formation rate, which is typically less than 5 tons per hectare per year (Le Roux and Smith, 2014). A case study conducted in the upper and lower areas of Didimana in the EC province revealed that approximately 75% of farmers lose about 21% of their crops annually due to soil erosion. Moreover, 55% of crops, livestock, and household food supply are impacted by soil erosion (Ighodaro *et al.*, 2016). These findings highlight the severe impact of soil erosion on rural communities in SA, primarily driven by unsustainable farming practices and inadequate livestock management, leading to soil degradation, and reduced agricultural production (Gomiero, 2016). Human activities play a significant role in soil erosion and degradation, as noted by Barrios *et al.* (2006). Deforestation, overgrazing, improper tillage, nutrient depletion, salinization, and acidification are factors contributing to the decline in soil quality and agricultural productivity. In summary, soil erosion is a pressing issue in SA's rural areas, driven by human activities and unsustainable farming practices, resulting in significant crop and livestock losses. Addressing these challenges is crucial for the well-being and food security of rural communities in the country.

Most of the literature on soil erosion in SA reveals that the EC is the most affected province by soil erosion (Lahiff, 2005; Le Roux *et al.*, 2007; Hamann and Tuinder, 2012; Parwada and Van Tol, 2016, Blair *et al.*, 2018; Moyo and Ravhuhali, 2022). However, the current soil erosion in SA is still poorly controlled (Parwada and Van Tol, 2016), due to limited resources and fundamental plans that aim to control soil erosion. Furthermore, some of the approaches and strategies for managing soil erosion are not successful. This leads to ongoing soil erosion which affects most parts of the country. Water and unsustainable farming appear to be the most dominant agents causing erosion that is triggered by human activities mostly in farming and overgrazing (Le Roux *et al.*, 2007). Thus, EC is mostly affected by soil erosion in most of their local communities, especially in areas where farming is mostly practiced along the river catchments. Furthermore, overgrazing is also the cause of soil erosion in the province of EC due to many livestock (Moyo and Ravhuhali, 2022). Manjoro and Kakembo (2012) state that soil erosion and woody shrub encroachment cause a serious land degradation challenge in the

rural catchments of the EC. As a result, there have been a lot of interventions in the province that are implemented to deal with the soil erosion problem, but soil erosion is still a major issue and poorly controlled (Parwada and Van Tol, 2016).

The current state of soil erosion control in SA is still inadequate, primarily due to limited resources and the absence of comprehensive plans aimed at effectively mitigating soil erosion (Parwada and Van Tol, 2016). Furthermore, some of the strategies and approaches employed for managing soil erosion have not yielded the desired results, contributing to the persistence of this issue across many parts of the country. The main drivers of soil erosion in SA, particularly in the EC, appear to be water and unsustainable farming practices, largely attributed to human activities, including farming and overgrazing (Le Roux *et al.*, 2007).

In contemporary times, many modern, innovative methods for soil erosion control have emerged. A notable example can be found in the study of Tsoraeva *et al.* (2021). This study looked closely at various countries and identified a range of effective strategies for combating water and wind-induced soil erosion. These strategies encompass the utilisation of constant tramlines, cage drainage localisation systems, and comprehensive drainage systems. Additionally, the study emphasised the importance of designing soil-protective crop rotations and implementing conservation and soil protection tillage techniques. For slope stabilisation and erosion prevention, the deployment of gabions, contour embankments, and strategic plantations was recommended. Further measures included embankments incorporating stones and trees, as well as contour farming practices such as contour plowing, contour tillage, and contour seeding (Tsoraeva *et al.*, 2021). These innovative methods offer promising avenues for addressing the pressing issue of soil erosion with a forward-looking, research-driven approach. Local involvement is paramount in implementing soil erosion control techniques, particularly since some methods are rooted in local indigenous knowledge (IK), which can be considered as IKS. The engagement of communities and their local knowledge is indispensable in preventing soil erosion, as their insights and practices can have a substantial impact. To effectively address soil erosion, it is crucial to involve and integrate local communities into prevention and control measures, harnessing the valuable insights they offer.

Globally, the management of soil erosion is heavily dependent on the application of scientific knowledge and cutting-edge techniques (DeWalt, 1994; Sillitoe, 2017). In SA, for instance, the assessment of soil erosion rates is often conducted on a large-scale spatial basis, employing advanced tools such as Geographic Information Systems (GIS) and remote sensing techniques,

as noted by Le Roux *et al.* (2007). However, it is essential to acknowledge that while these methods provide valuable data, they have presented significant challenges in the development of effective soil erosion management solutions, as highlighted by Parwada and Van Tol (2016: 545). There is a need for continued research and innovation in addressing critical environmental issue. In response to this ongoing challenge, this study aimed to critically assess local approaches to soil erosion management. Specifically, it examined the role of IKS and local community knowledge in managing soil erosion within their rural areas, which are prone to soil erosion. The study evaluated the effectiveness of local IK and community involvement in addressing soil erosion issues. Through a comprehensive analysis, this study explored how IKS and local communities are actively engaged in managing soil erosion, addressing this contemporary environmental concern. By focusing on the utilisation of local knowledge and community-based practices, this study aimed to contribute valuable insights to the ongoing discourse on soil erosion management strategies.

The study underscores the vital role of local knowledge and IKS in effectively managing soil erosion. While scientific knowledge is widely acknowledged and employed as a solution for soil erosion management, the significance of IKS cannot be underestimated in this context. It is essential to recognise that local and IKS bring a unique local relevance to soil erosion management. This study emphasised the need for greater respect and attention to local knowledge and practices, especially through IKS (Ajibade, 2008). In addition to emphasising the importance of local and IKS, the study highlighted the necessity for diverse approaches originating from local communities themselves. There exists a considerable gap in understanding how local communities can actively contribute to soil erosion management strategies. Therefore, this study was essential in shedding light on how local knowledge and IKS can be utilised critically to address soil erosion issues. Consequently, the study of local IKS served as a shift away from the predominant reliance on scientific knowledge in soil erosion management, emphasising the pivotal role of IKS and recognising the value of local knowledge. The IKS study marked a shift in mindset towards a holistic and locally relevant approach to addressing soil erosion challenges in EC.

## **1.2 Rationale of the study**

Soil erosion remains a significant and pressing issue in many developing countries, including SA. It poses a severe threat to both humans' lives and natural environments, given the

importance of soil as a resource (Ajibade, 2008). The quality of soil is a crucial determinant of human living standards, impacting agricultural potential, income generation for farmers, and providing habitat for communities (Ajibade, 2008; Borrelli *et al.*, 2018; Sartori *et al.*, 2019; Xionga *et al.*, 2019). Consequently, there is a compelling need for effective measures to control soil erosion in various parts of the world. Effective strategies and approaches are essential to address the continued threat posed by soil erosion, as it jeopardizes agricultural production and disrupts the habitats of animals, ultimately increasing the stress on human lives. While scientific knowledge plays a vital role in combating soil erosion, it is equally important to consider IKS and local knowledge in the quest for solutions. Recognising the value of both knowledge systems leads to more inclusive, equitable, and lasting environmental management practices. Hence, this study holds particular importance as it investigates the contributions of local communities in shaping soil erosion management strategies and approaches within their respective areas. By examining the roles and practices of local communities, the study sheds light on the holistic and locally relevant approaches needed to address the challenges posed by soil erosion. Effective strategies must encompass scientific knowledge and local knowledge (IKS).

The study was carried out in rural areas of the EC province, specifically within the Alfred Nzo District Municipality (ANDM). The primary objective was to identify communities experiencing soil erosion challenges. The study then proceeded to investigate how local communities in the EC are actively contributing to the management of soil erosion in these identified areas. A particular focus was on IKS, as they are expected to play a significant role in the study. The study delved into the roles and practices of the local community in soil erosion management. Given the gap in the application of IKS related to soil erosion management in various parts of the world, this study holds immense importance. It aimed to comprehensively explore and document the local knowledge regarding soil erosion management. Ultimately, the study seeks to uncover the indigenous methods employed by the EC communities to manage soil erosion. By doing so, it intended to provide valuable insights into how rural communities address this environmental issue, contributing to a broader understanding of effective soil erosion management strategies. The study addresses the existing knowledge gap in this field, shedding light on valuable local practices for soil erosion management.

Local communities play a significant role in actively contributing to soil erosion management (Tibasiima *et al.*, 2023; Negasa, 2023). Being intimately familiar with their areas, they witnessed and experienced the soil erosion issues affecting their communities. The limited

success of top-down approaches to soil erosion management worldwide underscored the importance of recognising local knowledge as a valuable resource in addressing this problem. This study is essential in unearthing crucial information that provided indigenous methods for managing soil erosion. It highlighting documented the existing knowledge and strategies employed by the EC to address soil erosion challenges. Additionally, the study has explored the depth of community involvement in soil erosion management in order to reveal the various ways and strategies that the EC community can employ and draw from their local knowledge of soil erosion management. Given the scarcity of IKS regarding soil erosion management, this study is a vital resource. It seeks to identify and document the valuable contributions of rural communities to soil erosion management in order to fill a critical knowledge gap in this field.

Across the world, numerous organisations have launched campaigns and programmes aimed at restoring the land for both present and future generations. These organisations are namely, the United Nations Decade on Ecosystem Restoration, United Nations Environment Programme (UNEP), and Food and Agriculture Organisation of the United Nations. The severe impact of soil erosion on food production has prompted these efforts (WFP and FAO, 2021). Understanding the challenges and opportunities faced by small farmers is essential for developing policies and interventions that support their livelihoods and contribute to sustainable agricultural development. In summary, this study has contributed to the body of knowledge regarding soil erosion management through local knowledge and IKS. Its findings have the potential to be valuable and beneficial not only to the present generation but also to future generations in countries facing significant soil erosion issues, fostering sustainable land management practices.

### **1.3 Aim and objectives of the study**

The overall aim of this study was to critically assess the role of indigenous knowledge systems and community involvement in soil conservation in rural areas in order to examine the effectiveness of local rural knowledge in managing soil erosion problems in the ANDM, Eastern Cape.

The following specific objectives achieve the research aim:

- i. To review the nature and impact of soil erosion in rural areas in Sub-Saharan Africa.

- ii. To assess the historical impact of the Bantu Authorities Act (No. 68) of 1951 on soil erosion and agricultural land abandonment in the Eastern Cape province.
- iii. To evaluate the local farmers perceptions on the indigenous knowledge systems and their role in managing soil erosion in the Eastern Cape.
- iv. To provide recommendations on the impact and potential of indigenous knowledge systems and local community involvement in managing soil erosion.

#### **1.4 Research questions**

- i. What is the nature and impact of soil erosion in rural areas in Sub-Saharan Africa?
- ii. What is the role of the BAA on soil erosion and agricultural land abandonment in the Eastern Cape province?
- iii. Are indigenous knowledge systems effective in managing soil erosion in rural areas?
- iv. Are the current soil erosion management strategies effective?
- v. What is the impact and potential of indigenous knowledge systems and local community involvement in managing soil erosion?

#### **1.5 Research Design**

##### **1.5.1 Mixed methods approach**

This study employed a mixed methods approach, a methodology involving the collection, analysis, and integration of both quantitative and qualitative research in a single study or multiple studies within a sustained program of inquiry (Creswell *et al.*, 2003; Creswell *et al.*, 2004; Almalki, 2016). This approach combines qualitative data, which provides a deep understanding of the respondents, with quantitative data, which offers detailed insights into specific phenomena described by the respondents (McCusker and Gunaydin, 2015). Mixed methods are particularly suitable for examining complex research problems that cannot be fully understood using a single method, making this approach highly relevant for the current study. In this study, Chapter 3 focuses on qualitative data, which was interpreted separately. Chapter 4 addresses quantitative data, following a similar process, as each paper included its own method. The findings from both chapters are synthesised and interpreted in Chapter 5.

Figure 1.1 shows the summary of the methodology adopted by the study during data collection. The mixed methods approach provides a more comprehensive and detailed understanding of

the phenomenon (Dunning *et al.*, 2008). This study interpreted separately quantitative and qualitative data that were collected simultaneously and analysed separately. After both analyses were completed, the results were compared to draw overall conclusions in the synthesis section. The more evidence collected in the study, the better and more varied the angles of interpretation of the data through a mixed methods approach. Hence, the study was purely mixed, providing an equal opportunity for both quantitative and qualitative information to be collected. This allowed the study to make sense of the information collected from different sources, thus enabling the interpretation of the results using different methods (Almalki, 2016).

While mixed methods research offers valuable insights, it comes with notable challenges. Scholars have pointed out that it can be time-consuming, costly, and pose difficulties in data analysis, often leading to budget constraints, reduced sample sizes, and limited interview durations (Dunning *et al.*, 2008; McCusker and Gunaydin, 2015). Despite these obstacles, mixed methods research holds the advantage of leveraging results obtained from one method to inform the other, enabling comprehensive coverage of research objectives (Almalki, 2016). Moreover, it allows different methods to complement and clarify each other, addressing various phenomena and potentially challenging initial findings (Creswell *et al.*, 2003).

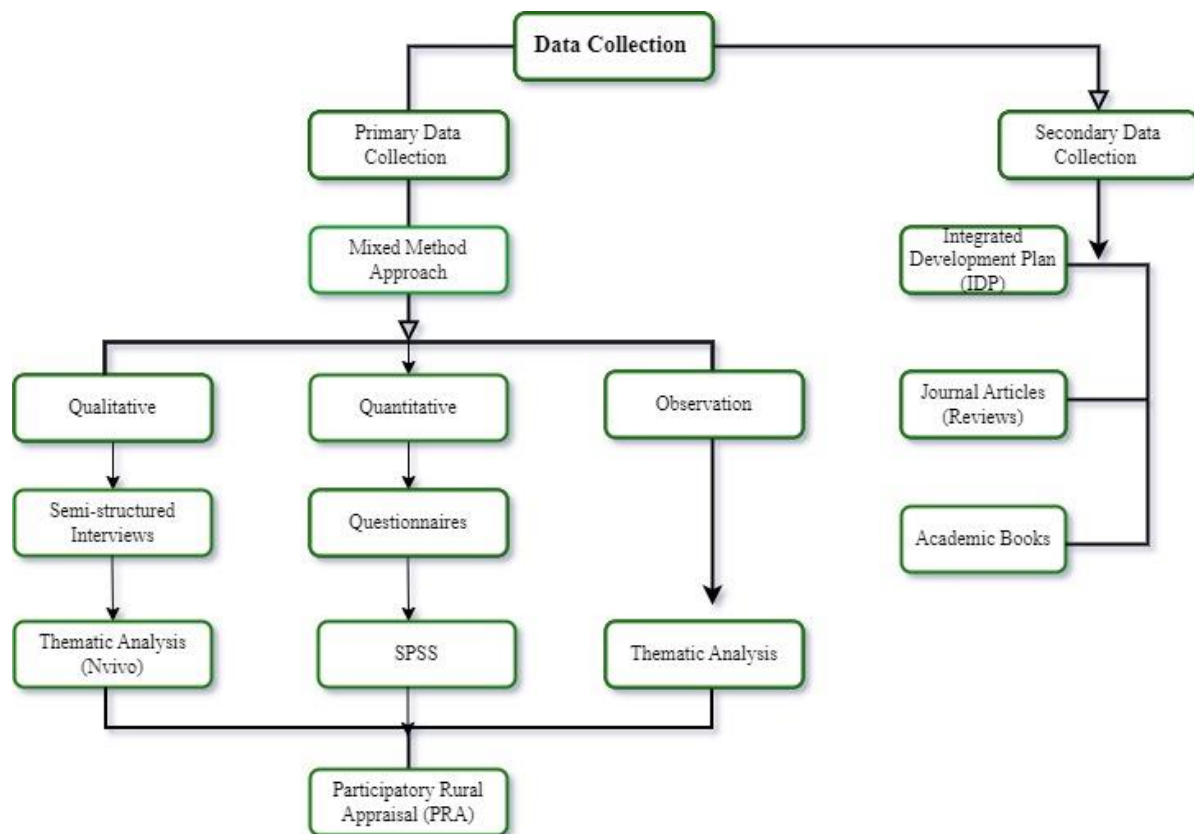


**Figure 1.1: Diagram showing the methodology flow of the study.**

## 1.5 Structure of the dissertation

This thesis adheres to the "publication model", where the different chapters focus on articles written by the author throughout the study. Thus, each chapter is anticipated to be read as a definite article that will address the research objectives, creating a mass of knowledge for the subject of the thesis. Also, selective reiteration or duplication among articles is inevitable. This dissertation consists of 5 chapters:

CHAPTER 1 (Introduction) - serves as an introductory foundation for this study, offering context and background information to frame the study. It outlines the primary aims and objectives, research questions, and rationale behind the investigation. This chapter also provides an overview of the subsequent chapters, highlighting the fundamental issues addressed within each one.

CHAPTER 2 (The Role of Local Indigenous Knowledge Systems and Community Involvement in Managing Soil Erosion in Sub-Saharan Africa: A Review) provides a detailed

literature review of the role of local indigenous knowledge systems and community involvement in managing soil erosion within sub-Saharan Africa. It highlights the contribution of the indigenous knowledge system in managing soil erosion in rural areas of sub-Saharan Africa. The review focused on understanding the nature and impacts of soil erosion in rural areas, and ways to identify and assess existing soil erosion management strategies.

CHAPTER 3 (The Legacy Effects of the Bantu Authorities Act (No. 68) of 1951 on the Abandoned Agricultural Land in Eastern Cape Province: Implications on Food Security and Sustainable Land Management) - investigate the effects of the Bantu Authorities Act (No. 68) of 1951 on abandoned agricultural lands and soil erosion at Alfred Nzo District Municipality. This was to find the perceptions of rural community farmers on the effects that this Act has caused in their communities. The findings highlighted that there is a clear need for updated and robust research that evaluates the current status, effectiveness, and socio-economic impact of IKS practices in SSA's rural communities.

CHAPTER 4 (Indigenous Knowledge Systems: Rural Farmers' Perspectives on Soil Management Strategies in the Alfred Nzo District Municipality) - comprehend rural farmers' perspectives on soil management and evaluate the contribution of indigenous knowledge systems and community engagement in addressing soil erosion in the Alfred Nzo District Municipality. Results revealed that local knowledge and IKS practices, such as contouring systems, crop rotation, mulching, associated crops, and planting vegetation cover, remain relevant for enhancing food production and food security in rural ANDM villages. The findings further highlighted that elderly individuals tend to possess valuable IKS practices for managing soil erosion. Moreover, there is a gender imbalance in farming participation, with more men than women involved in the study.

CHAPTER 5 (Synthesis) - Conclusively, the synthesis of the research work is provided in this final chapter which serves as the culmination of the dissertation, offering a succinct summary of the study's significant findings. This chapter also highlights the implications of the research and presents recommendations for future studies of a similar nature. Additionally, it encapsulates the critical conclusions drawn from the study.

## CHAPTER 2

### THE ROLE OF INDIGENOUS KNOWLEDGE SYSTEMS AND COMMUNITY INVOLVEMENT IN MANAGING SOIL EROSION IN SUB-SAHARAN AFRICA: A REVIEW.

This chapter is based on:

**Shinga, T.V. and Nkomo, S.L.** (In preparation). “The role of indigenous knowledge systems and community involvement in managing soil erosion in Sub-Saharan Africa: A Review”.

*Geoderma*.

## 2.1 Abstract

Indigenous Knowledge Systems (IKS) and community involvement play a crucial role in conserving soil erosion in rural areas of developing countries. This paper is a systematic review of existing literature on the role of local IKS and community involvement in managing soil erosion in sub-Saharan African (SSA). The primary objectives were to conduct a comprehensive overview of the current state of IKS in rural SSA communities concerning soil erosion management and to identify gaps in the literature for future research. The review focused on two main objectives: firstly, to understand the nature and impacts of soil erosion in rural areas in SSA, and secondly, to identify and assess existing indigenous soil erosion management strategies. The findings revealed that various IKS practices, such as stone walls, terracing, mulching, organic manure, crop rotation, shifting cultivation, and bush fallow, are employed by local communities in SSA. However, a notable limitation was the reliance on studies conducted over 25 to 30 years ago, raising concerns about the currency and relevance of these practices in contemporary SSA. Furthermore, the recent literature, although limited, lacks sufficient supporting concrete evidence of the current implementation and success of IKS practices in local communities. The effectiveness of these practices in addressing soil erosion, contributing to local incomes, and enhancing food security remained inadequately demonstrated. Considering these findings, there is a clear need for updated and robust research that evaluates the current status, effectiveness, and socio-economic impact of IKS practices in SSA's rural communities. This will not only contribute to addressing soil erosion challenges but also provide valuable insights into the sustainability and practicality of these IKS practices in contemporary agricultural landscapes.

**Key Words:** Soil Erosion, Soil Erosion Management, Indigenous Knowledge, Rural Areas, Community Involvement.

**Sub-Saharan African Countries (40):** Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Cote d'Ivoire, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, United Republic of Tanzania, Togo, Uganda, Zaire, Zambia, Zimbabwe.<sup>1</sup>

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## 2.2 Introduction

Indigenous Knowledge Systems (IKS) and community involvement play a crucial role in conserving the environment and biodiversity in developing countries (Mulat, 2013). A qualitative study by Sithole (2020) conducted in Zimbabwe highlights the importance of IKS in agriculture. The study found that the integration of IKS into agricultural practices contributes to sustainable farming, economic efficiency, and environmental conservation, highlighting the need to preserve and promote these traditional practices (Sithole, 2020). In a study conducted by Chuma *et al.* (2022) in northern Kabare, South-Kivu province, eastern Democratic Republic of Congo (DRC), small farmers use hedges, mulching, terraces, channels, ditches, and ridges as soil erosion management strategies. These practices align with contemporary soil conservation and should be upheld for wise resource management. Rural communities worldwide connect environmental preservation to their culture. These traditions should be integrated into conservation strategies, as they have proven to be effective (Taye and Megento, 2017; Bapfakurera and Nduwamungu, 2020). Unfortunately, IKS are sometimes undervalued which is a concern as involving the community is vital when it comes to conservation, particularly the soil. Farmers have a holistic approach to soil erosion prevention and crop production, so it is important to consider their perceptions of erosion and fertility loss when providing advice (Hudson, 1993; Ericksen and Ardon, 2003; Nhemachena *et al.*, 2011; Materechera, 2022). Sub-Saharan Africa (SSA) study by Materechera (2022) highlights the crucial role of indigenous knowledge (IK) in sustaining agriculture among smallholder farmers in the region. It demonstrates how traditional practices and techniques, honed over generations, contribute significantly to the resilience and productivity of farming systems. The research emphasises the importance of IK with modern agricultural practices to achieve sustainable food production and enhance the livelihoods of rural communities in SSA (Materechera, 2022).

Globally, soil erosion is a major environmental issue that affects most of the world as it occurs in various forms (Borrelli *et al.*, 2018; Sartori *et al.*, 2019; Xionga *et al.*, 2019). Soil erosion occurs in two main categories: water erosion and wind erosion. The literature extensively documents the well-known environmental and human factors influencing soil erosion (e.g., Reij, 1991; Borrelli *et al.*, 2017; Sartori *et al.*, 2019; Xionga *et al.*, 2019 etc.). Human activities and associated land use changes, primarily deforestation and the adoption of practices that will lead to degradation in the quality of soil, are the leading causes of accelerated soil erosion worldwide (Borrelli *et al.*, 2017). Poor farming practices and related factors result in land use changes that further contribute to soil erosion. Soil erosion is widely acknowledged as a

significant threat to various aspects, encompassing food security, soil nutrients, carbon cycling, land productivity, and the sustainability of agriculture (Borrelli *et al.*, 2017; Sartori *et al.*, 2019; Xionga *et al.*, 2019). Consequently, soil erosion poses a substantial risk to global socioeconomic conditions, particularly in rural areas heavily reliant on agriculture as their source of income (Borrelli *et al.*, 2017). Other forms include splash, rill, sheet, and the devastating gully (Ajibade, 2008). In most of the world, there is no part of the state that is free from at least one of the mentioned various forms of erosion. Borrelli *et al.* (2017) found that countries that are economically less developed experience higher soil erosion rates. For instance, in the region of SSA soil erosion is the most obvious component of land degradation often coming in the form of spectacular gullies and other factors (Hudson, 1993). Soil erosion is one of the major environmental degradations that need to be solved with different approaches. Developing countries including SSA countries are the ones that are experiencing high soil erosion rates due to various poor farming activities and natural causes (Reij, 1986).

Soil erosion is a widespread issue in agriculture, primarily in countries that are developing where poor farming practices are common due to a lack of experience (Ananda and Herath, 2003). Human activities related to agriculture, dating back thousands of years, have exacerbated soil erosion, leading to land degradation, particularly in the more humid zones of SSA and the higher potential agricultural areas of East and Southern Africa (Hudson, 1993; Valle Junior *et al.*, 2014). Poor farming is the primary driver of soil erosion, making the protection and mitigation of soil resources crucial in today's world (Borrelli *et al.*, 2017; Xionga *et al.*, 2019). Soil erosion has led to reduced land productivity and land abandonment (Blair *et al.*, 2018; Moyo and Ravhuhali, 2022), exacerbating poverty and food insecurity in the regions that already facing hunger and poverty. The study by Moyo and Ravhuhali (2022) examines the phenomenon of abandoned croplands in communal areas of South Africa (SA), particularly focusing on the factors driving abandonment and the subsequent patterns of secondary succession influenced by livestock grazing. The study explored how land use changes due to socio-economic, political and environmental conditions contributed to land abandonment (Moyo and Ravhuhali, 2022). Studies indicate that socio-economic and political injustices play a crucial role in facilitating soil erosion and land abandonment in rural areas. For example, in SA, scholars argued that colonial policies and legislation such as the Natives Land Act No. 27 of 1913 (NLA) and Bantu Authorities Act of 1951 (BAA) played a crucial role in facilitating land abandonment in the Eastern Cape (EC) province (Lahiff, 2005; Andrew *et al.*, 2013; Hall, 2014; Beinart and Delius, 2014). During the introduction of this legislation, black people were

forcefully removed from their land and were prohibited from buying or renting land in areas designated for “white people” (Andrew *et al.*, 2013; Hall, 2014; Beinart and Delius, 2014). The segregation directly affected landownership and resulted in agricultural land abandonment in most former Apartheid homelands (Blair *et al.*, 2018; Moyo and Ravhuhali, 2022). Enforcing these laws limited people the rights to access arable land for crop and livestock farming in SA. Hence, many studies indicate that poor farming practices and overgrazing are regarded as the main causes of soil erosion in the EC province (Keenleyside and Tucker, 2010; Blair *et al.*, 2018; Moyo and Ravhuhali, 2022).

Animal overgrazing is also one of the causes of soil erosion in developing countries due to unsustainable farming (Mwendera *et al.*, 1997; Moyo and Ravhuhali, 2022; Baade *et al.*, 2024). This results from intensive grazing that surpasses natural vegetation regeneration, leading to bare soil exposure. Additionally, it involves vegetation depletion, where continuous and excessive grazing damages plant cover and root systems, making the soil more susceptible to erosion by wind and water. Over time, this leads to land degradation, reducing land productivity and contributing to food security challenges. To address these issues and promote environmental sustainability, adopting sustainable grazing practices and involving the community is essential. In developing countries, factors such as unreliable rainfall and poor soils contribute to unpredictable soil degradation and harsh environments (Osbahra and Allan, 2003). When soil loses its vegetation cover due to overgrazing and unsustainable activities, it becomes vulnerable to erosion. Soil erosion is a significant issue in countries like SA, with the EC being the most affected province (Phinzi and Ngetar, 2017; Parwada and Van Tol, 2016). This poses a serious threat to EC residents since the soil is a vital resource, influencing agriculture and serving as a habitat for people and biodiversity. Agricultural production remains a crucial source of employment and income for many rural and urban households. Investing in sustainable land use practices can enhance yield production, mitigate land degradation, and improve household income and food security (Baade *et al.*, 2024).

In this paper, literature about the role of local IKS and community involvement in managing soil erosion in SSA is reviewed through studies that have been conducted within the SSA region. The aim is to provide a coherent overview of existing local IKS in SSA rural communities on how they are managing soil erosion and subsequently provide recommendations for future studies by identifying gaps in the literature. The paper focuses on reviewing literature with two objectives: firstly, this paper seeks to review the literature to determine the nature and impacts of soil erosion in rural areas in SSA. Secondly, to identify

and assess existing soil erosion management strategies in rural areas. The main purpose is to provide what is known about the role of local IKS and community involvement in managing soil erosion in rural areas of SSA in particular. Thereafter, provide recommendations for future work and/or for further improvements.

### **2.3 Review methodology**

This paper reviewed literature about the role of IKS in rural communities of SSA in managing soil erosion. It focused on two objectives, namely (1) to determine the nature and impacts of soil erosion in rural areas in SSA, and (2) to identify and assess existing soil erosion management strategies in a rural area, which have been conducted in SSA. To gather information, the study searched articles that focused on each of the objectives and thereafter were critically examined. The study used three main databases to obtain this information from related academic literature, which included Google Scholar, Web of Science, and SCOPUS. To narrow the focus, only published papers addressing soil erosion in rural SSA were selected from the multitude of available studies.

The selected articles were chosen using key search terms to make sure they provided useful information for the study. Therefore, the study's search criteria involved utilising the following keywords in the databases; “soil erosion”, “soil erosion in rural areas”, “nature of soil erosion”, “nature of soil erosion in rural areas”, “impacts of soil erosion”, “impacts of soil erosion in rural areas”, “nature and impacts of soil erosion”, “nature and impacts of soil erosion in rural areas”, “soil erosion management”, “soil erosion management in rural areas”, “soil erosion management strategies”, “soil erosion management strategies in rural areas”, “solutions”, “measures”, “local knowledge on soil erosion”, “indigenous knowledge systems (IKS)” and “community involvement”. The above words were entered into Google Scholar, SCOPUS, and Web of Science in the same way. All the sources were sorted according to their relevance and only studies that directly focus on rural areas of SSA were selected. The stratified sampling was used in a situation where there were too many studies that were found during the search by partitioning them into groups that would fit into the relevant objectives of the study. Stratified sampling is a method of random sampling that divides the whole population of samples into smaller subsets of samples, known as strata (Li and Yang, 2022). The study also systematically went through the reference lists of published papers that specifically focus on soil erosion in rural areas or communities of SSA to find relevant studies. These studies were

selected based on their relevance to the study. It is acknowledged that selecting only articles that specifically focus on soil erosion in rural areas or communities of SSA to go through their reference lists might be biased. The study incorporated a variety of sources, including books, newspapers, and websites relevant to soil erosion and IKS in SSA. Due to challenges in locating sources specifically focused on rural areas, the research also considered materials discussing soil erosion and IKS more broadly if they pertained to the SSA region.

The number of sources that were selected for review did not exceed 200. To address all the objectives of the study, the selection of sources was systematically and carefully divided into two. The first sources did not exceed 100 and focused on determining the nature and impacts of soil erosion in rural areas. The second also did not exceed 100 and focused on identifying and assessing the existing soil erosion management strategies in rural areas. Some articles addressed both sections as they are related and were also included in both objectives. The articles were meticulously reviewed and selected for inclusion in this paper based on their relevance to each specified objective. The study thoroughly went through all the selected sources by reading and noting all the relevant information and approaches about soil erosion that were needed in the study. The study analysed each article based on case studies that explored the role of IKS in preventing soil erosion in rural areas of SSA (see **Appendix 1** of the lists of included studies in the review). The information was used to identify the impacts of soil erosion and recommendations for managing soil erosion in rural areas of SSA.

## **2.4 Results and discussion**

### **2.4.1 Soil erosion in rural sub-Saharan Africa**

Soil erosion is one of the major forms of land degradation in the SSA region with serious impacts on agricultural productivity. It is usually the most visible component of land degradation, and it is certainly the most extensively studied physical process (Reij, 1991: 18). Soil erosion in the region mostly takes place in the form of water erosion as seen in most countries within the region. This usually occurs in many areas of SSA where slopes are less than 1% (Hudson, 1993). Kiage (2013) states that soil erosion and land degradation processes pose a serious threat to the livelihoods of many people in SSA. Food production remains the biggest threat, especially to the rural livelihoods of many poor and densely populated areas of the region. There are very few rural communities in the region that have been able to contain

land degradation while intensifying agricultural production (Hudson, 1993), as population pressure continues to grow.

Most African rural communities are heavily relying on available natural resources for their source of food and income (FAO, 2019). Farmers are forced to use fertilisers or manures to maintain their yields and/or temporarily or permanently abandon the piece of land that they use to produce more food. Wynants *et al.* (2019) asserted that African rural communities do not have enough access to capital, fertilisers, and technology which is why they cannot be able to invest in improved land management. Most countries in Africa are not able to deal with soil erosion and invest in improving land management strategies. Blake *et al.* (2018) state that there is a need for urgent intervention to deal with the irreversible loss of ecosystem services as unsustainable land management leads to rates of erosion that exceed natural soil production. In SSA, that is much needed as the region is affected by soil erosion.

Ananda and Herath (2003) revealed that the negative impacts of technical change, inappropriate government policies, and poor institutions are largely responsible for the continued soil erosion in developing countries. On the other hand, Hudson (1993) asserted that the root cause of soil erosion in the region lies in a range of economic and political parameters which are typically outside farmers' control. Hence, government interventions are lacking in most developing countries in dealing with soil erosion. It is the main reason for the continuing soil erosion, as most interventions to prevent soil erosion are not implemented effectively. Ananda and Herath (2003) stated that the potential for market-based approaches (e.g. Payment for Ecosystem Services (PES), Conservation Tillage and Agroforestry) to mitigate soil erosion is limited due to negative externalities. However, Ananda and Herath (2003) noted, that these approaches can be limited by negative externalities such as social equity, environmental impacts and short-term-focus. Developing countries do not have relevant people on the line to help in dealing with soil erosion. Blake *et al.* (2018) asserted that in northern Tanzania the loss of vegetation cover remains the main factor that causes soil erosion and has decreased ecological resilience. Local communities attribute the issue to a lack of alternative livelihood opportunities and insufficient enforcement of environmental protection legislation.

The soil erosion literature in SA classifies EC province as a high-erosion-potential area (Phinzi and Ngetar, 2017; Parwada and Van Tol, 2016). However, most of this data was collected in a very large-scale spatial context. Parwada and Van Tol (2016) argued that data collected at a large spatial scale tend to ignore site-specific properties which might influence soil erosion. In

this scenario, traditional soil erosion mitigation measures applied in the EC have proven ineffective (Parwada and Van Tol, 2016). It is evident that controlling soil erosion at the local level requires the effective use of IKS. Xiong *et al.* (2019) suggest that improving the global applicability of the Universal Soil Loss Equation (USLE) based model can enhance the accuracy of estimating global soil erosion and its variability. However, that has not been working effectively as there is still uncertainty regarding soil erosion events across the globe although it is largely taking place. It makes it difficult to establish useful approaches that can be used to prevent or manage and control soil erosion for the present and future generations. It should be noted that (Phinzi and Ngetar, 2017; Xiong *et al.*, 2019) focused on quantifying soil erosion, their studies did not suggest soil conservation methods nor allude to the role of IKS.

Before focusing on the concern regarding soil erosion management, it is vital to look closely at the theoretical viewpoints regarding soil erosion. Ananda and Herath (2003) identified three major theoretical viewpoints of soil erosion, which are population explanation, past policies, and poor institutions. These theoretical viewpoints on soil erosion clearly outline that soil erosion is influenced by different factors. The growing population pressure leads to the deforestation of forests because humans are seeking to find new agricultural livelihoods. As people grow, they demand more food production areas so that everyone will be accommodated. Consequently, that leads to soil erosion as forest areas are cleared. A weak property right prevents the mitigation of soil erosion and the policies of the past increase soil erosion through soil conservation subsidies that tend to create more unnecessary distortions (Ananda and Herath, 2003). Even institutions when that do not have a solid plan for soil erosion management, accelerate the problem even further.

Since the effects of soil erosion started manifesting themselves, that became a big concern and thus, humans decided to investigate causes and proper possible solutions to curb the risk (Ajibade, 2008). Soil erosion problem needs to be managed and there is a huge lack of knowledge on how this can be controlled or managed. There are also different arguments in terms of the approaches or strategies that can be used to manage soil erosion, but these arguments relate to scientific knowledge and IKS particularly. There seems to be an issue with how soil erosion data is collected mostly in developing countries, general approaches are used to control and manage soil erosion. However, Parwada and Van Tol (2016) argued that the ignorance of specific site properties when soil erosion mitigation options are devised leads to inadequate implementation of ineffective measures against the soil erosion problem. Therefore,

there is still a need for an effective approach to managing soil erosion which should start with collecting effective soil erosion data locally in the region.

#### **2.4.1.1. Rural communities IKS of soil erosion conservation and management measures in SSA.**

In SSA, water erosion is typically the concern, except in arid regions where wind erosion takes precedence (Hudson, 1993). Vegetation cover is a pivotal factor in erosion control, whether classified as indigenous or scientific knowledge. It remains the fundamental starting point for erosion prevention. Efforts to combat soil erosion in SSA often commence by addressing vegetation cover, as it has the potential to nearly halt erosion. Despite various practices implemented in the region to manage erosion, the active involvement of local communities is essential, given their profound understanding of the local environment.

Hudson (1993) emphasises the significant impact of management and conservation practices on erosion rates. Ananda and Herath (2003) argue that private property rights are the most effective means to mitigate land degradation and soil erosion, especially in fragile areas. However, this presents a challenge in Africa, where historical injustices like apartheid have led to the forceful dispossession of indigenous peoples from their lands (Hebinck *et al.*, 2011; Hamann and Tuinder, 2012; Kelly, 2015). Blake *et al.* (2018) emphasised the need for interdisciplinary system thinking to empower local communities and break the cycle of land degradation. It is suggested that farmers' perceptions of soils are driven by the practical demands of agriculture rather than holistic views of plant productivity by soil scientists (Ericksen and Ardon, 2003). Consequently, IK becomes rooted in the pragmatic, utilitarian, and everyday demands of life (Briggs, 2005). Despite this, Ugboma (2014) insists that IK is pivotal to Africa's development, particularly in rural communities, making IKS essential for addressing soil erosion in SSA.

##### **a) Indigenous Soil Conservation Techniques**

The work that has been done in SSA and abroad regarding indigenous soil conservation techniques has revealed interesting results (Hudson, 1993; Ericksen and Ardon, 2003; Nhemachena *et al.*, 2011; Materechera, 2022). Most of the studies have included both soil and water indigenous soil conservation measures (Reij, 1991; Taye and Megento, 2017; Bapfakurera and Nduwamungu, 2020; Negasa, 2023). These studies have demonstrated a fundamental way in which farmers used their IKS to prevent soil erosion in their farms. Table 2.1 below, shows some of the examples of indigenous soil and water conservation techniques

that are practiced in different countries across Africa. This has been developed by Reij (1991) in the International Fund for Agricultural Development (IFAD). It also showed the amount of rainfalls that these countries receive and the population density in persons/km. The major indigenous soil and water conservation techniques that are used by the below-listed countries are the bench terraces and stone bunds. The major crops are mainly sorghum, millet and maize which are mainly planted by the farmers.

In various African regions, indigenous soil and water conservation techniques have proven successful in promoting diverse crop cultivation. Farmers employ a range of methods, including crop rotation, crop mixtures, manure application, protection of nitrogen-fixing trees, terrace construction, pitting systems, drainage ditches, and small dams in valley floors (Reij, 1991). While crop rotation, crop mixtures, manure application, and terrace construction have roots in IKS, they are widely recognised and integrated into mainstream soil conservation and sustainable agriculture. These methods are extensively documented in scientific literature, with Morgan (2009) highlighting their role in soil erosion control and land management, Farooq and Siddique (2016: 115–142) discussing their application in conservation agriculture, and World Overview of Conservation Approaches and Technologies (WOCAT) promoting them as global best practices in soil and water conservation. Ethno-engineering practices are adapted to diverse climatic conditions, exemplified by the Dogon in Mali constructing small earth ridges around sorghum or millet plants (Galláis, 1975; Galláis en Sidikou, 1978; Kassogue *et al.*, 1990 cited by Reij, 1991). The Dogon are an ethnic group in Mali known for their unique culture, art, and architecture, notably their cliff dwellings and cosmological beliefs. Farmers in mountainous areas implement intensive land management practices, often terracing steep slopes to optimise limited land resources. While some locations witness the abandonment of indigenous techniques, there are instances of revival and expansion. Notable examples include stone lines in Ader Doutchi Maggia (Niger), planting pits in the Djenne–Sofara region (Mali), terracing in the Rif mountains (Morocco), and traditional terrace cultivation in the Eastern plains (Sudan) (Reij, 1991). These indigenous practices showcase tangible improvements, emphasising their resilience and efficacy in sustainable farming.

**Table 2.1: Examples of indigenous soil and water conservation techniques in Africa with prominent 'ethno-engineering' practices by (Source: Reij, 1991).**

| Country      | Region                               | Rainfall (mm)            | Population density persons/km <sup>2</sup> | Indigenous soil and water conservation techniques                                  | Major Crops                                          | Publications                                                                       |
|--------------|--------------------------------------|--------------------------|--------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------------------|
| Burkina Faso | Southwest                            | 1000-1100                | 35                                         | stone bunds on slopes; network of earth bunds and drainage channels in lowlands    | sorghum<br>millet<br>maize                           | Savonnet (1976)                                                                    |
|              | Southwest                            | 1000                     | 35-80                                      | contour stone bunds on slopes, drainage channels                                   | sorghum<br>millet                                    | Pradeau (1975)                                                                     |
|              | Central                              | 400-700                  | 29 (1975)                                  | stone lines, stone terraces, planting pits (zay)                                   | sorghum<br>millet                                    | Savonnet (1958)<br>Reij (1983)<br>Roose (1990)                                     |
| Cameroon     | North                                | 800-1100                 | 80-250                                     | bench terraces (0,5 -3 m. high)<br>stone bunds                                     | sorghum<br>peanuts<br>millet                         | Boulet (1975)<br>Boutrais (1987)<br>Riddell and Campbell (1986)<br>Hallaire (1971) |
| Cape Verde   | S. Antao Island,<br>North Cape Verde | 400-1200<br>(in uplands) | >100                                       | dry stone terraces (rainfed, irrigated), 0.5 - 2 m. high                           | sugar cane<br>maize<br>sweet potatoes<br>pigeon peas | Haagsma (1990a)<br>Kloosterboer and Eppink (1989)                                  |
| Ethiopia     | Southwest                            | 1200                     | 100                                        | dry stone terraces (walls 1-2 m. high)<br>rectangular basins (approx. 2 m. x 4 m.) | millet<br>maize<br>cotton                            | FAO (1990)<br>Hallpike (1972)                                                      |

| Country      | Region                            | Rainfall<br>(mm) | Population<br>density<br>persons/km <sup>2</sup> | Indigenous soil and water<br>conservation techniques                                                                        | Major Crops                 | Publications                                                                 |
|--------------|-----------------------------------|------------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------|
| Niger        | Ader Doutchi<br>Maggia            | 300-500          |                                                  | stone lines, planting pits (tassa)                                                                                          | sorghum<br>millet           | IFAD (1986c; 1991c)                                                          |
| Nigeria      | Jos Plateau,<br>Central Nigeria   | 1000-1500        | 110-450                                          | stepped, level benched stone terraces,<br>rectangular ridges (sagan), mound<br>cultivation                                  | millet<br>maize<br>beans    | Netting (1968)<br>Netting <i>et al.</i> (1989)                               |
| Mali         | Djenné-Sofara,<br>Central Mali    | 400              | 20-30                                            | pitting systems                                                                                                             | sorghum<br>millet           | Avers (1989)                                                                 |
|              | Central                           | 500-650          | 13-85 Average<br>25 (1990)                       | cone-shaped mounds, planting holes,<br>terraces square basins, stone lines, bunds<br>or low walls, millet stalk trash lines | millet<br>sorghum<br>onions | Galláis (1975)<br>Galláis en Sidikou (1978)<br>Kassogue <i>et al.</i> (1990) |
| Rwanda       | Northwest                         | 1100-1400        | 500-800                                          | terraces (myanamo) (0,5 -1.0 m. wide),<br>stone contour bunds, contour or graded<br>earthen bunds                           | beans<br>bananas<br>sorghum | Nyamulinda (1989)<br>Roose <i>et al.</i> (1988)                              |
| Sierra Leone |                                   | 2000-2500        | 38 (1976)                                        | sticks and stone bunding on fields and in<br>gullies drainage techniques                                                    | rice<br>cassava             | Millington (1984), (1985)                                                    |
| Somalia      | Hiraan region.<br>Central Somalia | 150-300          | 13                                               | earth bunds with upslope wing walls<br>(caag) and earth bunds dividing plots of<br>land into a grid (gawan)                 | sorghum<br>cowpeas          | Critchley <i>et al.</i> (1991)                                               |
| Sudan        | East                              | 225-400          | 10-15 (1985)                                     | earth bunds (straight) with upslope wing-<br>walls (teras) and water-spreading<br>techniques                                | sorghum                     | Critchley <i>et al.</i> (1991)<br>Ibrahim (1988)<br>Randell (1963)           |

| Country  | Region                                       | Rainfall<br>(mm) | Population<br>density<br>persons/km <sup>2</sup> | Indigenous soil and water<br>conservation techniques                                                             | Major Crops                      | Publications                    |
|----------|----------------------------------------------|------------------|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------|----------------------------------|---------------------------------|
|          | Djebel Marra<br>Highlands,<br>Western Sudan  | 600-1000         | 20-37 (1976)                                     | bench terraces                                                                                                   | millet<br>sorghum                | Miehe (1986)                    |
| Tanzania | Uluguru<br>Mountains,<br>Eastern<br>Tanzania | 1500             | 100-300                                          | ladder terraces (trash contour ridges)                                                                           |                                  | Temple (1972)                   |
|          | Southwest                                    | 1000             | 40                                               | Matengo pit system: digging of pits (1.0 -<br>1.5 m. in diameter), ridges                                        | millet<br>maize<br>cassava       | Allan (1965)<br>Basehart (1973) |
|          | Ukara island,<br>Northern<br>Tanzania        | 1500             | 210                                              | earth and stone terraces, tied ridging,<br>stone barriers in gullies, mound cropping                             | millet<br>cassava<br>rice        | Allan (1965)<br>Ludwig (1968)   |
| Chad     | Ouddai                                       | 250-650          | 5-6 (1987)                                       | water harvesting in drier regions: various<br>earth bunding systems with upslope<br>wingwalls and catchment area | millet<br>sorghum                | Sommerhalter (1987)             |
| Togo     | North                                        | 1400             | 80                                               | bench terraces and contour bunds,<br>(rectangular) mound cultivation                                             | yam<br>millet<br>sorghum<br>rice | Allan (1965)<br>Sauvaget(1981)  |

Hudson (1993) has identified various indigenous soil and water conservation techniques in the SSA region, with a focus on soil erosion conservation. These techniques include stone lines, trash lines, ridges and furrows, pitting systems, mounds with green manure incorporated into the soil, stone terraces, mulching, and the protection of *Acacia albida* stands (a nitrogen-fixing tree). Stone lines and planting pits have traditionally been employed in Burkina Faso, Mali, and Niger for rehabilitating degraded land. Other indigenous conservation techniques include traditional stone lines in the Ader Doutchi Maggia (Niger), pitting systems in the Djenné-Sofara region in Mali, and the "*caaq* (creating barriers or structures to manage water flow and prevent soil erosion) and *gawan*" (planting or cultivating crops in a way that promotes soil health and fertility) techniques in the Central Rangelands of Somalia (Hudson, 1993). Regrettably, these techniques have been overlooked by both African and expatriate researchers and conservation specialists. Hudson (1993) suggests that this oversight may be rooted in the belief of researchers and conservation specialists in the superiority of their soil conservation methods such as crop rotation, crop mixtures, manure application and terrace construction, assuming without further investigation that indigenous techniques are rudimentary. One could attribute this neglect to arrogance and the dominance of scientific knowledge in recent centuries, overshadowing the IKS of native people. These methods, though effective and sustainable, have often been overlooked or considered rudimentary by researchers and conservation specialists who assume the superiority of modern soil conservation techniques without fully investigating the scientific basis of indigenous practices.

A study conducted in western Ethiopia by Teklu and Gezahegn (2003) showed that farmers hold a wealth of knowledge about their land resources, their characteristics, limitations and potentials, and management options. This is why involving farmers is vital when formulating policies or strategies to deal with soil erosion. Farmers or local people know their land better than outsiders. Therefore, it is important to ensure that they are included in soil erosion management and conservation programmes. In western Ethiopia, farmers were able to recognise soil erosion and nutrient depletion and establish the cause and effect of the relationship between such factors. They formulated management strategies such as crop rotation, fallowing, "*Boraatii*" cut-off drains and "*Bo'oo*" or "*yaa'a*" drainage furrows that were commonly used as locally based soil conservation and soil erosion control methods to arrest the problems of soil erosion (Teklu and Gezahegn, 2003). This reveals the extensive knowledge that local people possess about managing soil erosion which is unfairly disregarded.

A project funded by the German Agency for Technical Cooperation for soil regeneration in Rwanda has developed new technologies that are built upon traditional agricultural practices that enhance traditional agricultural practices for soil regeneration (Warren, 1991). One key approach is **terracing**, which involves constructing terraces on sloped land to mitigate soil erosion and improve water retention, ultimately enhancing crop yields while preserving soil integrity. **Agroforestry** is another important practice, integrating trees with crops to enrich soil fertility, provide shade, and foster diverse ecosystems that benefit both agriculture and biodiversity. Additionally, **cover cropping** is employed to protect the soil during fallow periods, enhancing soil structure and nutrient availability. The use of **composting** is also promoted, as it improves soil health by increasing microbial activity and nutrient content through organic matter recycling. Lastly, various **soil conservation practices**, such as contour plowing and bundling, are implemented to manage water runoff effectively and reduce erosion. Together, these technologies aim to create resilient and sustainable farming systems that contribute to soil regeneration in Rwanda. This project was done together with local people where they used their skills and knowledge to reduce deforestation and soil erosion. It shows that local knowledge is vital and should be considered when projects and strategies are implemented in the community. Not only local knowledge but also corroboration between the government and local people are also important. There is much value in local people in rural areas that they possess and add value to decision-making.

#### **b) Recent studies of indigenous soil conservation techniques**

Studies have demonstrated a wide range of indigenous soil conservation measures that are used to prevent soil erosion in rural areas and most of them like in the past include water resources. Soil and water are fundamental and need to be protected by farmers. For instance, a perspective study conducted in surrounding areas of Lake Ziway, Central Rift Valley of Ethiopia showed that *Leucaena leucocephala*, *Faidherbia albida*, *Azadirachta indica*, and *Schinus molle* are the dominant tree species planted in the study area for soil and water conservation purposes (Negasa, 2023). The work done in Nigeria by Ugboma (2014) about rural women notes that IK is used to improve their livelihoods, for instance, the use of the *Jatropha* system (cultivation of *Jatropha curcas* plant) has helped in erosion control, soil improvement as well as renewable energy (Ugboma, 2014). It helps control soil erosion with its deep roots, improves soil health by adding organic matter, and provides a source of renewable energy through oil extracted from its seeds, which can be converted into biodiesel. Additionally, *jatropha* serves as a living

fence and enhances biodiversity, making it a valuable resource for improving the livelihoods of rural women in Nigeria.

A study conducted in Kondoa District, Tanzania (Lane, 2009) revealed that this district is renowned for experiencing severe soil erosion, resulting in the loss of productive land and environmental degradation. The agricultural community, recognising the significance of traditional methods, has willingly adopted them. These include intercropping different crops for enhanced soil stability, constructing terraces on slopes to reduce runoff, and integrating trees with crops through agroforestry to improve soil fertility. Additionally, practices like mulching to protect soil, contour plowing to minimise runoff, and planting cover crops during fallow periods help sustain agricultural productivity and protect the environment. Together, these methods leverage local knowledge to address erosion challenges effectively. This shift underscores a broader trend where farmers are incorporating time-tested indigenous practices into their routines. Lane (2009) and Lwoga *et al.* (2011) have documented this transition, highlighting the pivotal role of local knowledge and the successful integration of traditional agricultural methods. The symbiotic relationship between local women's indigenous methods and the adaptive strategies of farmers underscores a holistic and community-driven approach to sustainable land management. Through indigenous methods of local women, soil erosion was restored and managed properly. Even farmers have learned how to adapt their agricultural practices as many farmers rely on traditional agricultural methods (Lane, 2009; Lwoga *et al.*, 2011).

In the rural area of Khambashe in the EC of SA has identified several indigenous techniques used by women in Khambashe village to improve food production and food security. For example, the utilisation of organic manures, contouring, soil enhancement, mulching, and ridges play a crucial role in soil conservation. The effectiveness of various soil conservation techniques, such as the utilisation of organic manures, contouring, soil enhancement, mulching, and ridges, is well-documented in agricultural literature (e.g., Reij, 1991; Kolawole, 2004; Garutsa and Nekhwevha, 2018; Bapfakurera and Nduwamungu, 2020). These practices have been widely recognised for their positive impact on soil conservation. Farmers predominantly rely on soil enhancement for crop production, while mulching is primarily employed by women food producers. Machar and Debela (2021) study conducted in Bule Kenga kebele, Ethiopia shows that the major IK of soil fertility management in the study area was crop rotation, organic fertiliser, agroforestry, intercropping, and green manure. Indigenous traditional practices like

the use of organic manure, mulching, and contouring to enhance food production and security remain pertinent in the village of Khambashe, with the majority of community members confirming their continued utilisation for crop production (Garutsa and Nekhwevha, 2018).

In agriculture, rural women in the SSA region utilise their IK to enhance agricultural productivity (Ugboma, 2014). Lwoga *et al.* (2011) argued that efforts should be focused on enabling communities to innovate, share, and preserve their knowledge for sustainable agricultural growth, rather than separating IK from its holders. Ugboma (2014) emphasises the significance of IK across various aspects of rural African communities, including science, agriculture, medicine, education, and cultural affairs. For instance, the use of oxen by rural women in Ethiopia to plough the land for farming has garnered praise from the United Nations (Ugboma, 2014). Oxen have been historically important in agriculture, providing sustainable and reliable power for cultivating crops and tilling the land. Additionally, elderly women in rural Khambashe in the EC, SA possess extensive knowledge of indigenous methods for food production, processing, and storage (Garutsa and Nekhwevha, 2018). In summary, IKS play a vital role in various aspects of rural life, particularly in the rural regions of SSA.

Small-scale farmers in Tanzania have a robust foundation of IKS and a deep understanding of their environment. They demonstrated the capability to apply effective managerial skills and adaptive strategies in crop and animal farming as well as forage resource management (Lwoga, Ngulube and Stilwell, 2010 cited by Lwoga *et al.*, 2011). The Tanzanian government has introduced a strategy to remove all livestock from the most severely eroded parts of the Irangi Hills to encourage the natural regeneration of vegetation. Moreover, they introduced local by-laws prohibiting the cutting of greenwood and forest clearance for cultivation, alongside a program of rehabilitation involving tree planting, reseedling of badlands, and the promotion of stall-feeding of cattle and other farm conservation strategies (Lane, 2009). All this was done to ensure that soil erosion in Tanzania is controlled and managed effectively. This led to effective management of soil erosion including in dry terrain. In a recent Southern African study of different agroforestry systems by Veste *et al.* (2024) noted that agroforestry systems (AFS) have gained traction in Southern Africa, providing ecosystem services such as soil protection, food security, and biodiversity conservation. Various AFS models have been promoted, including intercropping systems, improved fallows, parkland systems, biomass transfer, fodder banks, alley cropping, multi-story plantations, tree/home gardens, and shelterbelts. These

systems have shown promise in enhancing crop productivity, soil health, and biodiversity at both farm and landscape scales (Veste *et al.*, 2024).

Ajibade (2008) identified six effective soil erosion control measures among farmers in Asa, Kwara State, Nigeria. These measures include 'Ebe ati Pooro,' 'Idian,' 'Agbin-Taala,' 'Agbin-la,' 'Agbin-Po,' and a method comparable to the fallowing. **Ebe ati Pooro** involves creating barriers or bunds using local materials to slow down water runoff and prevent soil erosion, effectively capturing sediment and promoting water infiltration. **Idian** refers to planting specific crops known to thrive in local conditions, which help stabilize the soil and improve its structure. **Agbin-Taala** focuses on using cover crops or green manures during fallow periods to protect the soil, enhance fertility through nitrogen fixation, and prevent erosion. Similarly, **Agbin-la** emphasizes intercropping or planting diverse crops to maintain soil integrity and resilience. **Agbin-Po** involves applying organic mulch over the soil surface, which protects against erosion, conserves moisture, and adds organic matter as it decomposes. The study revealed that traditional or peasant farmers employ their methods, albeit unconsciously, to control soil erosion, highlighting the relevance of IKS in agricultural development. For instance, "Ebe ati Pooro" involves ridging, creating narrow elevations or jointed mounds for crops like maize and millets, and softening the soil for quick seed germination. Idangan refers to the use of wrapped weeds or grasses to cover seeded heaps and ridges, acting as a form of mulching in Nigeria. In Idangan, grass or weeds are wrapped around the base of seedlings or along ridges to help retain moisture, suppress weeds, and protect the soil from erosion. This traditional method of mulching is particularly valuable in arid and semi-arid regions where water conservation and soil protection are critical for successful crop growth (Akinbamijo and Lal, 2003; Akinola and Oyedele, 2015; Nwachukwu and Alaka, 2019).

According to Ajibade (2008), farmers employ the practice of covering seeds with weeds or grasses to protect them from direct sunlight, especially in the period leading up to the wet season. Agbin-Taala/Agbin-la-Okoko-Taala involves planting crops, particularly tree crops, around farmlands to create boundaries between farms. This serves as a crucial measure to protect the soil from erosion, with tree crops acting as a shelter for the farm. Agbin-la typically involves crop rotation, such as planting beans after maize, allowing for a variety of crops to be grown without letting the field lie fallow but preventing soil depletion (Ajibade, 2008; Adeoye *et al.*, 2019). Adeoye *et al.* (2019) in their study explored how mixed cropping influences crop performance in a specific agro-ecological zone in Nigeria. Highlighting its importance in

diversifying agricultural production and mitigating risks associated with mono-cropping. The study highlighted Agbin-Po which is known as mixed-cropping, which refers to cultivating more than one crop on farmland simultaneously. Farmers adopt this practice to mitigate the risk of total crop failure if one crop fails, the other may still thrive. Fallowing, a common practice in SSA involves leaving part of the farmland unused (fallow) after several years of intensive use to restore soil nutrients. This practice helps prevent soil erosion by allowing the soil structure to recover and become more resistant to the forces of water or wind erosion (Ajibade, 2008). In turn, this enhances soil nutrient levels and provides a sustainable solution to prevent soil erosion.

Taye and Megento (2017) conducted a study about IK and practice in water and soil conservation measures that were introduced in Ethiopia under Albuko Woreda/district in South Wollo. In this study, Taye and Megento (2017) mentioned several IK practices. Such practices are namely;

1. Microchannels
2. Drainage ditches (local name is ‘feses’)
3. Plow furrows
4. Soil (stone) bund
5. Planting trees
6. Application of manure (soil fertility) animal dung and urine
7. Traditional cut-off drains (digging the soil deep)
8. Contour ploughing (curved plough)
9. Leaving crops residues on the field after harvest
10. Crop rotation
11. Mixed cropping
12. Surface mulches.

These IK practices underscore the crucial role of local communities in addressing the prevention and control of soil erosion in SSA. In Ethiopia, these are vital indigenous soil conservation measures that are applied which were identified by Taye and Magento (2017). In many parts of SSA, including SA and Niger, farmers commonly employ soil (stone) bunds, water diversion ditches, and contour ploughing for soil and water conservation (Taye and Megento, 2017; Chuma *et al.*, 2022). For soil fertility, crop rotation, and mixed cropping are most commonly, followed by the traditional cut-off drain and fallowing. Since farmers are

sometimes located far from the farmer's homesteads, the use of manure is mainly near their homesteads. Traditional cut-off drains are used to prevent the loss of seeds fertiliser, and soil (Taye and Megento, 2017). In a study conducted by Chuma *et al.* (2022) in northern Kabare, South-Kivu province, eastern DRC, small farmers predominantly utilised hedges, mulching, terraces, channels, ditches, and ridges as soil erosion management strategies.

Contour ploughing is also common in most rural farmers in the region. It is sometimes compulsory to do this in steep areas where the tilling of land along the slope's contours is required to reduce the runoff on the steeply sloping ground. Farmers typically utilise surface mulches in their fields as a protective cover, especially when crop cover is absent. Taye and Megento (2017) state that mixed cropping in Ethiopia helped farmers reduce erosion by having a crop on the land for a more extended year period. Survey results indicate that some farmers are implementing this measure to enhance soil fertility and safeguard the land from erosion. A recent study conducted by Bapfakurera and Nduwamungu (2020) in Musanze and Nyabihu Districts, North-Western Rwanda revealed several indigenous soil and water conservation practices farmers have adopted (see Figure 2.1). These conservation practices are based on biological, and mechanical water conservation measures and indigenous soil fertilisation systems. Mixed cropping, cultivation on ridges/rows, stone binds/barriers and composting are the major used in indigenous soil and water conservation by the Rwanda farmers. These practices highlight the active engagement of local communities in implementing indigenous soil conservation methods in SSA to prevent soil erosion. The significant involvement of local communities underscores the essential role played by farmers who possess vital IK in effectively preventing soil erosion within their communities.

| Indigenous Soil and water conservation Practices | MUKAMIRA  |            | BUSOGO    |            | TOTAL     |            |
|--------------------------------------------------|-----------|------------|-----------|------------|-----------|------------|
|                                                  | Frequency | Percentage | Frequency | Percentage | Frequency | Percentage |
| Biological Soil and water conservation measures  |           |            |           |            |           |            |
| 1. Mixed Cropping                                | 100       | 88.0       | 98        | 83.1       | 198       | 83.9       |
| 2. Intercropping                                 | 71        | 60.2       | 65        | 55.1       | 136       | 57.6       |
| 3. Crop Rotation                                 | 41        | 38.0       | 49        | 41.5       | 90        | 38.1       |
| 4. Indigenous agroforestry                       | 26        | 22.0       | 34        | 28.8       | 60        | 25.4       |
| 5. Fallow                                        | 22        | 18.6       | 25        | 21.1       | 47        | 19.9       |
| 6. Alley cropping                                | 26        | 22.0       | 21        | 17.8       | 47        | 19.9       |
| 7. Minimum Tillage                               | 15        | 12.7       | 18        | 15.3       | 33        | 14.0       |
| 8. Mulching                                      | 8         | 6.8        | 23        | 19.5       | 31        | 13.1       |
| Mechanical Soil and water conservation measures  |           |            |           |            |           |            |
| 1. Cultivation on ridges/rows                    | 93        | 78.8       | 88        | 77.0       | 181       | 76.7       |
| 2. Stone bund/barrier                            | 76        | 64.4       | 83        | 70.3       | 159       | 67.4       |
| 3. Traditional dams/water Retention ditches      | 76        | 64.4       | 81        | 68.6       | 157       | 66.5       |
| 4. Traditional cut-off drain/Drainage systems    | 58        | 49.2       | 44        | 37.3       | 102       | 43.2       |
| 5. Terraces                                      | 30        | 25.4       | 22        | 18.6       | 52        | 22.0       |
| Soil fertilization systems                       |           |            |           |            |           |            |
| 1. Fresh farm yard manure                        | 73        | 61.9       | 87        | 73.7       | 160       | 67.8       |
| 2. Composting                                    | 82        | 69.5       | 75        | 63.6       | 157       | 66.5       |
| 3. Crop residue                                  | 48        | 40.7       | 37        | 31.4       | 85        | 36.0       |
| 4. Green Manure                                  | 8         | 6.8        | 12        | 10.2       | 20        | 8.5        |
| 5. Weed burning                                  | 4         | 3.4        | 6         | 5.0        | 10        | 3.0        |

**Figure 2.1: Indigenous soil and water conservation systems used by the farmers of Musanze and Nyabihu Districts, North-Western Rwanda (Source: Bapfakurera and Nduwamungu, 2020).**

Based on Figure 2.1 above, indigenous soil and water conservation measures are utilized in the following three themes or ways:

➤ **Biological soil and water conservation measures**

Farmers employ various indigenous biological soil and water conservation measures, including mixed cropping, intercropping, crop rotation, indigenous agroforestry, fallow, alley cropping, minimum tillage, and mulching. According to Bapfakurera and Nduwamungu (2020), mixed cropping stands out as the most widely adopted indigenous practice in Rwanda.

➤ **Mechanical soil and water conservation measures**

Surveyed farmers implement various indigenous mechanical soil and water conservation measures, such as cultivation on ridges/rows, stone bands/barriers, traditional dams/water retention ditches, traditional cut-off drains/drainage systems, and terraces. The predominant method observed is cultivation on ridges/rows, a widespread practice across the region and commonly used by farmers in the surveyed area.

➤ **Indigenous soil fertilisation systems**

Farmers employ various indigenous soil fertilisation systems, such as fresh farmyard manure, composting, crop residue incorporation, green manure, and weed burning.

According to Bapfakurera and Nduwamungu (2020), the most widely practiced indigenous soil fertilisation system is the use of fresh yard manure.

A study of “IK of soil fertility management in southwest Niger” by Osbahra and Christie (2003) suggests that farmers have extensive ecological knowledge and experiences to make complex and dynamic farm decisions. In this study, they were able to identify and divide soil types into two soil classes, hard soils (locally known as “*botogo*” and “*gangani*”) and sandy soils (*tassi*) through their IK. Furthermore, farmers were able to also identify more fertile soils which were “*botogo*” soils compared to “*gangani*”. This is an indication that local farmers use a variety of indicators to understand and explain the condition of their land fertility (Taye and Megento, 2017). At Ekiti State in Western Nigeria, they utilised the conservation of soil fertility through mulching, organic manure application, crop rotation, shifting cultivation, trash burning, and bush fallow (Kolawole, 2004). It is a fundamental indication of the extensive and in-depth knowledge that local farmers have about soil in their communities without involving scientific knowledge. However, this showed a fundamental difference between local and scientific systems in the area when soil properties were defined and described.

Osbahra and Christie (2003) recognise that IK is diverse, rooted in local and historical contexts, and shaped by social processes, attributes that are not considered in conventional scientific soil frameworks. It is important to dwell on the local knowledge as it proves that they carry in-depth local soil knowledge as rural farmers have good perceptions of soil fertility management. Osbahra and Christie (2003) concluded that there is an urgent need for more research and studies to discover, develop and maximise the benefits of IKS. Although IKS are important, there is a need to be taught and transferred effectively to the new generation. This will allow a new generation to use these IKS and possibly improve them as technology continues to grow. In the region, the indigenous farming systems and conservation practices are under increasing pressure and need to be improved. The infusion of new knowledge and skills is essential for survival. It can be effectively done in the form of training, where training programmes are developed in rural communities to increase the sharing of skills and the use of IKS. For instance, in Kenya, the training of staff and land users was an integral part of the Swedish-funded soil and water conservation programme (Hudson, 1993). Such programmes can play a fundamental role in putting the IKS into practice in most parts of the region to ensure that soil erosion is prevented locally.

### **c) Regulations of soil erosion control**

Developing countries have developed regulations to control erosion, such as banning cultivation in hilly lands, but farmers violate most of these regulations (Ananda and Herath, 2003). The purpose of these regulations was to control soil erosion but were not implemented in a community-based manner. The approach that was used was not suitable to the communities as people are familiar with their own land and the top-down approach was the main issue. It is crucial for farmers to be actively involved in the regulatory process to ensure that regulations are appropriate for their communities and to foster compliance. Farmers need to be consulted when regulations are made in order to be suitable in their communities and see the need for following these regulations. It can mean that such regulations are not suitable for particular rural communities, and they must be involved in the formulation of regulations for soil erosion control. Appropriate regulations and policies are required in most developing countries such as SSA to encourage sustainable land management to meet the demands of food production. The relationship between technological advancements, economic policies, and the environment is crucial due to the rapid depletion of soil resources in developing nations (Ananda and Herath, 2003).

Local participation in framing policies that are implemented locally is more successful than those that are implemented without the consultation of the local communities who are affected. For instance, a group discussion study by Tibasiima *et al.* (2023) conducted in Rwenzori region, Uganda, explored a hybrid approach to soil erosion control by integrating traditional and scientific strategies. Rather than solely focusing on structural measures and penalties, the approach emphasises managing soil erosion through a contextualised strategy. This includes off-field interventions like regulating construction practices and integrating traditional practices (e.g. payment of seven goats by any household that does not implement soil erosion management) such as ridge maintenance (Tibasiima *et al.*, 2023). The goal is to co-create effective erosion management strategies that blend local knowledge with modern techniques for sustainable outcomes. In a study conducted in Malawi, Pangapanga-Phiri *et al.* (2024) asserted the need for policies that support conservation agriculture adoption through financial and technical assistance. The study aimed to understand the factors contributing to the sustained adoption of conservation agricultural practices among smallholder farmers. It highlights the importance of economic incentives, knowledge dissemination, and community support in promoting the sustained adoption of conservation agriculture. Ananda and Herath (2003) identified that lower output prices might encourage subsistence farmers to increase

resource exploitation, which can increase erosion. Policies such as increasing the output prices can contribute to decreasing farmers' resource exploitation while decreasing soil erosion. Therefore, policies such as import controls and high prices can also enhance soil erosion (Ananda and Herath, 2003).

Hudson (1993) argued that the primary flaw in the early soil and water conservation policy was its assumption that legislation alone could protect the environment. This took place during the colonial period when native people were not allowed to voice their opinions about land management. Policies during that era failed as land users were aware of the existence of laws, yet they also knew that the thinly spread colonial authorities lacked the means to monitor compliance or penalise offenders (Hudson, 1993). Local farmers in the colonial period did not care whether they are policies or not, they were using their land according to their knowledge of farming and use of land. Ananda and Herath, (2003) have identified the potential of economic and institutional approaches to control soil erosion, see **Table 2.2** below. Together, these approaches aim to create a supportive economic and institutional environment that encourages sustainable practices to combat soil erosion.

**Table 2.2: Ananda and Herath (2003) identified several economic and institutional approaches to control soil erosion, each with its mechanisms for promoting sustainable land management**

| Approaches           | Explanations of the Approach                                                                                                                                                                                                                                                                                                         |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Market approaches | These strategies leverage market forces to incentivize soil conservation practices. For example, farmers might receive financial rewards for implementing erosion control measures, such as planting cover crops or adopting sustainable farming practices, which are recognized by the market.                                      |
| 2. Pigouvian taxes   | Named after economist Arthur Pigou, these taxes are levied on activities that generate negative externalities, such as soil erosion. By imposing a tax on practices that harm the environment, such as excessive pesticide use or unsustainable farming, it encourages farmers to adopt more sustainable practices to avoid the tax. |

|                                                     |                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3. Efficient water pricing                          | Setting water prices that reflect its true cost encourages efficient usage and conservation. When farmers face higher prices for water, they are more likely to adopt practices that reduce water use and associated soil erosion, such as efficient irrigation methods.                              |
| 4. Tradeable permits                                | This approach allows for the creation of a market for permits related to soil use. For instance, landowners who implement soil conservation measures may receive permits that they can sell to others who need to offset their environmental impact, thus incentivizing sustainable practices.        |
| 5. Institutional approaches to soil erosion control | These involve establishing organizations or regulatory frameworks that guide and enforce soil conservation practices. Effective institutions can provide education, technical assistance, and support for sustainable practices among land users.                                                     |
| 6. Property rights                                  | Clearly defined property rights incentivize landowners to invest in soil conservation since they can benefit from the long-term health of their land. When land tenure is secure, landowners are more likely to engage in practices that enhance soil quality and reduce erosion.                     |
| 7. Social capital                                   | This refers to the networks, norms, and trust that facilitate cooperation within communities. High levels of social capital can lead to collective action for soil conservation, as community members work together to implement and share best practices, enhancing overall land management efforts. |

Such approaches (see **Table 2.2** above) can be a solution to controlling soil erosion in rural areas if only they are implemented properly with active and dedicated citizens who know the value of soil in their lives. These potentials of economic and institutional approaches can contribute tremendously to ensuring that soil erosion is controlled in developing countries. This can ultimately help the IKS to shine and its work to be visible within the rural communities (Sithole, 2020).

#### 2.4.2 Contribution of indigenous knowledge systems to soil erosion management

Decades ago, there was less research that focused on IKS, and even fewer examples of successful IKS-based interventions (Grenier, 1998). Unlike in the past, IKS is increasingly becoming fundamental for many kinds of development activities to be successful (Warren, 1991), particularly in the recent management of natural resources. The importance of the IKS approach to soil erosion management has been disregarded while some are standard soil conservation practices that have been used continually. However, recently there has been some focus on IKS (Taye and Megento, 2017; Bapfakurera and Nduwamungu, 2020; Sithole, 2020; Chuma *et al.*, 2022; Materechera, 2022). There is still new knowledge that is being discovered and continuously added although it is still not enough. Critchley *et al.* (1992) in their focus on soil and water conservation in SSA, identified that several indigenous conservation techniques exist but they have not been studied enough or have not been studied at all. It shows that IKS has not yet received the necessary attention as a vital approach to managing soil erosion and other natural resources. Erkossa and Ayele (2003) revealed that in Ethiopia, efforts to address soil erosion have led to the development of indigenous technologies since ancient times, including "Boraatii" cut-off drains and "Bo'oo" or 'yaa'a" drainage furrows. On the other hand, Erkossa and Ayele (2003) mentioned "Joro" ridge or terracing farming, for soil conservation and nutrient management, "ciicata" crop rotation to enhance fertility and control weeds, "Kolaasaa" crop rotation to maintain soil fertility and control weeds, and their integration with crop rotation for soil fertility maintenance and weed control that are among the IKS practices.

While local knowledge is disregarded in scientific knowledge, it should be clear that these practices are the necessary basis for an effective and appropriate soil erosion approach. Soil erosion cannot be managed only through scientific knowledge, there is also a need for IKS. Barrios *et al.* (2006) conclude that many technical solutions to soil degradation exist but are not adopted because they are developed without the participation of the land user or do not build on local knowledge about soil management. Therefore, understanding the effectiveness of IKS on soil erosion management is important. It can contribute tremendously to finding different ways that local people can use to control and manage soil erosion. There should be an innovative way that ensures that there is cooperation and collaboration between scientific and local knowledge. In the innovation process, scientific knowledge can be combined with IKS to tackle soil erosion in rural areas (Nhemachena *et al.*, 2011).

Soil erosion management in SAA employs methods such as installing erosion prevention materials within revetments to curb plant rooting and minimise soil loss during floods (Park *et al.*, 2016; Zhang *et al.*, 2017). However, some studies have highlighted limitations or challenges of this approach (e.g. Kohler *et al.*, 2018; Moyo *et al.*, 2019). This failure underscores the importance of incorporating local knowledge as a solution, given that local communities are the end-users of these innovations (Ajibade, 2008). The effectiveness of erosion prevention materials within revetments in SSA is context-dependent, with supporting evidence from some studies and critical perspectives from others. For a comprehensive understanding, it is essential to consider local conditions, implementation strategies, and the specific challenges faced in each area (Park *et al.*, 2016; Zhang *et al.*, 2017). To enhance the effectiveness of modern approaches, it is crucial to engage and consult with local communities who hold valuable knowledge. Unfortunately, the contribution of IKS to soil erosion management has not been adequately explored in the existing literature. Recognising the significance of IKS is vital, as it can promote attitudes and beliefs that prioritise environmental conservation over exploitation (Ajibade, 2008).

There is a need for greater attention to IKS that can contribute to soil erosion management. For instance, Dewalt (1994) argued that there is a need for more effective and creative interactions between IKS and scientific knowledge. Therefore, the focus on soil erosion management needs to receive attention from scientists and IKS, not only based on scientific knowledge and ignoring IKS. Furthermore, IKS about soil and land is often viewed as an unfamiliar body of ancient human wisdom and perspectives concerning soil resources (Barrera-Bassols and Zinck, 2003). IKS of soil erosion needs to adequately receive attention as it can contribute to soil erosion management in local communities. According to Dewalt, (1994), there are uncertainties on using IKS to manage soil erosion. Such uncertainties are due to scientific knowledge which disregards and criticises the importance of IKS. However, this can be reduced through relevant scientific knowledge that integrates local knowledge (Dewalt, 1994).

Barrera-Bassols and Zinck (2003) state that obtaining a detailed soil knowledge of local peoples is based on the distinction between morphological (colour, texture, consistence, moisture) as well as ecological, productive, and even symbolic characteristics. This is mostly based on the knowledge that has been obtained from the past years which was based on IKS. However, that proves that there is still more that must be done in a study of local knowledge about soil erosion and that is based on ensuring that IKS research and scholars on soil erosion are increasingly studied. The marginalization of IKS by the scientific community has hindered

effective strategies for addressing soil erosion, a pervasive issue affecting many regions, including SSA. This disregard not only undermines the rich, context-specific insights that local communities possess but also perpetuates a one-dimensional approach to environmental management. Consequently, the ongoing challenges of soil erosion are exacerbated, as integrated strategies that combine scientific rigour with indigenous practices are often overlooked. By failing to recognize the value of IKS, the scientific community misses opportunities to develop more holistic and effective solutions to combat soil erosion in diverse ecological and cultural contexts (Barrios *et al.*, 2006; Ajibade, 2008; Nhemachena *et al.*, 2011).

The issue is that the focus is more based on a scientific approach while there is also a need to look closely at IKS management strategies. The scientific approach has received much attention compared to IKS, but soil erosion is still taking place. IKS regarding soil erosion management has not received adequate attention, especially in the SSA region. One major reason is the systematic neglect or underestimation of the potential of IKS particularly in soil conservation techniques, by African and expatriate researchers, soil and water conservation specialists, and government staff, with only a few exceptions (Hudson, 1993). Many IKS conservation techniques exist, but they have hardly or never been studied at all. Some have disappeared due to being disregarded and unnoticed in local communities. Therefore, the next section will closely look at the indigenous ways of controlling soil erosion and other management strategies that are used in rural SSA.

## **2.5 Future directions and recommendations**

While IKS in SSA has historically been undervalued, recent studies, including those cited in sections 2.4.2.1 and 2.4.2.2, demonstrate a growing interest in documenting, analysing, and integrating these methods into modern soil conservation and agricultural practices. This ongoing research highlights the relevance and effectiveness of indigenous techniques, challenging the earlier tendency to disregard them. However, it remains unclear whether these techniques are gradually being abandoned or actively maintained and expanded. Although some reports acknowledge the presence of indigenous techniques (Sithole, 2020; Materechera, 2022; Chuma *et al.*, 2022), limited research prevents a deeper understanding of their current use and evolution. Many indigenous methods remain understudied, highlighting a critical knowledge gap. Further research is needed to address this lack of recent and detailed information, particularly regarding the extent of IKS practices in local communities.

Additionally, a key challenge lies in farmers' lack of awareness about soil erosion, which can hinder the adoption of conservation techniques (Taye and Megento, 2017). When soil erosion is not perceived as a significant issue, farmers are less likely to implement preventive measures. Raising awareness among rural communities about the serious threat erosion poses to food security in SSA is crucial. Increased awareness can encourage proactive conservation efforts, helping farmers recognize the potential benefits of indigenous techniques in erosion prevention. Future research should prioritize both increasing awareness and assessing the viability of IKS for sustainable soil management. Additional research should prioritise creating awareness in rural communities and identifying the potential benefits and necessity of soil erosion prevention and control.

To build a deeper understanding of indigenous techniques and assess both their limitations and potential for further development, research efforts should focus on targeted, rapid studies alongside practical field trials involving local resource users. These trials would not only refine the technical efficiency of indigenous methods but also evaluate their effectiveness under various conditions. While existing studies, including those in sections 2.4.2.1 and 2.4.2.2, indicate ongoing research and documentation of some soil conservation strategies, gaps remain in assessing the broader applicability and long-term sustainability of these practices. Therefore, further research should aim to generate concrete evidence on the benefits of IKS, demonstrating their practical value to farmers and their role in sustainable soil management.

Policies also need to be considered that SSA countries have about IKS practice projects. Despite a substantial increase in the knowledge of indigenous practices due to heightened research efforts in the coming years, the practical application of this knowledge may still face significant institutional constraints. Notably, the current project design may prove inappropriate, and governments and donor agencies may tend to prioritise quick and tangible results, posing challenges to effective implementation. Having proper policies is essential and is required to ensure that people have a better understanding of what they are practicing. This will also ensure government involvement in ensuring that IKS practices are adopted at a local level and used to continue with farming while promoting sustainable land management and soil prevention. This will possibly result in high interest in farming and high production of food that will yield high income while promoting food security.

There remains a need to document IKS, as these practices are essential in addressing contemporary soil erosion challenges. Despite the challenges posed by modern technology, many farmers successfully manage soil and water using traditional indigenous practices. A holistic approach is required to study the integration of scientific and IKS for more effective soil erosion management. Researchers, experts, and policymakers should acknowledge the significance of IKS in soil and water conservation and prioritise integration over the replacement of traditional methods with new, externally imposed technologies. Combining indigenous and modern techniques can mitigate soil degradation and reduce the cost of maintaining soil protection structures. Collaboration between indigenous and modern techniques may be necessary to enhance technical efficiency in addressing degradation and increasing returns to labour, leading to higher incomes. Local indigenous techniques, initially developed in a specific socio-economic context, have been significantly influenced by labour migration and market forces, altering the prevailing circumstances. Most farmers prefer a blend of both modern and indigenous measures, seeing it as the most suitable solution for erosion control and soil fertility improvement (Bapfakurera and Nduwamungu, 2020).

Promoting indigenous soil and water conservation systems is crucial. Agricultural extension officers should receive training on integrating modern and IK in farming practices. IKS for soil and water conservation deserve recognition and appreciation from policy makers, experts, researchers, and development agents when introducing modern conservation technologies. Modern approaches should enhance and complement indigenous soil and water conservation practices rather than replace them (Bapfakurera and Nduwamungu, 2020). Research efforts should prioritise the integration of indigenous and modern knowledge to strengthen soil conservation. Rural communities are eager to embrace new ideas for agricultural development. Collaboration with local farmers is essential for improving identified economically and environmentally beneficial indigenous practices (Kolawole, 2004).

## **2.6 Conclusions**

In conclusion, this paper systematically reviewed existing literature on the role of local IKS and community involvement in managing soil erosion in SSA. The primary objectives were to provide a comprehensive overview of the current state of local IKS in rural SSA communities concerning soil erosion management and to identify gaps in the literature for future research.

The review focused on two main objectives: firstly, to understand the nature and impacts of soil erosion in rural areas, and secondly, to identify and assess existing soil erosion management strategies. The findings revealed that various IKS practices, such as stone walls, terracing, mulching, organic manure, crop rotation, shifting cultivation, trash burning, and bush fallow, are employed by local communities in SSA. However, a notable limitation was the reliance on studies conducted over 25 to 30 years ago, raising concerns about the currency and relevance of these practices in contemporary SSA. Furthermore, the recent literature, although limited, failed to provide concrete evidence of the current implementation and success of IKS practices in local communities. The effectiveness of these practices in addressing soil erosion, contributing to local incomes, and enhancing food security remained inadequately demonstrated. Community-related factors closely associated with the utilisation of IKS practices included cultural patterns, the presence of agriculture-oriented individuals, the absence of factional disputes, communication patterns, decision-making processes, and people's attitudes. In essence, while IKS is recognised as crucial to local farmers, the inadequacy of research hinders a thorough understanding of the utility of these practices in addressing the persistent issue of soil erosion in SSA. Considering these findings, there is a clear need for updated and robust research that evaluates the current status, effectiveness, and socio-economic impact of IKS practices in SSA's rural communities. This will not only contribute to addressing soil erosion challenges but also provide valuable insights into the sustainability and practicality of these IKS practices in contemporary agricultural landscapes.

## CHAPTER 3

### **THE LEGACY EFFECTS OF THE BANTU AUTHORITIES ACT (NO. 68) OF 1951 ON THE ABANDONED AGRICULTURAL LAND IN EASTERN CAPE PROVINCE: IMPLICATIONS ON FOOD SECURITY AND SUSTAINABLE LAND MANAGEMENT.**

This chapter is based on:

**Shinga, T.V., Nkomo, S.L., and Khoza G.M.** (In preparation). “The Legacy Effects of the Bantu Authorities Act (No. 68) of 1951 on the Abandoned Agricultural Land in Eastern Cape Province: Implications on Food Security and Sustainable Land Management”. *Land*.

### 3.1 Abstract

Abandoned agricultural lands are increasingly becoming a contemporary environmental issue, not only in South Africa but throughout the world. Studies show that agricultural land abandonment is mainly driven by land policies, socioeconomic, ecological, edaphic and environmental factors. In South Africa, land policies are the main drivers of agricultural land abandonment. For instance, the Bantu Authorities Act (No. 68) of 1951 (BAA) was introduced in the country by the apartheid regime as the policy to continue the segregation or separation of black people from their land and development. Since then, the legacy of this Act continues to threaten the food security, and livelihoods of rural farmers and ultimately results in land degradation. Hence, this study investigates the effects of this Act on abandoned agricultural lands at Alfred Nzo District Municipality using semi-structured interviews in order to find the perceptions of rural community farmers on the effects that this Act has caused in their communities. There were 16 selected abandoned croplands within the 28 villages and 320 semi-structure interviews (SSI) were conducted for this study. The results revealed the ongoing issue of abandoned croplands that is taking place in these selected villages before and after the introduction of the BAA. Most of them have been utilised as grazing lands by the community. According to farmers perspectives, it was evident that farming activities were more prevalent before the introduction of BAA. Results from the main farmer's perception and their views were that the BAA disadvantaged them through facilitating (intentionally or unintentionally) conditions allowing for (1) infrastructure and property vandalism, (2) pushing black farmers away from farming and (3) ring-fenced black rural villages into institutional poverty. These perceptions of the farmers were based on the historical and recent factors that have led to agricultural land abandonment in their villages. The insights gained from experienced rural farmers indicate that their knowledge is not only crucial for individual farmers but also has the potential to influence and improve their farming decisions and practices.

**Key Words:** Abandonment, Bantu Authorities Act, agricultural lands, legacy effect, policy.

### 3.2 Introduction

Agricultural land abandonment is a multifaceted process characterised by intricate economic, political, environmental, and social dimensions (Prishchepov *et al.*, 2012; Renwick *et al.*, 2013; Paudel *et al.*, 2014; Blair *et al.*, 2018; Prishchepov *et al.*, 2021; Moyo and Ravhuhali, 2022). Local actors, such as landowners, organisations and government officials, primarily make all land-use decisions. However, their actions are influenced and constrained by broader-scale factors, including institutions such as national policies and governance, as well as global market dynamics (Renwick *et al.*, 2013). A study carried out by the Institute for European Environmental Policy (IEEP) under World Wide Fund for Nature (WWF) in Netherlands with the aim of assessing the likelihood of large-scale agricultural abandonment in the European Union (EU), reports that data on past abandonment are relatively sparse and mostly out-of-date (Keenleyside and Tucker, 2010). The study illustrated that the drivers of abandonment are changing over time, and the results of land use modelling studies are difficult to interpret and vary according to their socio-economic and policy assumptions (Keenleyside and Tucker, 2010). Specifically, it warns of the possibility of widespread abandonment of farmland across the EU, which could have negative impacts on both the environment and society (Keenleyside and Tucker, 2010; Renwick *et al.*, 2013).

Prishchepov *et al.* (2012) conducted a study focusing on Eastern Europe, where they explored the relationship between institutional settings and land cover/use patterns. They found higher abandonment rates in countries where land use regulatory institutions underwent changes and took time to establish. Specifically, the study revealed that countries experiencing changes in land use regulatory institutions tended to exhibit higher rates of land abandonment. Moreover, the establishment of new regulatory mechanisms often required considerable time, further exacerbating the phenomenon. The study has demonstrated that post-Soviet institutional changes in Eastern Europe after the collapse of the Soviet Union triggered widespread agricultural land abandonment during the first decade of transition (Prishchepov *et al.*, 2012). Another study by Renwick *et al.* (2013) that focused on how changes in agricultural and trade policies affect land use in the EU, showed that when policies change, there is a significant increase in land abandonment. They have criticised the EU policies that seem to worsen the trend of land being left unused across the EU. By shedding light on these dynamics, these studies highlighted the importance of institutional stability and coherence in shaping land utilisation patterns (Keenleyside and Tucker, 2010; Prishchepov *et al.*, 2012; Renwick *et al.*,

2013). This implies that changes in regulatory institutions can disrupt established patterns of land use and contribute to higher rates of land abandonment, as stakeholders may struggle to adapt to new rules or face uncertainty about future policies. Based on the above studies results, their conclusions showed that there will be significant abandonment in Europe over the next few decades (Keenleyside and Tucker, 2010; Prishchepov *et al.*, 2012; Renwick *et al.*, 2013). Hence, this can cause a significant impact on the people's livelihoods and primarily affect semi-natural habitats managed by extensive farming systems.

Paudel *et al.* (2014) conducted a study in Nepal, focusing on the drivers of agricultural land abandonment. Their study provided three key drivers of agricultural abandonment: first, sociopolitical instability, which forced people to move out; second, reduced agricultural production, concomitant with the availability of more attractive alternative opportunities; third, farming ceasing to be a viable occupation for many farmers to maintain the sustainable household economy and being seen as an occupation for those who cannot do much else. Socioeconomic and political influence plays a crucial in causing agricultural land abandonment in Nepal. Ahmed, (2021) argued in a study of Biofuel feedstock plantations closure and land abandonment in Ghana, that social, economic and environmental outcomes of post-closure make it a critical phase of biofuel projects' lifecycle. Therefore, these results show that agricultural land abandonment has serious social, economic and environmental implications, particularly for the poorest of the poor.

Most of the abandoned agricultural lands are as the results of policy implications in most countries as highlighted above in Europe and sub-Saharan Africa. Consequently, abandoned agricultural lands affect food security and causes discouragement of farming amongst local farmers. However, a perspective study from Eastern Europe by Rey Benayas *et al.* (2007), asserts that abandonment of agricultural land may be beneficiary to humans through passive revegetation and active reforestation, water regulation, soil recovery, nutrient cycling and increased biodiversity and wilderness. They argue that when agricultural land is abandoned, it can lead to natural regeneration and reforestation, which in turn can provide various ecosystem services such as water regulation, soil recovery, nutrient cycling, and increased biodiversity and wilderness. Arguably, it is evidence that once people have abandoned their land, no one will be responsible for monitoring the land continuously which leads to the loss of valuable soil (Borrelli *et al.*, 2017; Sartori *et al.*, 2019; Xionga *et al.*, 2019; Hancock *et al.*, 2020; Moyo and Ravhuhali, 2022). Hence, previous policies have significantly influenced the prevalence of

land abandonment globally. This study primarily assesses the impact of historical policy decisions on the phenomenon of land abandonment.

Studies argue that agricultural land abandonment is occurring across the world and is mainly driven by socioeconomic, ecological, edaphic, land policies and environmental factors (Kakembo and Rowntree, 2003; Keenleyside and Tucker, 2010; Prishchepov *et al.*, 2012; Renwick *et al.*, 2013; Paudel *et al.*, 2014; Blair *et al.*, 2018; Prishchepov *et al.*, 2021; Moyo and Ravhuhali, 2022). Goga *et al.* (2019) defined abandoned agricultural lands as land that is void of any activities associated with agricultural production until this land becomes overgrown by non-agricultural vegetation. Abandoned agricultural lands are areas where farming activities have ceased to occur. The estimated global agricultural land abandonment is approximately 0.55 million km<sup>2</sup>, (ca. 88% and ca. 12%) of cropland recolonised by forest and semi-natural vegetation, respectively (Borrelli *et al.*, 2017). Most rural communities across the world are faced with serious land abandonment challenges where land is not used for several consecutive years (Yin *et al.*, 2018; Yin *et al.*, 2020; Li and Song, 2021, Meijninger *et al.*, 2022). The increasing migration, rural depopulation, and an influx of people around the world moving to urban areas significantly contribute to land abandonment in rural areas (Benayas *et al.*, 2007; Li and Song, 2021). Hence, the increasing abandonment of agricultural lands appears to be the most common contemporary environmental issue threatening food security (Blair *et al.*, 2018; Dimopoulos *et al.*, 2023), the livelihoods of smallholder farmers (Blair *et al.*, 2018), and economic development (Moyo and Ravhuhali, 2022).

The growing international population, particularly in developing countries, is associated with the emergence of socioeconomic systems that can require a higher caloric return per unit of land and the capacity to distribute large quantities of food (Milner and Boldsen, 2023). Li and Song (2021) in Chongqing, China, examined a wide range of factors contributing to land abandonment, namely, expansion of built-up areas, agricultural subsidies, lack of labour and ageing, reform of the political system, geomorphological types, climatic characteristics, unfavourable farming conditions, and climate change. These are crucial factors that can result in land abandonment in most parts of the world. Agricultural activities play a fundamental role in ensuring rural economic development and are the main development drivers in rural areas, bringing social progress by increasing productivity, employment, and income (Meijerink and Roza, 2007).

Cropland abandonment is a common environmental issue that has persisted in recent years (Low *et al.*, 2015; Moyo and Ravhuhali, 2022). Ultimately, cropland abandonment seems to be the main dynamic issue taking place, whether naturally or socially (Li and Song, 2021). Yin *et al.*, (2020) asserted that cropland abandonment is a common type of land-use change across the globe and can be caused by a range of social, economic, and environmental factors. Kakembo and Rowntree (2003) observed that the complex interaction of social, economic, and environmental factors has led to land abandonment and consequent soil erosion. That is felt most severely in rural areas, resulting in environmental and socio-economic impacts. The noticeable cropland abandonment in rural areas has a direct impact on farmers' livelihoods and food security (Blair *et al.*, 2018; Paudel *et al.*, 2020). This is mostly visible in developing countries as their agricultural sectors typically generate little income (Yin *et al.*, 2020). Unfavourable natural conditions, including unsustainable land management, soil erosion, poor soil quality, climate change effects, and steep terrain, are the primary factors leading to reduced profitability in the agricultural sector (Li and Song, 2021). Borrelli *et al.* (2017) state that the main causes of severe soil erosion are human activities and related land use changes, particularly in developing countries.

Globally, soil erosion is a major environmental issue and occurs in various forms (Pimentel and Burgess, 2013; Borrelli *et al.*, 2017; Sartori *et al.*, 2019; Xionga *et al.*, 2019). Soil erosion is widely regarded as a major threat to agricultural production due to the loss/depletion of (soil nutrients and carbon cycling), land productivity, and sustainable agriculture (Borrelli *et al.*, 2017; Sartori *et al.*, 2019; Xionga *et al.*, 2019; Hancock *et al.*, 2020). The agricultural lands are no longer used like in the past decades in most rural communities due to poor conditions as nutrients are depleted in the soil. Sartori *et al.*, (2019) estimated that global food production has decreased by approximately 33.7 million tonnes (of which 22.5 million tonnes are crops) due to severe soil erosion. The loss of vegetative soil cover is especially widespread in developing countries where populations are large and growing, and agricultural practices are often inadequate to protect topsoil (Pimentel and Burgess, 2013). Soil erosion is a problem for global food production. Therefore, there is a need for rural revitalisation and rehabilitation particularly in developing countries in order to positively transform rural areas to sustainably conserve their land.

There are few studies that have looked at the impacts of policies in relation to agricultural land abandonment in South Africa (SA) (Blair *et al.*, 2018; Moyo and Ravhuhali, 2022). Blair *et al.*

(2018) has looked at the cropland abandonment in a SA smallholder communal land. Moyo and Ravhuhali, (2022) has focused on the abandoned croplands in relation to the drivers and secondary succession trajectories under livestock grazing in communal areas of SA. However, there are few studies that has looked at the policy implications on agricultural land abandonment in the province of the Eastern Cape (EC), SA. Therefore, this study sought to focus on the effect of the policy of the Bantu Authorities Act of 1951 (BAA) on agricultural land abandonment in EC as the province is one of the notables with good agricultural land. From the results provided in the above studies (Keenleyside and Tucker, 2010; Prishchepov *et al.*, 2012; Renwick *et al.*, 2013; Paudel *et al.*, 2014; Blair *et al.*, 2018; Prishchepov *et al.*, 2021; Moyo and Ravhuhali, 2022), it is evident that land abandonment is a dynamic process driven by many factors. Land abandonment results in complex and dynamic changes in agricultural management and land use; such that abandonment can be gradual, and sometimes temporary (Keenleyside and Tucker, 2010). Many of the contributory causes of land abandonment are locally specific and some may be temporary. The choice of different time spans and different regions for study can be expected to give very different results (Keenleyside and Tucker, 2010; Prishchepov *et al.*, 2012). The results might have differed from one region to another. Therefore, the findings in the SA context might provide either different or similar results from other countries.

From 1910s and 1950s, black SA citizens experienced land dispossession and segregation (Hebinck *et al.*, 2011; Hamann and Tuinder, 2012; Kelly, 2015). In SA, the term "black people" refers to the largest and predominant ethno-racial group within the country, representing a significant (81.4%) population (Statistics South Africa, 2023). The segregation of black people was perpetuated by the Natives Land Act No. 27 of 1913 (NLA) of segregationist and racist legislation by the apartheid regime. During the early 1913 period, black people were forcefully removed from their land and were prohibited from buying or renting land in areas designated for "white people" (Andrew *et al.*, 2013; Hall, 2014; Beinart and Delius, 2014). Black people faced restrictions on land ownership and were primarily viewed as labourers for the minority (7,3%) population (Statistics South Africa, 2023). The BAA was introduced in the country by the racial segregation under the all-white government of the South African apartheid regime as the policy to continue the segregation or separation of black people from their land and development (South African History Online (SAHO), 2011; Hebinck *et al.*, 2011; Hamann and Tuinder, 2012; Kelly, 2015). The BAA laid the foundation for ethnic government in South African homelands, leading to the creation of Bantustans and the implementation of policies

that segregated education and citizenship for Black South Africans, lasting until its repeal in 2010 (SAHO, 2011; Hebinck *et al.*, 2011). The racial segregation directly affected black people's landownership and resulted in agricultural land abandonment in most former Apartheid homelands established by the apartheid government (Blair *et al.*, 2018; Moyo and Ravhuhali, 2022). Abandoned agricultural lands are, thus, increasingly becoming a contemporary environmental issue, in SA, and throughout the world. According to Daniels (1987), of the 122 million hectares of land in SA, approximately 81.2% are occupied by Whites in White areas and 3.6% by legal Blacks who have no legal right to landownership in these areas. Minorities are still controlling most of the agricultural lands, and of the best quality, which is a pattern that is still prevalent today (Andrew *et al.*, 2013).

Since the end of apartheid in 1994, South Africa has pursued land reform through restitution, redistribution, and tenure reform to address historical injustices and promote equitable land ownership (Lahiff, 2007). However, progress has been slow and uneven, with many land reform projects struggling to achieve sustainable economic development (Walker, 2005). In the Eastern Cape, particularly within the ANDM, land use and ownership have experienced notable changes. In the Eastern Cape, land ownership remains highly dualistic, with privately owned commercial farms and communal lands managed under traditional leadership structures (Cousins, 2016). As of 2024, South Africa's land reform efforts continue, but progress remains slow due to bureaucratic inefficiencies, land claims backlogs, and policy uncertainty (Hall, 2023). The government has introduced new land redistribution initiatives, but their effectiveness in addressing inequality in the EC is still debated (Hall, 2023). While policy changes and land reform programs have influenced land ownership in the EC and ANDM since 1994, many challenges persist, including land tenure insecurity, poverty, and inefficient land use. Future reforms need to focus on improving tenure security, supporting smallholder farmers, and addressing governance conflicts between traditional and municipal authorities.

In the mid-1920s, SA saw a shift where white SAs began to accept that creating national parks was not just morally right but also financially viable (Carruthers, 2007). They embraced the idea that observing and studying game animals was a legitimate use of land, prompting the state to allocate land for this purpose. The questions persist about the future for those displaced from areas now used for biodiversity conservation and eco-tourism. Land reform and restitution programs implemented to return land to black people have been criticised for their slow progress. Rötter *et al.* (2024) argue that while these initiatives transferred agricultural land from

white to black occupants, the new beneficiaries lack the necessary skills and resources previously provided by the former administration to sustain agriculture among marginal producers. Today, the country is still trying to address the legacies of colonialism and apartheid through an assertive agenda focused on transformation and redressing historical injustices created by the National Parks Act, Act No. 56 of 1926 (NPA) (Carruthers, 2007), which came before the introduction of BAA.

Previous research on cropland abandonment in SA has identified that such phenomena hiked between the years 1970 and 1990 (Blair *et al.*, 2018; Moyo and Ravhuhali, 2022). Such an increase was attributed to the introduced government policies that separated people from their land, which resulted in most crop fields being far away from their homesteads. Subsequently, many farmers were discouraged from working, having to walk long distances to their crop fields to plough and attend to their crops. The EC province seems to be greatly affected by the BAA in terms of unequal land ownership (Lahiff, 2005; Hamann and Tuinder, 2012; Blair *et al.*, 2018; Moyo and Ravhuhali, 2022). This has resulted in agricultural land abandonment that caused soil erosion in most parts of the province, especially at ANDM (Lahiff, 2005; Hamann and Tuinder, 2012; Moyo and Ravhuhali, 2022). Furthermore, apartheid regime policies (BAA) have also played a crucial role in causing agricultural land abandonment in the province. Today, the province's rural communities are experiencing severe soil erosion in their agricultural lands. Multiple studies provide consistent evidence that the EC exhibits the highest soil erosion rates among SA's other provinces (Manjoro and Kakembo, 2012; Le Roux and Smith, 2014; Parwada and Van Tol, 2016; Phinzi *et al.*, 2021; Moyo and Ravhuhali, 2022). Mandiringana *et al.* (2005) found that this caused the low fertility status of cultivated soils in most communal areas where subsistence agriculture is practiced within the EC. Hamann and Tuinder (2012) comment that the apartheid regime forced people in the EC to live on sparse land, resulting in the overutilisation of resources, and subsequent land degradation. These areas have an inadequate supply of nutrient inputs due to soil erosion of the vulnerable topsoil (Blair *et al.*, 2018).

A case study in the upper and lower areas of Didimana, EC province, revealed that approximately 75% of farmers annually lose around 21% of their crops, with 55% of these losses attributed to soil erosion (Ighodaro *et al.*, 2016). The abandonment of agricultural land contributes to changes in land use and land cover (LULC), observed by Kakembo and Rowntree (2003), was most notable between 1965 and 1988. During this period, significant LULC changes occurred in communal lands, coinciding with a substantial increase in soil

erosion in the EC. In the ANDM, between 95% and 99% of the agricultural output comes from commercial farming and little comes from smallholder farmers whose practices are deeply rooted in former homeland subsistence farming practices (ANDM IDP 2017-2022). However, the district has the smallest commercial agricultural sector. The land where agricultural activities were taking place is no longer used as crop fields, remaining abandoned and unvegetated (Kakembo and Rowntree, 2003). Thus, the abandonment of agricultural lands poses a greater threat to environmental and socio-economic activities (Prishchepov *et al.*, 2012). On the contrary, it appears that the BAA may be the cause of cropland abandonment.

Due to the high level of abandonment of agricultural land in the EC, this study sought to collect information that will fill the knowledge gap about this phenomenon that has appeared to be contributing to the increased soil erosion rate within the ANDM upon the introduction of the BAA. This study aims to investigate the effects of the BAA on abandoned agricultural lands and soil erosion at ANDM using SSI in order to find the perceptions of rural community farmers on the effects that this Act has caused in their communities. The objectives of the study were to: Objectives were to firstly (1) identify the abandoned agricultural lands and soil erosion in rural areas of the ANDM through field observations and Google Earth imagery. Secondly (2) find the perceptions of rural community farmers about the effect of the BAA and abandoned agricultural lands in rural areas of the ANDM through SSI and thirdly (3) evaluate how the BAA has contributed to the abandoned agricultural lands and soil erosion in selected rural villages of ANDM. The study suggests the potential need for effective agricultural development planning to enhance the quality of life and economic prosperity of rural farmers in the district. In the future, this study hopes to serve as a valuable resource for addressing agricultural land abandonment and soil erosion concerns, offering insights and techniques for historical context on land abandonment.

### **3.3 Historical background of the Eastern Cape province**

The EC is a SA province that came into existence in 1994 after the apartheid government separated people into homelands (Lahiff, 2005; Hamann and Tuinder, 2012). The province incorporated areas from the former Xhosa homelands of the Transkei and Ciskei, together to be part of the EC province. The region was divided by the apartheid regime into zones of 'white' occupation and the so-called 'African homelands' of Transkei (in 1951) and Ciskei (in 1961) by the twentieth-century policies of segregation (Hamann and Tuinder, 2012; Lissoni

and Ally, 2018; Garutsa and Nekhwevha, 2018). These events took place under the apartheid government that introduced the BAA where they reestablished tribal organisations for Black Africans and forcefully removed them from their homelands (Hebinck *et al.*, 2011). This was one of the pieces of cruel legislation introduced in SA to support the apartheid government's policy of separating black people from their homeland (Lahiff, 2005). The other notable racial discrimination Act was the so-called NLA, where black people were restricted to 7.5% of the land while minorities were given 92.5% (Hamann and Tuinder, 2012; Andrew *et al.*, 2013). The rightful owners of the land were forcefully removed and dispossessed from their land and other property, and severe curtailment of social, economic, and political rights. Andrew *et al.*, (2013) state that this began during the mid-17th century when the first Europeans arrived with the Dutch East India Company (VOC) at the Cape of Good Hope.

Historically, the livelihoods of the people from the EC were based on agriculture combined with gathering and hunting (Shackleton and Luckert, 2015). People were practicing cultivated grains and crop farming such as vegetables in small fields and gardens to sustain their living. They relied on their surrounding environment and the loss of land increasingly strained the traditional ways of their lives which forced them to adopt new lifestyles to survive (Hebinck and Averbek, 2007). Consequently, the native people were landless and without livestock to sustain their lives. These communities were forced to work in mines and other organisations. This has led to neglecting farming and white people predominantly owning most land that belonged to the black people. Tribal authorities were set up and positions were given to Chiefs and headmen who became responsible for the allocation of land, the welfare and pension system, and development (Lahiff, 2005; Hebinck *et al.*, 2011; Kelly, 2015). However, traditional leaders who were not cooperating with the policies of the BAA were faced with harsh penalties like being removed from their Chief position and deposed.

Traditional Leadership of the African population was often seen to have been to some extent representative of the apartheid government. For instance, Hamann and Tuinder (2012) reported that the first Chief Minister of the Transkei in 1963, Mr. Kaiser Matanzima supported the idea of apartheid's concept of separate development and became the Prime Minister in 1976 when the Transkei was granted independence. They continued to state that Mr. Kaiser Matanzima was mainly supported by most of the majority government-appointed chiefs and ruled as a puppet state dictator. However, the Transkei region was the scene of various attempts to establish segregated districts before the period of apartheid. During 1978 and 1980, Mr. Kaiser Matanzima broke diplomatic ties with the apartheid government over a land dispute and

threatened to end the ‘non-aggression pact’. Mr. Kaiser Matanzima wanted to also rule a united territory of Ciskei. That is when in 1985, apartheid practitioners conceived a plan to merge the Transkei and Ciskei to create a united nation of Xhosa speakers’ who they thought would support the SA government and help it to eradicate unrest in the EC. However, the plan, which included having Ciskei's president, Mr. Lennox Sebe, assassinated, failed after it was leaked to General Mr. Bantu Holomisa (SAHO, 2011; Hamann and Tuinder, 2012). That is when Matanzima began to lose support by the mid-1980s and resigned in 1986 (SAHO, 2011). Thereafter, Mr. Bantu Holomisa staged a bloodless coup in January 1988, becoming Head of State where all the anti-apartheid parties that had been suppressed by Mr. Kaiser Matanzima were unbanned and entered a (sometimes uneasy) alliance with the African National Congress (ANC) (Hamann and Tuinder, 2012). This resulted in Tribal Authorities being challenged and land administration in the former Bantustans began to collapse in rural areas in the 1980s and 1990s.

The BAA policies were viewed as brutal and a crime against humanity as black people were racially discriminated against in their land. Lahiff (2005) states that the BAA resulted in overcrowding, out-migration of labour, lack of economic development or investment, and chronic poverty of the black people. This has resulted in enormous pressure on the natural resource base and an inability of most disadvantaged black people to obtain a livelihood from the soil. Kelly (2015) asserted that after the introduction of the BAA, the land that was suitable for cultivation was no longer utilised as the people were divided into residential, arable, and grazing areas. Consequently, due to the discriminatory provisions of the BAA, black people were restricted from relocating from their land, resulting in only a limited number of families having access to economic resources for farming. That was mainly caused by the forceful removal of people from their homelands. Furthermore, that has led to the highly exploitative incorporation of black people's labour into the white-controlled economy that is brought by this Act with its policies. Black people were left without land after the 1951 SA colonisation and apartheid regime that introduced the BAA (Lissoni and Ally, 2018). The BAA promised to grant black people greater administrative authority in an illusion of decentralisation and false autonomy (Kelly, 2015). This played a crucial role in terms of land ownership which is still a contemporary issue even after the Country's democratic era (Hall, 2004). Today the democratic government throughout the country has not yet done enough work to implement policies that will help people gain their land back and ultimately revitalise their livelihoods.

Due to black people having little land in the EC and spatial dualities and inequalities, which have led to many environmental issues caused by the BAA. Black people were forced to live on smaller land which led to the overutilisation of resources and therefore resulted in land degradation and soil erosion (Pimentel and Burgess, 2013; Zhao and Hou, 2019). This is mostly visible in the region of what was known as Transkei since there were no municipalities during the former Bantustans. Today, most parts of the EC are suffering from land abandonment which contributes significantly to soil erosion evidently through severe gullying (Parwada and Van Tol, 2016). Since most of the abandoned land is cropland, food security in the province is subsequently compromised.

### 3.3.1 Bantu Authorities Act No. 68 of 1951

Under the apartheid in SA, BAA was established as mentioned in the above section 3.3. The Act Commenced on 17 July 1951 and provided for the establishment of black homelands and regional authorities and, to create greater self-government in the homelands, abolished the Native Representative Council. Section 2 of the Act focused on the “establishment of tribal, regional and territorial authorities”. It “was an attempt to restructure the government of the reserves on more traditional lines, but in practice came to mean the establishment of a system of indirect rule through the medium of subservient and sometimes well-rewarded chiefs, chosen for their preparedness to enforce government policy at the expense of their popularity” (Davenport, 1987: 383).

The Bantu Authorities Act No. 68 of 1951 explained the ‘Black area’ and ‘tribal authority’ according to the following:

“**Black area**” means any area consisting of land referred to in subsection (1) of section twenty-one of the Development Trust and Land Act, 1936 (Act No. 18 of 1936), or any scheduled Black area as defined in that Act; (Definition of “Black area” inserted by s. 9 of Act 46/1959);

“**Tribal authority**” means a Black tribal authority established under subparagraph (i) of paragraph (a) of section 2(1) and a community authority established under subparagraph (ii) of the said paragraph. (Definition of “tribal authority” substituted by s. 77 of Act 42/1964 and s. 39 of Act 21/1971).

The Zulu words for **Bantu Authorities** are ‘*ukuphathwa*’ (to be administered) ‘*kwemingcele*’ (boundaries). The system of BAA throughout the reserve areas was directly experienced by

ordinary people through its ‘betterment’ schemes, involving tighter distinctions between lands designated for farming or grazing, closer settlement of homesteads, increased fencing of land, dipping fees and culling of cattle, increased levels of taxation, a grid of local bye-laws and regulations, and forced removals to achieve these objectives” (Ehrenreich-Risner, 2018). The BAA set up a hierarchical structure of authority in each reserve, which corresponded to different ethnic groups. Removals from rural areas stem from the elimination of squatting and labour tenancies on white farms, as well as the eradication of Black Spots, areas of black-owned or mission land surrounded by white-owned land. These removals trace their origins back to the 1913 and 1936 Lands Acts (Alan Baldwin, 1975).

### **3.4 Methodology**

#### **3.4.1 Study area**

ANDM is situated in the north-eastern with a portion bordering the coast in the southern part of the EC province in SA. The geographic coordinates of ANDM are 30°54’83’’ South and 28°8’59.7’’East. The district is part of the impoverished former Transkei apartheid homeland that had been established under the NLA (Conservation South Africa, 2015). It is one of the poorest and most underdeveloped districts in SA (Department of Cooperative Governance and Traditional Affairs (COGTA), 2020). Although the district is currently divided into villages administered by tribal authorities under state control, before democracy in 1994, it was dominated by the apartheid government which introduced the BAA as a form of segregation and forcibly removing black Africans from their homelands (Hebinck *et al.*, 2011; Hamann and Tuinder, 2012; Lissoni and Ally, 2018). The district is mainly rural and dominated by village settlements with low levels of economic development and largely depends on agriculture, remittance, state grants and tourism (particularly in the coastal part of the district) to generate income (ANDM IDP, 2017-2022). The population sizes of the district, according to Statistics South Africa (2016), since 1996, 2011, and 2016 were 749 585, 801 344, and 867 864, respectively. It is estimated that the population will increase to 909 000 in 2023 (COGTA, 2020). The 2022 Census data indicate a total population of 936,462 in the ANDM, with 225,562 people in Matatiele, 214,477 in Umzimvubu, 350,000 in Winnie Madikizela Mandela, and 146,423 in Ntabankulu. As shown in Figure 3.1, the district is divided into four local municipalities (LM), namely, Matatiele, Umzimvubu, Ntabankulu, and Mbizana which is now known as Winnie Madikizela Mandela LM.

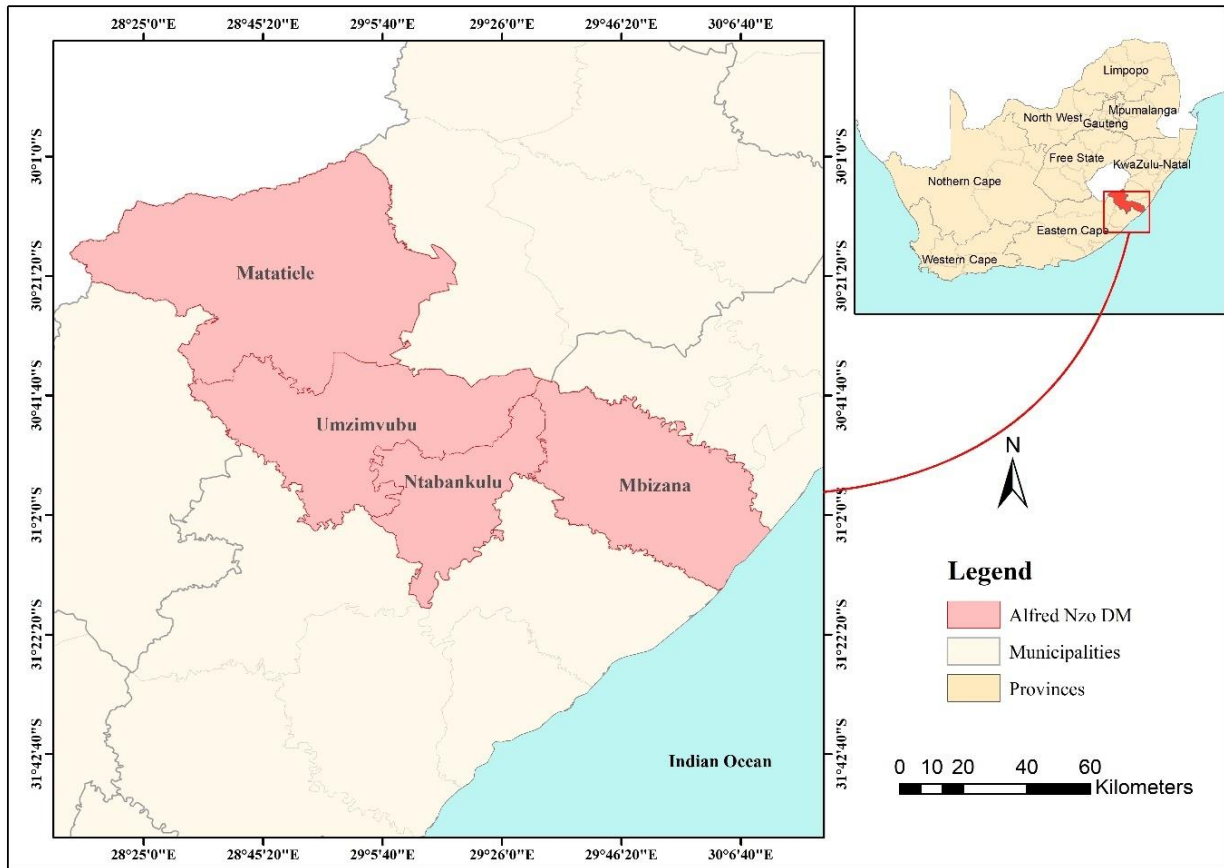


**Figure 3.1: Map showing the study area of Alfred Nzo District Municipality (ANDM) with its four local municipalities.**

The landform of the ANDM is characterised by steep slopes and high elevations and is generally rugged. The district has a very mountainous terrain ranging from 1377m on the coast to 3463m inland with an average elevation of 1193m (<https://en-au.topographic-map.com/>). It experiences moderate summer temperatures ranging from 18-24°C, and rainfall that primarily occurs between October and March with an average of 500mm to 1500mm. Winter can be dry and very cold with temperatures averaging between 7-10°C and sometimes dropping below 0°C in July resulting in snow (Conservation South Africa, 2015; Phinzi *et al.*, 2021). The vegetation is mostly grassy, dwarf shrubland, with weakly developed soils. Overgrazing by sheep and goats easily leads to soil erosion and the dominance of shrubs. There is a high-water runoff in most parts of the district area because of poor vegetation cover (Parwada and Van Tol, 2016). This has led to an increase in soil erodibility. The study area is mainly characterised by red-yellow apedal freely drained soils and cave sandstones that are susceptible to soil erosion and land degradation (ANDM IDP, 2017-2022).

### 3.4.2 Materials and methods

#### 3.4.2.1 Identification of farmers

In this study, a total of 320 small-scale rural farmers (crop and livestock) were selected as participants. The study was conducted in four local municipalities (Mbizana, Ntabankulu, Umzimvubu, and Matatiele) at ANDM and several villages within these local municipalities were investigated. The farmers were selected from a number of communities (also referred to as villages in this study) across 4 local municipalities in the ANDM. Table 3.1 below shows the village names, and the number of participants selected in the respective communities. A purposive sampling method was used to identify and select participants who were experienced rural farmers, with a deep-rooted background in farming and agriculture, in their respective villages. The targeted farmers were people with historical knowledge of farming practices in their communities. Hence, the study purposively selected farmers (both male and female) who are above 50 years of age and have been actively involved in crop and/or livestock farming for more than 30 years. Selecting experienced farmers was crucial because they would have historical knowledge of the issues that caused land abandonment and soil erosion. In this study, the selected communities were chosen because they have severe soil erosion and land abandonment. The targeted communities were identified using Google Earth Pro (and physical ground truthing) in order to identify previously cultivated crop fields and grazing areas which are currently abandoned fields or have been severely eroded.

**Table 3.1: Selected Villages at ANDM**

| <b>Local Municipalities</b> | <b>Villages Names</b>                 | <b>Total</b> |
|-----------------------------|---------------------------------------|--------------|
| <b>Matatiele LM</b>         | Moyeni                                | 20           |
|                             | Hebron                                | 20           |
|                             | Lupindo, Bethesda                     | 20           |
|                             | Khoapa - Mahangu - Dengwane           | 20           |
|                             |                                       | <b>80</b>    |
| <b>Umzumvubu LM</b>         | Mpendle - Nkanini - Mabubazi - Cabazi | 20           |
|                             | Mvalweni, Panaukuku, Mrolweni         | 20           |
|                             | Mndeni, KwaHala                       | 20           |
|                             | Esingeni                              | 20           |
|                             |                                       | <b>80</b>    |
| <b>Ntabankulu LM</b>        | Nyabeni Village                       | 20           |
|                             | Sipetu and Annesville                 | 20           |
|                             | Maqoyini                              | 20           |
|                             | Tabankulu Village                     | 20           |
|                             |                                       | <b>80</b>    |

| <b>Local Municipalities</b>                       | <b>Villages Names</b>  | <b>Total</b> |
|---------------------------------------------------|------------------------|--------------|
| <b>Winnie Madikizela Mandela<br/>(Mbizana) LM</b> | Bonda                  | 20           |
|                                                   | Ludeke                 | 20           |
|                                                   | Zizityaneni and Majazi | 20           |
|                                                   | Mdikiso and Mbobeni    | 20           |
|                                                   | <b>Total</b>           | <b>80</b>    |
|                                                   |                        | <b>320</b>   |

#### 3.4.2.2 Sampling method

The snowball method was used to purposely select experienced rural farmers for all the communities. The researcher was assisted by members of the communities to select the best people who fit the research criteria. The purposive sampling technique (also called judgment sampling) is the deliberate choice of a participant due to the qualities the participant possesses (Etikan *et al.*, 2016; Sharma, 2017). This technique has allowed the researcher to decide what needs to be known (land abandonment and soil erosion) and set out to find people (local farmers) who can and are willing to provide the information through knowledge or experience. Therefore, this was done through the identification and selection of individuals (320 farmers) who were proficient and well-informed about a phenomenon of interest which was mainly abandoned agricultural lands and soil erosion (Etikan *et al.*, 2016). The capabilities of using this technique are that it can provide researchers with the justification to make generalisations from the sample that is being studied. Such generalisations are either theoretical, analytic or logical in nature. However, purposive samples, irrespective of the type of purposive sampling used, can be highly prone to researcher bias (Sharma, 2017). This means it can be biased. Therefore, the study made sure that participants were selected without any bias (targeted farmers who were recommended by the community members) even though the study targeted old farmers. The main criteria used to select the farmers were determined using their age (50+), their knowledge of the history of the area (including the impact of BAA policies) and their involvement in farming (crop/livestock) for more than 30 years. In all the communities, the selected farmers were visited either at their homes or in their communal gardens.

#### 3.4.2.3 Qualitative data collection

The study was based on qualitative data where semi-structured interviews (SSI) were used to collect information from participants. Pope *et al.* (2000) state that qualitative research produces large amounts of textual data in the form of transcripts and observational fields (mainly for

ground-truthing). Hence, SSI and field observation were undertaken during the data collection as part of the qualitative data collection. SSIs are exploratory through the use of analytical categories to describe and explain social phenomena in an often-open-ended manner allowing for flexibility (Dearnley, 2005; Adams, 2015). SSIs are relevant in the study, as they will allow the researcher and stakeholders to critically engage in dialogue about their perceptions of agricultural land abandonment that is taking place in their villages. The analytical categories and instruments for an SSI, designed and carried out in the spirit of qualitative research, are developed in response to the demands of the material collected (Dearnley, 2005). SSI allow the participants to openly share their thoughts, feelings, and experiences regarding agricultural land abandonment. The field observation was used to verify that the participants were saying things that corresponded with the reality or situation in the district.

Field observations were adopted as one of the data collection methods and seeing was utilised as the basis of observations (ground-truthing). This method emerged as the foundation and backbone of scientific research and is known as the action or process of closely observing or monitoring something or someone (Marvasti, 2014). This method in scientific research can unveil hidden phenomena and make them visible. It has played a role in the study by observing the abandoned agricultural lands and soil erosion in different rural areas of ANDM. Field observations were employed to identify agricultural lands within rural areas of ANDM that have been abandoned and experienced soil erosion. Some agricultural lands that were used previously for farming were left fallow or overgrazed which led to severe soil erosion. Kakembo and Rowntree, (2003) note that the changes in land use and soil erosion distribution were identified between 1938 and 1988 by analysing sequential aerial photographs of the ridge between the Great Fish and Keiskamma rivers near Peddie town, EC. They further stated that abandonments started between 1965 and 1988 in communal lands and have since become worse within the district as depicted in the provided (Photos and Google Earth Images) below, these selected villages are among the most severely affected.

The study collected SSI from participants aged 50 and above, residing in villages where they have had extensive farming experience. Specifically, the study interviewed individuals with more than 30 years of farming experience within ANDM, in EC. SSI consist of features of both structured and unstructured interviews. During the interviews, participants were visited in their homes or practicing farming where interviews were conducted using their language of preference that they understand (given a choice to do it in English, *IsiXhosa*, and *IsiZulu*). However, most participants were speaking *IsiXhosa* since EC is dominated by the Xhosa

people. SSI allowed the interviewees the freedom to express and explain their knowledge by providing their thoughts in areas of particular interest or expertise (Horton *et al.*, 2004). The duration of SSI lasted between 20 to 30 minutes with each farmer/participant. Since the majority of farming in the ANDM is traditional subsistence farming, the selected participants were small-scale farmers. During the interviews of the participants, all SSI were audio recorded and transcribed using verbatim.

#### **3.4.2.4 Secondary data**

The secondary data was collected through a variety of search strategies for this study. The utilisation of Google Scholar was the primary search strategy that led to the discovery of additional academic websites and subsequent journals. Secondary data is information that has already been collected by someone else, and which is available for you, the researcher, to use (Clark, 2013). Gathering secondary data was essential in this study to integrate and complement the existing literature with the primary data. Thus, Google Scholar was the main instrument that was used to obtain secondary data about the subject study. Secondary data included journal articles (reviews of academics), literature, and academic books. Government websites were visited to gather recent Integrated Development Plans (IDPs) for ANDM and together with IDPs from the four local municipalities located within the district. The study incorporated Google Earth imagery, newspaper articles, case studies, and maps. Additionally, historical aerial imagery was obtained from SA's National Geo-Spatial Information (NGI), a part of the Department of Agriculture, Land Reform and Rural Development (DALRRD). Over 100 years ago, NGI initiated an integrated survey system and extensive mapping and aerial imagery coverage for the country, making it the national mapping organisation of SA. These Google Earth imageries were analysed using GIS which is a technology or tool that allows users to capture, store, analyse, and visualise spatial data and information related to geographic locations. From a number of detailed case studies of land abandonment in different regions that have been carried out, it has been revealed that it is difficult to obtain an accurate picture of land abandonment, even at a small scale, using the best available data (e.g., Keenleyside and Tucker, 2010; Prishchepov *et al.*, 2012; Renwick *et al.*, 2013; Paudel *et al.*, 2014; Blair *et al.*, 2018; Prishchepov *et al.*, 2021; Moyo and Ravhuhali, 2022).

### **3.4.3 Thematic analysis**

Data analysis in qualitative research is a creative process. As the instrument of data analysis, the study explores and reflects on the meaning of the data. Results were analysed thematically using NVivo version 12 for the collected SSI. Thematic analysis is an appropriate method of analysis in this study as it involves seeking to understand experiences, thoughts, or behaviours across the collected data (Kiger and Varpio, 2020). The collected data was transcribed and uploaded into NVivo software for analysis. The transcriptions of participants' interviews were grouped according to their relevant themes or categories. Themes can evoke a particular way of thinking about the data and allow readers to recall what has been presented and its relation to their practice (Lochmiller, 2021). From a qualitative aspect, SSI was analysed qualitatively which involved transcribing, categorising, and identifying themes that were established from the responses provided by the participants. Qualitative data collected through SSI were recorded, transcribed, and sorted to identify initial and common trending themes.

The study generated themes using NVivo which is a software package designed to aid the analyses of qualitative data. Thus, the themes enabled the categorisation and organisation of data using NVivo software, for further sorting and identification of common themes around the perceptions of participants from SSI. Since the study was aimed at finding the perceptions of the farmers, NVivo has played a vital role in generating and building themes from the conducted SSI. SSI was aimed at finding the perceptions of experienced farmers about the BAA regarding agricultural land abandonment in the ANDM. NVivo was useful in searching for the most used or common words, terms, and phrases from the participant's interviews and putting them according to themes. Therefore, NVivo contributed to identifying themes and patterns in the data to generate meaningful insights.

## **3.5 Results and discussion**

Figure 3.2 shows an aerial photo taken in Matatiele LM between Manguzela and Kwahlomendlwini villages in 1978, illustrating the extensive farming activity at that time. Figure 3.3, a recent Google Earth image from 2023, depicts the same area. Comparing these images clearly shows changes in the croplands; in 1978, there were many active croplands, while by 2023, they have drastically decreased, with the majority abandoned.



**Figure 3.2: Aerial photograph of Matatiele LM between Manguzela and Kwahlomendlwini villages in 1978**

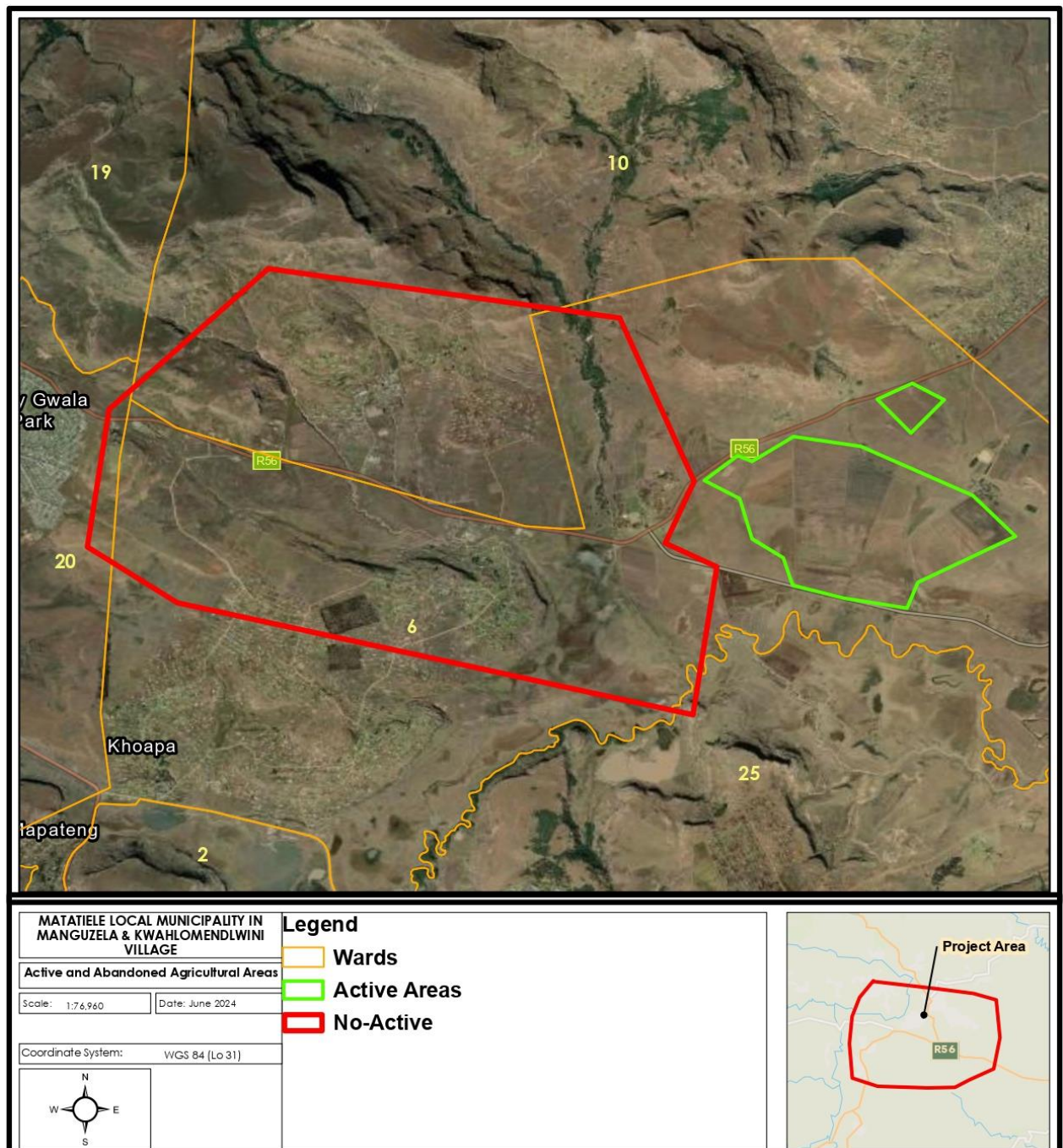


**Figure 3.3: A recent Google Earth image showing the same area in Matatiele LM between Manguzela and Kwahlomendlwini in 2023 is shown in Figure 3.2.**

### **3.5.1 Rural farmers' perception of agricultural land abandonment in the EC.**

The SSI were about 20-30 minutes which were recorded with the permission of the participants. The SSIs were conducted with experienced rural farmers. During the interview, it was clear that most farmers had an in-depth understanding of the historical background of agricultural land abandonment and the severe soil erosion taking place in their villages. In all the villages, the selected farmers had strong knowledge of the BAA and other Acts (NLA and Development Trust and Land Act, 1936) that were introduced during the colonial period in SA. According to most farmers, these Acts remain relevant to their lives because they left a negative legacy on their communities. Most farmers stated that farming was their main livelihood, and the introduction of the BAA further denied them a right to a sustainable lifestyle, ultimately resulting in massive agricultural land abandonment in the EC province. Farmers indicated that before the colonial period, most of their villages had sustainable agricultural systems that were managed by local people. The main argument raised was that the BAA ensured that they were dispossessed of opportunities and natural assets, which made their living conditions difficult and impossible to manage. Many farmers believed that if the BAA had not been introduced, there would have been minimal land abandonment and soil erosion in the EC province. Farmers argued that the introduction of BAA limited their access to fertile croplands and grazing areas. This ultimately resulted in few agricultural opportunities and caused an increase in mismanagement (mainly due to poor farming conditions rather than practices) of land (Blair *et al.*, 2018; Moyo and Ravhuhali, 2022). This has led to implications for food security (Blair *et al.*, 2018; Paudel *et al.*, 2020; Dimopoulos *et al.*, 2023) and sustainable land management (Borrelli *et al.*, 2017; Sartori *et al.*, 2019; Xionga *et al.*, 2019; Hancock *et al.*, 2020) within the rural communities of ANDM.

#### **3.5.1.1 Farmers perceptions on the impact of the BAA on their agricultural rights and livelihoods.**

The main perceptions of the respondents about agricultural land abandonment about the BAA were based on the former Chief Minister of the Transkei in 1963, Mr. Kaiser Matanzima. Selected farmers mentioned that during his time, people were removed (losing land rights) from their original lands where they used to conduct farming. In the past, until around the late 18th century, the livelihoods of the Xhosa people from the EC were based mainly on agriculture, such as the planting of maize, vegetables, sorghum, and other crops (Hebinck and Averbek,

2007). Most farmers explained that they were separated from their land where they practiced farming and some of their livestock were taken from them during Mr Matanzima's governance. Some expressed that they were moved into lands (such as in mountainous and erosion-prone areas) that were not suitable for farming. Such action left them under-resourced and disempowered which has made it hard to continue with their farming and management of their resources. This is in line with the expression of Hamann and Tuinder (2012) who reported that Mr. Matanzima supported the idea of Apartheid's concept of separate development and became the Prime Minister in 1976 when the Transkei was granted independence.

*“During the apartheid, we were separated from our land where we used to practice farming as black people by the white people, and they took all our livestock. This is why you see all these (pointing around) abandoned agricultural lands in our village” (72-Year Old Male farmer, 2023).*

Another farmer explains:

*“The Transkei was mainly ruled by Mr. Kaiser Matanzima where we saw a lot of fencing taking place in our lands where we were removed from, where we used to practice farming. Matanzima with the white government contributed to the abandonment of all these agricultural lands that you see here in our village, that is why you see all these agricultural lands (pointing at abandoned agricultural lands) abandoned today. The fencing of agricultural lands was helping us with the fencing of crops and livestock lands, which is not what we see today, the agricultural lands are as you see here (referring to the village), they are no longer fenced. During the time (before BAA influence) when we had our own land, before we were removed, we were able to look after our livestock and had our own fencing to prevent overgrazing. In the past (before and during Mr. Matanzima's time) people were gathering together as a team to go and fill the eroded agricultural lands with soil and stones but today that does not take place which is why the soil erosion has also increased” (78-Year Old Male farmer, 2023).*

Another farmer explains:

*“During the times of Mr. Matanzima, people were still actively farming and they continued to farm even in degradation-prone areas. However, the communal spirit for land management became eroded during Mr Matanzima's governance. For example,*

*our people began to participate in less communal conservation initiatives. Our village had a programme where once or twice a year the community members will gather to rehabilitate eroded croplands, but this has all vanished” (76-Year Old Female farmer, 2023).*

Hence, many farmers blame the negative impact of the BAA policy on the dispossession of land rights and farming opportunities for black farmers. Perceptions of farmers were also rooted in acknowledging injustices caused by the NLA on black communities and this has fundamentally contributed to agricultural land abandonment. Agricultural lands in SA were (and remain) privately owned as a result of settler colonialism and the apartheid regime which engineered and enforced a rigid division between private land held by whites and ‘communal’ reserves or Bantustans for black people (Andrew *et al.*, 2013).

Colonisation limited African people's land ownership to 7% and later 13% through the NLA of SA (Hamann and Tuinder, 2012; Andrew *et al.*, 2013). Farmers expressed that colonisation contributed even further by restricting them as black people from buying or occupying land. Such action has forced most people including farmers to forcefully leave all their farming lands that belonged to them where they used it for farming purposes. During these times there was a huge mass relocation of black people to poor homelands and poorly planned and serviced townships. This was mainly expressed by many farmers who explained that the land where they were relocated to had poor agricultural potential. All the land where they used to farm which was fertile was taken from them by the apartheid government. The apartheid government took their land and controlled most of the black people’s agricultural land, and of the best quality, a pattern that is still prevalent today.

*“We have been relocated to very poor land, this land is not that fertile, but we have no choice but to continue farming because we have to sustain our living and feed our families...Our land was taken from us by the white people (Cough loudly) they took all our land...” (77-Year Old Male farmer, 2023).*

Farmers explained further that colonisation caused people to migrate to urban areas and leave behind their families and homelands to look for opportunities. They were no longer able to practice farming as their lands were taken from them, which left them landless with no croplands to farm, relying mainly on unsuitable lands for crop farming. According to most farmers, livestock was forcefully taken from them, but the remaining livestock still contributed to severe soil erosion. Farmers argued that the BAA policy reduced not only access to arable

lands but also limited grazing areas, consequently resulting in overgrazing and increased soil erosion. Farmers expressed that during those times their livelihoods were threatened as the land that was sustaining their livelihoods including their grandparents for thousands of years became fruitless. Most farmers mentioned that many people became discouraged from continuing with farming as they were not happy with the land that they were relocated to (many referring to their current villages) by the apartheid government.

Farmers explained that their livelihoods were threatened by hunger and poverty as they were not productive in farming. Their livelihoods and connection to the land were jeopardised severely because they were not able to sustain their lives in the ways they used to in the past (Hebinck and Averbek, 2007). Their right to food security was taken from them which further resulted in implications of land abandonment. Therefore, they were forced to migrate to urban areas as it was their only livelihood option they had, which was to go and find employment (Lahiff, 2005; Benayas *et al.*, 2007; Li and Song, 2021). Hence, this resulted in the majority of the farmers being drawn into a tightly controlled system of labour migration between the Transkei and Ciskei Bantustans and enterprises requiring their labour. Their removal from their agricultural lands meant they lost access to land for grazing and cultivation (Andrew *et al.*, 2013). This has been expressed by several studies (Keenleyside and Tucker, 2010; Renwick *et al.*, 2013) that the widespread abandonment of farmland has the potential to cause negative impacts on both the environment and society.

*“Colonisation made us move from our villages and go to urban areas to look for jobs...this was something we were not used to as we grew up with our grandparents and parents practicing farming” (81-Year Old Female farmer, 2023).*

Another farmer explains:

*“The first problem is, that colonisation has caused people not to see the value of farming whereby they were made to believe they must go and work in urban areas. They will leave their places and go to town to look for a job leading to the land not being used” (79-Year Old Male farmer, 2023).*

According to most farmers, this marked the beginning of socio-economic challenges that the EC province is facing today such as land abandonment, landlessness, poverty, and inequality. Some farmers indicated that the BAA was an addition to an already existing system of colonial dispossession of black people's resources and rights. These farmers argued that when the BAA

was introduced, the colonial system had already stripped-off indigenous black people of their rights to access natural resources (complaining about the model that the coloniser used to introduce NLA and NPA in SA). The introduction of NLA has impacted indigenous people's rights to access their resources (Carruthers, 2007). Carruthers (2007) indicates that the NPA introduced in 1926 aimed to make these areas financially viable for the apartheid regime. This has limited black people their right to access the resources that that was sustaining their livelihoods. The introduction of the BAA contributed to unsustainable farming practices because people had limited space for animal grazing and crop production. Majoring of the farmers interviewed indicated that before the BAA, they were practicing a sustainable method of crop and animal rotation but had to resort to a monoculture agricultural system in order to continue their livelihood. This according to farmers, contributed massively to soil nutrient depletion, land degradation, increase in soil erosion and ultimately land abandonment.

The farmers' perceptions are in line with those of Blair *et al.*, (2018) who maintain that between the 1950s and 2010s, there was a widespread increase of cropland abandonment in former SA 'homelands' which include Transkei. In that same period, Kakembo and Rowntrees (2003) also revealed that from 1965 onwards there was a drastic increase in the severe forms of erosion (evident through intense gullying of the catchments) resulting in deformation of the landscape, more particularly in previously cultivated crop fields. According to most farmers, the BAA introduced the poverty legacy that the EC province is currently experiencing because black people were limited in the space to freely practice sustainable agriculture, leading to the overutilisation of resources that caused soil erosion today (Hamann and Tuinder, 2012). As supported by Li and Song (2021) research findings, unfavourable conditions reduce crop yields and increase the cost of farming in poor communities.

Before the introduction of these apartheid-era laws and policies (Davenport, 1987; Carruthers, 2007; Andrew *et al.*, 2013; Hall, 2014; Beinart and Delius, 2014), rural farmers in the EC practiced sustainable farming. They mainly used fallowing and shifting cultivation to maintain soil fertility and crop yields. Livestock management systems included rotational grazing lands, using fenced grazing areas (means separated agricultural lands for croplands and livestock farming) known as “*izinkambi*” to prevent overgrazing (Shackleton and Luckert, 2015). They were also people who were looking after livestock (herdsmen) that were males, locally known as “*abelusi*” which means herdsman or shepherd. These herdsmen were guiding livestock into grazing lands and were connected to the natural resources of their villages. These practices ensured food security and sustained livelihoods. However, these methods became impractical

after their lands were forcibly taken by colonisers, who also took away their livestock and relocated them to mountainous and erosion-prone areas (Kelly, 2015; Lissoni and Ally, 2018). This displacement discouraged and disempowered farmers from continuing their sustainable lifestyle (Hebinck and Averbek, 2007). As a result, they were forced into areas unsuitable for farming, leading to mismanagement of resources. This shift contributed to unsustainable agricultural practices, soil erosion, and implications for food security. Therefore, agricultural land abandonment in rural areas (Blair *et al.*, 2018; Moyo and Ravhuhali, 2022) of ANDM is rooted in the legacy of the BAA and other apartheid-era laws and policies such as (NLA, NPA etc.).

### **3.5.1.2 Farmer's perceptions of the major disadvantages that the BAA brought to their farming practices and land management systems.**

During the SSI, all the farmers touched on key disadvantages that they felt were caused by the BAA on their farming practices and management systems which led to perpetuating land abandonment in their villages. In summary of their views, farmers expressed that the BAA disadvantaged them through facilitating (intentionally or unintentionally) conditions allowing for (1) infrastructure and property vandalism, (2) pushing black farmers away from farming and (3) ring-fenced black rural villages into institutional poverty.

#### **a) Infrastructure and property vandalism**

##### ***The issue of fencing agricultural lands***

One of the main factors raised by farmers in most of the villages was the issue of fencing in croplands and grazing lands. Many farmers explained that in the past, croplands and grazing lands were separated and fenced in their villages. They used the term “*izinkambi*” meaning fenced grazing areas, to refer to these separated agricultural lands for both croplands and livestock farming. This separation is mainly linked to the era of Mr. Matanzima, who supported the idea of separate development (Hamann and Tuinder, 2012). Farmers emphasised that in the past, agricultural lands were properly fenced, unlike in recent years. This change was facilitated by the introduction of the BAA, which resulted in black people being separated from their lands after the introduction of this Act.

*“The biggest challenge is fencing, people in the village does not have fencing equipments. Fencing that we used to have in the past was all taken by community*

*members that are within the village... they destroyed the fence we had in those farms which is why they are now abandoned” (63-Year Old Female farmer, 2023).*

Farmers believe that fencing helped them practice farming more easily, as they did not have to worry about livestock damaging their croplands. However, recently the land has been left unfenced, and livestock can potentially destroy their crops, discouraging them from continuing to farm. They assert that many people in the community are now less diligent about looking after their livestock compared to past years when they were herdsman who were looking after livestock. This negligence has led to livestock being left unattended, often resulting in the destruction of croplands in their villages. Farmers argue that this situation has caused significant disadvantages to their farming practices, which they believe were intentionally disrupted by the BAA to interfere with their traditional farming and land management systems (Pimentel and Burgess, 2013; Zhao and Hou, 2019). They emphasise that the fencing, which separated croplands from grazing lands, was an essential system for managing both crops and livestock. According to the farmers, this system restricted livestock from reaching croplands by confining them to designated grazing areas. The fencing not only facilitated the separation of land but also prevented overgrazing, which often leads to soil erosion—a serious contemporary environmental issue in these villages.

Farmers pointed out that the lack of fencing is one of the reasons for abandoned lands experiencing high levels of soil erosion. Without fencing, farming is no longer practiced effectively. They revealed that after being forcefully removed from their original lands, local people took the fencing materials to secure their homes and kraals. This has negatively impacted crop farming, leading to its decline in their villages. Farmers asserted that with proper fencing, there would be fewer abandoned lands, as more people would be actively farming. Additionally, fencing helped control grazing lands for livestock such as sheep, goats, and cattle, preventing overgrazing and the subsequent destruction of croplands. In the past, fencing minimised overgrazing, thereby reducing soil erosion. However, due to the introduction of the BAA, people are now left with limited land for both grazing and croplands (SAHO, 2011; Hebinck *et al.*, 2011; Hamann and Tuinder, 2012; Kelly, 2015). Rural farmers in the ANDM area emphasised that the theft or removal of fencing has left their croplands unprotected, contributing to agricultural land abandonment (Blair *et al.*, 2018; Moyo and Ravhuhali, 2022).

### ***Lack of equipment/ unavailability of farming equipment***

Many farmers expressed that the lack of equipment, especially in recent years, is a major reason for abandoning their agricultural lands. Although not the primary issue, the unavailability of proper equipment has discouraged many farmers in their villages. The absence of ploughing equipment is a significant problem, as noted by *Blair et al.* (2018) as one of the main factors contributing to land abandonment in rural areas. Farmers explained that the introduction of machinery, such as tractors, has made farming more expensive. In the past, farmers stated that they used bulls “*inkabi*” (known as mature male cattle) or donkeys for ploughing, which was more affordable. They asserted that the introduction of machinery coincided with the BAA era, which indirectly changed their farming systems and made them reliant on machinery. Farmers further emphasised that they were not using machines in the past and instead relied on cattle and donkeys. Farmers believed that there was also a strong sense of community, with villagers helping each other with ploughing. This cooperation and active farming were integral to their livelihoods as they assisted them with proper food security.

Farmers mentioned that abandoning the use of bulls (*inkabi*) has made field ploughing for farming practices too expensive. In the past, cattle and donkeys were commonly used for ploughing as noted by the farmers. However, recently these methods have declined with the widespread adoption of tractors, which many farmers cannot afford. The farmers further asserted that the shift to machinery, introduced during apartheid-era laws and policies, has made it difficult to access the necessary equipment at the right time in the production process. Many now hire tractors or contractors rather than buying their own equipment, as purchasing and maintaining a tractor is costly.

*“At the time cattle (inkabi) were used for farming and not tractors. People did not see the value of livestock and as I am talking to you right now, I do not see anyone farming with cattle anymore, they only use tractors whereby tractors need people with money. Therefore, people end up not farming because they cannot afford tractors” (67-Year Old Male farmer, 2023).*

A tractor can make land preparation operations faster and easier. It is also effective in both dry and wet soil conditions and has better traction, which is why most farmers worldwide use it. However, in rural areas like the ANDM villages, accessing a tractor on time is challenging, and many farmers cannot afford it. Additionally, tractors cannot prepare land in mountainous areas that farmers were moved into, unlike bulls (*inkabi*), which can plough steep and rugged

terrain. The introduction of tractors, coinciding with apartheid-era policies (Hall, 2004; Kelly, 2015; Lissoni and Ally, 2018), has disadvantaged farmers who were relocated to mountainous areas. As a result, agricultural lands in these areas have been abandoned, as the system of the use of cattle and donkeys has declined or is no longer used. Tractors are only suitable for flat areas, leaving many villages at a disadvantage due to their relocation to unsuitable, hilly terrain. BAA policies moved farmers from flat areas ideal for crop and livestock farming to lands unsuitable for agricultural farming (Keenleyside and Tucker, 2010; Prishchepov *et al.*, 2012; Renwick *et al.*, 2013).

*“The decrease in planting as I said before there is not enough money for planting, in the earlier days’ cattle were used for farming and planting. But now things have changed as trackers were introduced which require money for hiring, money that we do not have. The introduction of trackers had a large influence on farming. The land is huge, but we do not have the power to do anything with it, even us who do crop farming, the lack of resources and not receiving any help with equipments for working. The equipment that we do not have are the trailer, planter and box barrier which are important equipment if we want to plant in November for example. You find out that we will want to plant in November but end up farming in December because of not having the proper types of equipment like a tractor, planter or spray” (75-Year Old Male farmer, 2023).*

Ploughing is an essential step in agriculture, done before sowing seeds to loosen and turn the soil for easier and smoother planting. A plough has been the most required agricultural equipment since the beginning of agriculture. However, unequal access to resources, climate constraints, lack of infrastructure, inadequate technologies, competitive markets, low remuneration, and other factors are damaging the stability and prosperity of farmers in developing countries like SA. Farmers have highlighted issues with the operating costs of equipment such as tractors, planters, sprayers, energy, spare parts, and servicing, which add additional burdens for small-scale farmers. Unlike in the past, they now rely on machinery that is difficult to maintain due to limited financial resources. These infrastructure challenges were not present before the introduction of the BAA (Ehrenreich-Risner, 2018). After the BAA was introduced, the use of heavy machinery became prevalent, resulting in major disadvantages for ANDM farmers (Lahiff, 2005; Hebinck *et al.*, 2011; Kelly, 2015). The BAA disrupted and completely changed their farming practices and land management systems which ultimately

resulted in land abandonment (Paudel *et al.*, 2014; Blair *et al.*, 2018; Moyo and Ravhuhali, 2022).

### ***Climate change: Irrigation systems and access to water***

Farmers also highlighted the issue of accessing water for irrigation. They mentioned that irrigation has become a huge problem due to changing climate and reduced rainfall in recent years. Rainfall is now much scarcer compared to past years. Additionally, farmers are now restricted from using the rivers and dams they previously relied on, as they are required to apply for a Water Use License Application (WULA). Farmers complained this process is unfamiliar and costly for them. These new restrictions, which did not exist in the past, unintentionally hinder agricultural practices and discourage farmers from continuing their farming practices. Farmers expressed concerns about the current conditions and the future impact of these restrictions on their traditional farming practices, passed down from their elders (Keenleyside and Tucker, 2010; Renwick *et al.*, 2013).

*“It is the infrastructure that becomes a problem...the government should intervene in the infrastructure not that they must give people cash, but they should provide them with infrastructure equipment. As I am talking to you, I pull water from that river (pointing to the river) because of the red tape such as having a water license, things that are difficult to have. But you asked for help, and they will ask you if you have a water use license, you tell them no which is leading to not receiving assistance. These are the red tapes that need to be removed. You end up paying a lot of money which leads to you just quitting the whole thing of farming. For example, in the next 50 years, what will land look like if it is like this now?” (54-Year Old Male farmer, 2023).*

Farmers have noted that the farming seasons have changed significantly in recent years compared to the past. These changes in yearly seasons have had a serious impact on farming, as the timing of farming activities has shifted drastically. Unpredictable weather conditions pose a significant problem; after planting their crops, farmers sometimes experience little or no rain and extreme heat (drought), which kills their crops. Recently, some farmers have started farming in December due to the summer heat, but by the time they need to harvest, the winter season arrives early in April. This early winter affects their crops and reduces their harvest. As a result, farmers note that often find themselves unable to yield any crops due to climate change. They emphasised that their crop yields are insufficient, wasting their time and money since

they have nothing to sell. They mentioned that changing climate leads to a lack of access to water for irrigation, with reduced rainfall and frequent droughts discouraging farming. This lack of access to water is a serious issue in many villages (Hancock *et al.*, 2020; Moyo and Ravhuhali, 2022). This is also in line with the results of Blair *et al.*, (2018) who found that many Transkei respondents blamed the decline in crop farming on a lack of access to water. This was also the case in the ANDM villages, where many farmers raised the issue of water access, contributing to land abandonment (Renwick *et al.*, 2013; Paudel *et al.*, 2014; Blair *et al.*, 2018; Prishchepov *et al.*, 2021).

*“Another thing is climate change because now we are unable to plant sorghum because the rain keeps changing, but some of the time it rains well. We still farm beans, but white maize becomes a problem because of quickly having insects therefore the red one is much better even though it takes time to harvest. The white maize has that problem of having insects meaning you must have pesticides that will kill the insects that eat maize. The other thing that becomes a problem in harvesting is sweet potatoes which is caused by climate change because even maize we used to plant around August but now we plant it around December due to climate change. Climate change has been a large effect on farming” (42-Year Old Female farmer, 2023).*

Climate change, which affects rainfall variability and access to water, emerged as a significant theme when experienced farmers explained their perceptions and reasons for cropland abandonment. A study by Blair *et al.* (2018) mentioned that up to 80% of farmers in Transkei, EC, attributed the death of their cattle (i.e., loss of draught power for ploughing) as a reason for ceasing crop farming. This might have also unintentionally contributed to land abandonment in ANDM-selected villages, which were part of the Transkei villages studied. Farmers have blamed the requirements of WULA, both variable rainfall and the lack of access to irrigated water, for agricultural abandonment (Blair *et al.*, 2018; Hancock *et al.*, 2020; Moyo and Ravhuhali, 2022). Their primary concern is experiencing poor yields after investing significant time, energy, and resources. This issue has been happening more frequently than expected or desired, unlike in the past. As a result, some farmers are forced to decrease their livestock size or sell them to avoid further losses, which disadvantages them. These changes directly affect their food security and livelihoods (Mandiringana *et al.*, 2005; Yin *et al.*, 2020).

### ***Expensive cattle medicines and fertiliser for agriculture nutrient management***

Farmers have noted that the high cost of cattle medicine and fertilisers for agricultural nutrient management has unintentionally contributed to land abandonment. Those who also have livestock emphasised that cattle medicines are very expensive. In the past, most people practiced both crop and livestock farming. Farmers stressed that treating livestock diseases is less effective and economical than prevention, leading to significant livestock losses. These losses have also disadvantaged crop farming, as they no longer have access to cattle manure (*umquba*) to use as fertiliser. In the past, farmers relied on cattle manure to enrich the soil for crop farming, but this practice has declined and is no longer used in many villages.

*“In the earlier days, we used cattle and fertiliser for farming but now most people cannot get the fertiliser and it is so expensive when you want to buy them” (60-Year Old Male farmer, 2023).*

Many farmers mentioned several practices they used in the past, noting that people who raised livestock and poultry historically used manure as fertiliser, soil amendment, energy source, and even construction material. They believed these practices made their croplands more fertile, which is not the case in recent years. Farmers believe that their current croplands are not as fertile as in the past, even though they consider the land they were forcefully moved to still fertile. Farmers are noting a disadvantage that was unintentionally caused by their removal from their original agricultural lands where they were sustainably practicing farming with ease. They stressed that these changes have disadvantaged them, as they now produce lower yields compared to the past when they had their own methods of fertilising their croplands.

Farmers are well aware that cattle manure is necessary and contains many useful, recyclable components, including nutrients, organic matter, solids, energy, and fiber. Besides cattle manure, farmers used a variety of organic fertilisers, such as poultry manure, domestic sewage (sludge), green manure, and composted agricultural wastes. However, they primarily relied on cattle manure. This reliance has resulted in farmers having to buy fertilisers in recent years, which is expensive since they did not need to purchase fertilisers in the past. Additionally, some farmers mentioned that pesticides and chemical compounds used to kill pests, including insects, rodents, fungi, and unwanted plants (weeds), are also expensive and decrease their yields (Borrelli *et al.*, 2017; Xiong *et al.*, 2019; Hancock *et al.*, 2020; Moyo and Ravhuhali, 2022). As a result, farming has decreased, croplands are no longer as fertile as before, and land

abandonment has increased as farmers become discouraged (Blair *et al.*, 2018; Paudel *et al.*, 2020).

#### **b) Contribution to a massive decline in black farmers**

##### ***Lack of youth interest and ageing of farmers***

Farmers' perceptions of land abandonment also include the lack of youth involvement in agriculture. Unlike in the past, farmers noted that agriculture no longer plays as significant a role as it did historically. They mentioned that today's education is seen as more important, unlike in the past when they did not attend school like the current generation. Farmers explained that farming today is more of a gamble, with very little income, which does not attract the youth. In the past, farming was the main economic activity and way of life, sustaining livelihoods. Today, the youth believe education is the key to sustaining their livelihoods. Some farmers believe the youth do not see the value of farming and consider it too labour-intensive. They mentioned that colonisation has instilled the belief that education is more important than farming and that farming is for unskilled or uneducated people. This has been facilitated by the main aim of the BAA, which was to discourage farming, forcing people to migrate to urban areas for jobs, as their land, which sustained their livelihoods, was forcibly taken (Lahiff, 2005; Hebinck *et al.*, 2011; Kelly, 2015). Many farmers believe that apartheid-era laws and policies have a major contributed to a massive decline in black farmers as they misled and brainwashed the youth, resulting into a massive decline of black farmers interests in farming (Andrew *et al.*, 2013; Hall, 2014; Beinart and Delius, 2014). They noted that while a few youths farm to earn some income, it is sometimes not something they are passionate about. However, old farmers still see farming as essential and full of potential.

*“We don’t have the youth because the youth cannot work where there is no money unlike us, we are able to work that is why we don’t have the youth” (63-Year Old Female farmer, 2023).*

*“The challenge I can say is the assistance and also motivation but the biggest threat that I have is that the youth is not interested in farming as they don’t receive the right motivation” (66-Year Old Male farmer, 2023).*

The literature (Blair *et al.*, 2018; Paudel *et al.*, 2020; Hancock *et al.*, 2020; Moyo and Ravhuhali, 2022) predicted that this peak in cropland abandonment took place between the 1970s and 1990s which explains the few amounts of youth that are into farming in recent years.

Therefore, farmers' perceptions from the selected villages were similar to the findings of Blair *et al.*, (2018) who attributed that agricultural decline was a result of a lack of interest in farming amongst the youth which was frequently conveyed with the phrase, "lazy youth". Farmers emphasised that this is a worrying issue as they are now getting old and no longer able to physically manage the fields themselves due to ageing. Old farmers have run out of the ability to practice farming which results in the loss of cropland ploughing and land abandonment. Many participants who were mainly conducting farming in the villages were old people and very few youths. Even the ANDM has mentioned in their IDP (2017-2022) that there is a lack of youth that are practicing farming within the district. This is a result of youth not being interested and some migrating to urban areas for education and to look for better opportunities. Farmers mentioned that the youth do not like to stay in rural areas as they believe that this limits their ability to be successful. They believed they must migrate to urban areas and look for better opportunities. Therefore, this has fundamentally contributed to a massive decline of black farmers and agricultural land abandonments in many villages according to the perceptions of the farmers. However, this is rooted in the colonisation laws and policies such as BAA, NLA, and NPA (Carruthers, 2007; Hamann and Tuinder, 2012; Andrew *et al.*, 2013; Kelly, 2015) that dispossessed people from their land, changing their sustainable land management systems.

### **c) Ring-fenced black people into institutional poverty**

#### ***Land ownership and user rights***

One of the main issues that farmers were asked about was land abandonment, leading to discussions on land ownership and user rights. Farmers stated that they do not own the land where they farm; it belongs to the chief (*inkosi*) or traditional leaders. This aligns with Hebinck *et al.* (2011), who noted that the BAA reestablished tribal organisations for Black Africans and forcefully removed them from their homelands. Lahiff (2005), Hebinck *et al.* (2011), and Kelly (2015) also noted that tribal authorities were set up, and positions were given to chiefs and headmen who became responsible for land allocation, welfare, pensions, and development. These apartheid-era laws and policies that were introduced, such as the BAA, have ring-fenced black people into institutional poverty. As expressed by the farmers, people were given little land, leading to reduced food production and, consequently, poverty (Lahiff, 2005).

Farmers explained that they are limited to the land allocated by the chief, which is often very small and infertile for planting crops. Andrew *et al.* (2013) noted that white people still control most of the best-quality agricultural lands, a pattern still prevalent today. BAA moved black people to mountainous land and prohibited them from buying or renting land in areas designated for “white people” (Andrew *et al.*, 2013; Hall, 2014; Beinart and Delius, 2014). Farmers mentioned that they cannot expand their farming area and have little land for grazing, forcing them to borrow land from relatives or neighbours who are not using it. However, this is challenging because some farmers are not permitted to farm on land not allocated to them, limiting their ability to expand as stipulated in the BAA (Ehrenreich-Risner, 2018). Additionally, some people who have abandoned their land do not want to give it away for farming purposes. As a result, farmers right to use the land is restricted to the allocated plots, and they do not have actual ownership. They are granted specific property use, a type of easement. Consequently, farmers are left with unproductive land and cannot perform sustainable land management as they used to on their original lands from which they were forcefully moved (Andrew *et al.*, 2013; Hall, 2014; Beinart and Delius, 2014).

*“The land I am using belongs to the chief (inkosi) because I am a co-owner of 100 hectares of land that I use for farming and grazing. All these abandoned lands that you see (pointing to the abandoned agricultural lands) there are owned by the chief” (72-Year Old Male farmer, 2023).*

*“You will see the land that has not been affected by soil erosion but is not used, it needs the involvement of chiefs because the land belongs to the chiefs” (58-Year Old Female farmer, 2023).*

*“Land abandonment is a big issue as you can see here in our village, this is where it needs the involvement of chiefs, who will sit down with them. I am not sure about the constitution but if for three years you did not use the land, the land must go back to the chiefs. No one was born with the land; you were also given so if you not going to use the land you must give it to someone else who will use the land and can’t just take the land to keep it for yourself without using it” (81-Year Old Male farmer, 2023).*

Farmers have criticised the post-apartheid land reform program, stating that it has not adequately addressed land issues in their villages (Carruthers, 2007; Rötter *et al.*, 2024). The program focused on three key areas: redistributing land to increase access for productive and residential purposes, restoring land to those who lost it due to discriminatory laws, and ensuring

secure tenure for those with insecure tenure. However, this has not been effectively implemented in most villages in the ANDM, where farmers still need productive land for farming.

### ***Lack of proper grazing lands***

In some villages, farmers who mainly possess livestock have emphasised that they have very little grazing land. Crop farmers have explained that the lack of properly fenced grazing lands is a disadvantage to their crop farming. Farmers stated that people today do not look after their livestock like in the past where they were herdsmen who were given a responsibility in the villages to look after livestock. Farmers mention that this is forcing them to erect fences or hire people to monitor their grazing lands, which is a new practice for them. Before the introduction of apartheid-era laws and policies (Hebinck *et al.*, 2011; Hamann and Tuinder, 2012; Kelly, 2015), grazing lands and croplands were separated, and people actively looked after their livestock, a practice that has since been abandoned. As a result, communal areas where agricultural cropping land abandonment is concentrated now rely on ruminant livestock production as a primary livelihood source.

*“Where we are as you can see it is on the mountain areas near Umtata, places are grazelands, hectares by hectares but it is not used because it is still owned by the white people. You find that many lands near Harrismith are not used, and the government cannot take them because it is still belong to white people. I am talking about lands that are beautiful and flat, lands that are 300 hectares but are not used. The land is used because it is owned by people who are no longer here, and we cannot access it, but we need it for farming” (60-Year Old Female farmer, 2023).*

Therefore, this situation benefits livestock production while crop production suffers. Livestock often occupy croplands, discouraging other farmers as livestock enter and destroy their crops. Furthermore, this has led to overgrazing, delaying the restoration of climax vegetation after land abandonment. Farmers stressed that having little land often results in them producing less yield which causes poverty as food insecurity increases when there is less farming. Moyo and Ravhuhali (2022) state that in humid areas, abandoned fields were used for pasture for many years without bush encroachment, while low grazing intensity rapidly led to bush encroachment. In the visited villages of ANDM, abandoned agricultural lands have been mainly occupied by livestock, while other parts experience bush encroachment. Farmers

explained that bush encroachment occurs due to increased tree recruitment, reductions in crop farming, grass-standing crops, and fire intensity.

### **3.6 Conclusion**

In this study, field observation, Google Earth imagery, NGI and SSI were used to obtain the perceptions and changes in agricultural activities in the selected villages of ANDM, to detect abandoned agricultural lands that have led to soil erosion. The results from this study confirmed that there were abandoned agricultural lands that took place in these selected villages before and after the introduction of the BAA. Most of them have been converted into grazing lands by the local community. Land abandonment and soil erosion are among the challenges that ANDM faces as spotted in these selected villages, which continue to limit agricultural activities. It was clear from the participant's perceptions that people were practicing more farming before the introduction of BAA was introduced. The main farmer's perception and the views that they expressed that the BAA disadvantaged them through facilitating (intentionally or unintentionally) conditions allowing for (1) infrastructure and property vandalism, (2) pushing black farmers away from farming and (3) ring-fenced black rural villages into institutional poverty. These are the main themes that were generated based on farmer perceptions in the visited villages. The commonly cited reasons for abandoned agricultural lands and the cessation of crop farming in the selected villages were similarly related to policy implications of colonisation; while the recent ones were mainly based on the issue of fencing agricultural lands; lack of access to ploughing equipment; insufficient supplementary income to purchase or hire tractors; climate change that affects irrigation; loss of cropland ploughing ability; ageing farmers and a younger, modernised youth less interested in farming; land ownership and user rights; and lack of proper grazing lands. These results demonstrated from the experienced rural farmer's perceptions show that rural farmer's information is not only essential to farmers but has the potential to significantly transform their farming decisions and practices. They possess historical knowledge that can help in shaping the future of sustainable agriculture within the ANDM. However, such information needs to be relevant, accessible and intelligible to be useful to society at large.

The findings of this study are potentially useful for improving agricultural development planning in the district, thereby strengthening food security and governmental policies to prevent further abandonment of agricultural land. This knowledge can motivate farmers to

return to farming in rural areas, promoting sustainable land management as practiced in previous years before the introduction of BAA. The government needs to intervene by facilitating faster land distribution to black farmers in rural areas and providing local farmers with proper farming equipment. A combination of past and modern information technologies is necessary for the long-term monitoring and evaluation of abandoned agricultural lands. Therefore, the study recommends effective agricultural development planning that can enhance the quality of life and economic well-being of people living in rural areas of the district.

## **CHAPTER 4**

### **INDIGENOUS KNOWLEDGE SYSTEMS: RURAL FARMERS’ PERCEPTIONS ON SOIL CONSERVATION AND MANAGEMENT STRATEGIES IN THE ALFRED NZO DISTRICT MUNICIPALITY.**

This chapter is based on:

**Shinga, T.V. and Nkomo, S.L.** (In preparation). “Indigenous Knowledge Systems: Rural Farmers’ Perceptions on Soil Conservation and Management Strategies in the Alfred Nzo District Municipality”.

## 4.1 Abstract

Soil erosion remains a pervasive and pressing environmental issue worldwide, particularly in developing countries, where it poses a significant threat to sustainability, food security, and human habitats. Rural areas, heavily reliant on agriculture for livelihoods, are especially vulnerable. To combat this issue, it is crucial to recognise and harness the value of local knowledge and Indigenous Knowledge Systems (IKS) in preventing soil erosion. This study had the overarching goal of comprehending the perspectives of rural farmers regarding soil management and appraising the impact of IKS and community engagement in addressing soil erosion within the Alfred Nzo District Municipality (ANDM). Specifically, the study seeks to understand the role, if any, of IKS in managing soil erosion in rural areas. Therefore, ANDM which consists of four local municipalities was investigated. Questionnaires and observations were used to collect data on IKS and its role in soil management. Results revealed that local knowledge and IKS practices, such as contouring systems, crop rotation, mulching, associated crops, and planting vegetation cover, remain relevant for enhancing food production and food security in rural ANDM villages. The findings further highlighted that elderly individuals tend to possess valuable IKS practices for managing soil erosion. Moreover, there is a gender imbalance in farming participation, with more men than women involved in the study. However, there is limited involvement of youth in agriculture, and the ageing of rural farmers is a concern. Interestingly, some farmers may not fully comprehend the critical importance of these practices. Despite these challenges, the study reveals that local knowledge and IKS practices are still relevant in the ANDM villages and contribute to managing soil erosion. The study also notes the presence of programs/projects aimed at rehabilitating eroded soil (dongas) and constructing gabion walls within ANDM to address soil erosion issues.

**Key Word:** Indigenous Knowledge Systems, soil conservation, soil management, ethnopedology, perceptions, farmers.

## 4.2 Introduction

Soil erosion mainly affects rural areas globally, where agriculture is the primary livelihood, impacting numerous countries (Borrelli *et al.*, 2017; Sartori *et al.*, 2019). Within the African continent that has high rates of soil erosion, South Africa (SA) is one of the countries that experiences soil erosion (Baade *et al.*, 2024). Soil erosion, particularly water erosion, has long been identified as a significant environmental issue in SA, facing most rural communities (Le Roux *et al.*, 2007; Baade *et al.*, 2024). Approximately 70% of the land space is affected by soil erosion in the country and Eastern Cape (EC) province appears to be the most degraded province in the country (Le Roux *et al.*, 2007; Manjoro and Kakembo, 2012; Ighodaro *et al.*, 2016; Parwada and Van Tol, 2016; Baade *et al.*, 2024). The EC ranks highest among provinces classified as water erosion risk areas, followed by the Free State and Northern Cape (Baade *et al.*, 2024). The predicted average soil loss rate for SA is 12,6 tons/ha/year and 151 759 ha in EC is severely affected, while the average soil loss rate under annual cropland (grain crops) is 13 tons/ha/year, which is much higher than the natural soil formation rate of less than 5 tons/ha/year (Le Roux and Smith, 2014).

Recent studies by Borrelli *et al.* (2017) indicate an average predicted annual soil loss rate of 1260 t km<sup>-2</sup> yr<sup>-1</sup> due to sheet and rill erosion on arable land in SA, reaffirmed in subsequent research (Borrelli *et al.*, 2017, 2020). In total, approximately 96,350 km<sup>2</sup> and 30% of all potential arable land can be considered at risk of water erosion (Borrelli *et al.*, 2017, 2020; Baade *et al.*, 2024). A case study done in upper and lower areas of Didimana, in EC, indicates that about 75% of farmers lose approximately 21% of their crops yearly due to erosion and 55% of their crops and livestock, as well as their household feeding, suffer due to soil erosion (Ighodaro *et al.*, 2016). These indications showed that rural communities in EC are faced with soil erosion. Mostly due to unsustainable farming and poor management of livestock that lead to soil degradation, (Gomiero, 2016). These lead to socioeconomic problems that most populations in Africa are facing such as poverty, food insecurity and increased mortality rates as farming production decreases. Such challenges are exacerbated by land degradation, which further disadvantages rural people and results in migration and conflicts over arable land (Baade *et al.*, 2024).

Parwada and Van Tol (2016) highlight that the current soil erosion in SA is still poorly controlled due to limited resources and fundamental plans that aim to control soil erosion. In the context of the ANDM IDP, significant attention has been directed towards addressing the

rehabilitation of gully and donga erosions through the introduction of specific programs and projects (ANDM IDP, 2016). Certain approaches and strategies employed for soil erosion management have proven to be ineffective. Some relevant approaches that have been used to address soil erosion include soil erosion modelling and bioengineering to name a few. These are scientific approaches, but it is important to note and consider that the effectiveness of these approaches can vary based on factors such as the local environment, soil type, climate, and level of community engagement. Ultimately, it leads to continuing erosion which affects most of the developing countries (Pimentel and Burgess, 2013; Gomiero, 2016; Borrelli *et al.*, 2017; Sartori *et al.*, 2019). Water and unsustainable farming appear to be the most dominant agents causing erosion triggered by human activities mostly in farming and overgrazing (Le Roux *et al.*, 2007). Thus, the EC is mostly affected by soil erosion in most of their local communities, especially in areas where farming is mostly practiced along the catchments.

Anthropogenic activities have a crucial role in facilitating soil degradation through deforestation, overgrazing, inappropriate tillage, nutrient mining, salinisation and acidification (Barrios *et al.*, 2006). Human activities play a pivotal role in accelerating soil degradation, encompassing processes like deforestation, overgrazing, unsuitable tillage practices, nutrient depletion, salinisation, and acidification (Barrios *et al.*, 2006). Soil degradation refers to the deterioration of soil quality, fertility, and its ability to support healthy plant growth, which can result from various detrimental actions such as those mentioned (Stavi and Lal, 2015). Most provinces that suffer from soil loss are practicing overstocking of livestock which in turn causes trampling and crusting of the soil and denudes the veld of vegetation resulting in soil loss (WWF, 2010). In SA, 68% of the land is utilised as rangeland for livestock agriculture, much of which is already degraded due to factors like gully erosion and vegetation loss, threatening livelihoods and food production (Baade *et al.*, 2024). Excessive livestock grazing in the EC province is a driver of soil erosion. Manjoro and Kakembo, (2012) stated that soil erosion and woody shrub encroachment cause a serious land degradation challenge in the rural catchments of the EC. Despite numerous interventions in the province, soil erosion remains a significant and inadequately managed issue (Parwada and Van Tol, 2016). Although substantial research exists on fundamental methods to prevent, reduce, and restore soil degradation, there remains a critical need for ongoing training and research into newer technologies to enhance human capacity. It is important to recognise that the benefits of rehabilitated land accrue over the long term, often extending beyond the lifespan of a farmer. Policy makers must understand this long-

term perspective, especially since approximately 25% of SA's land amounting to about 96,350 km<sup>2</sup>, including 30% of potential arable land, is at risk of water erosion (Baade *et al.*, 2024).

Indigenous Knowledge Systems (IKS) in agricultural development received limited attention in the past; however, recent publications have progressively acknowledged their significance, revealing that they were previously undervalued (Mosissa *et al.*, 2017; Muthee *et al.*, 2019). However, some local knowledge that was once regarded as primitive is now perceived as “sophisticated” knowledge (Mosissa *et al.*, 2017). Leveraging local knowledge within communities amplifies agricultural development, especially in rural areas of developing nations abundant with extensive IKS. Agriculture serves as the cornerstone of developing economies, with rural communities relying heavily on it for their livelihoods. The vitality of the agricultural sector, however, hinges on the sustainability of farming methods. In the context of SA, maintaining a robust agricultural industry is crucial for contributing to the country's gross domestic product (GDP), ensuring food security, promoting social welfare, fostering job creation, and supporting ecotourism, all while adding value to raw materials (WWF, 2010). Consequently, farming practices must not only safeguard the long-term productivity of the land but also guarantee profitable yields and prioritise the well-being of both farmers and farm workers (WWF, 2010). By recognising, respecting, and integrating such knowledge, agricultural development can align more closely with the needs of the local rural communities and the sustainability of the environment.

This study aimed to comprehend rural farmers' perspectives on soil management and evaluate the contribution of IKS and community engagement in addressing soil erosion in the ANDM. To achieve this, the study was designed with three specific objectives: firstly, to assess the perceptions of the local rural community about their involvement and role in soil erosion management; secondly, to evaluate the level of IKS and rural community involvement in managing soil erosion; and finally, to develop recommendations for improving IKS and local rural community involvement in managing soil erosion in SA. The study was conducted across four local municipalities (Mbizana, Ntabankulu, Umzimvubu, and Matatiele) within the ANDM.

### **4.3 Theoretical frameworks: Ethnopedology**

The theoretical framework of the study that shall be used is ethnopedology which is essential for achieving the understanding and some of the findings related to the study. Ethnopedology is known as the study of local (indigenous) knowledge of soils in rural areas in particular (Winklerprins and Sandor, 2003; Ajibade, 2008; Barrera-Bassols and Zinck, 2002; Barrera-Bassols and Zinck, 2003; Brinkmann *et al.*, 2018). Therefore, the ethnopedological approach is used to better understand the connection between local knowledge and soil resources in rural areas, which is why it is vital for the study. Most scholars believe that ethnopedology includes all the empirical soil and IKS that rural areas have, from the most traditional to the modern ones (Barrera-Bassols and Zinck, 2003; Krasilnikov and Tabor, 2010; Capra *et al.*, 2015; Brinkmann *et al.*, 2018 etc.).

#### **4.3.1 Definitions and history of ethnopedology**

The history of ethnopedology is well-defined, with its inception closely linked to the emergence of ethnoecology in 1954, as termed by Harold Conlin (Krasilnikov and Tabor, 2010). Ethnopedology explores indigenous ecological knowledge, particularly how various cultural groups perceive and interact with their surrounding ecosystems. Although different authors may offer varying definitions of ethnopedology, the fundamental concept remains consistent. According to Posey *et al.* (1984), ethnoecology involves the indigenous understanding of natural divisions within the biological world and the relationships among plants, animals, and humans within these divisions. Furthermore, Toledo (2000) characterises ethnoecology as an interdisciplinary approach that delves into how human groups view nature through the lens of their beliefs and knowledge. It also examines how these human groups utilise and manage natural resources based on their cultural perspectives.

In 1981, the term ethnopedology was coined by Williams and Ortiz-Solorio as a branch of ethnoecology. They used the term pedology as its root, but it has been applied in a much broader context to include how people understand, view, and manage the land at different spatial scales (Krasilnikov and Tabor, 2010). Pedology is regarded as a subdiscipline of soil science, which focuses on understanding and characterising soil formation and the theoretical frameworks (Bockheim, 2005) and seeks to find the entire understanding of humans about soil body(s), especially in the context of the natural environment thus the term is regarded as the root of ethnopedology (Dijkerman, 1974; Bockheim, 2005). In essence, ethnopedology and

ethnoecology are concerned with understanding the IK of natural resources and the intricate interactions among these resources within diverse cultural contexts.

Ethnopedology, a branch of ethnoecology, examines local perceptions, knowledge, and management practices related to soil and land within the environment (Winkler-Prins and Barrera-Bassols, 2004). Krasilnikov and Tabor (2010) define it as the study of how people understand, view, and manage land at various spatial scales, combining natural and social sciences such as soil science, social anthropology, rural geography, agronomy, and agroecology. Ethnopedology focuses on indigenous knowledge (IK) about soils, including soil morphology, genesis, and local soil classification systems, with a particular emphasis on rural areas (Winkler-Prins and Barrera-Bassols, 2004). In essence, ethnopedology acts as an interdisciplinary bridge between the social and natural sciences, enabling the integration of cultural and environmental insights regarding soil and land. It encompasses diverse empirical soil and land knowledge systems found among rural populations, ranging from traditional to modern approaches (Barrera-Bassols and Zinck, 2000). This field is fundamental for synthesising natural and cultural information held by various actors with distinct perceptions, knowledge, and management strategies concerning soil and land resources (Barrera-Bassols and Zinck, 2000; Barrera-Bassols *et al.*, 2006).

Ethnopedology was only recognised as a comprehensive discipline in soil science. It is a discipline of recent development, with an exponential increase in publications during the last 10 years (Barrera-Bassols, and Zinck, 2000). However, despite the clear meaning of ethnopedology, historically the term has not been reflected in soil science research. There has been less research that focuses on ethnopedology for approximately the last 20 years (Barrera-Bassols, and Zinck, 2000). The term has been valid for thousands of years and was identified by the indigenous peoples (Barrera-Bassols, and Zinck, 2000). Historically, until recently, the study of human or indigenous soil knowledge has been ignored. For almost all of the 20<sup>th</sup> century, the general situation regarding indigenous soil knowledge might be characterised as indifference as it was ignored and absent until recently when ethnopedology was recognised as a comprehensive discipline (Barrera-Bassols, and Zinck, 2000; Barrera-Bassols, and Zinck, 2003; Krasilnikov and Tabor, 2010). During the 19<sup>th</sup> and 20<sup>th</sup> centuries, both developed and developing countries lost significant human soil knowledge (Krasilnikova and Tabor, 2003). This can be due to the rapid industrialisation of societies during this period led to urbanisation and a shift away from rural agricultural lifestyles. Advances in technology and the adoption of

modern agricultural practices might also be contributing factors. In the past, there was limited information documented about indigenous soil knowledge.

To the colonised continents such as Africa, Asia, and America, the local agrarian knowledge tradition was regarded as imprecise, “primitive” and opposing scientific knowledge (Krasilnikov and Tabor, 2010). Scientifically based systems were replacing IK because it was not considered relevant to new land management techniques, such as chemical fertilisation, mechanised cultivation, new crops, and irrigation that accompany modern economic systems and world markets (Krasilnikova and Tabor, 2003). Unlike scientists, indigenous peoples do not consider the land merely as an economic resource but as a valuable resource (Toledo, 2000). This has led to a huge gap in the documentation of human soil knowledge in these continents. Even traditional knowledge in general was considered to be useless as it could not produce any growth, and farmers were regarded as “ignorant” (Krasilnikov and Tabor, 2010). This was mainly taking place in the colonised continents as the colonisers were mainly believing in scientific knowledge. In Europe, scientific research on the soil as a source of food started in the 18th century when there was population growth that increased the demand for agricultural production (Krasilnikov and Tabor, 2010). But there was also a huge gap in human soil knowledge as it was disregarded.

In the past, some places had little economic development that appreciated indigenous soil knowledge. Krasilnikov and Tabor (2010) state that in countries such as India and Africa, British and French there were researchers that paid a closer look at the soil knowledge of the local population, but this was mainly based on an ethnographic point of view. It was not based rather on ethnopedology. The first structured attempts to acquire soil and land information from indigenous peoples came from social and cultural anthropologists (Barrera-Bassols, and Zinck, 2000; Barrera-Bassols, and Zinck, 2003; Krasilnikova and Tabor, 2003). The authors asserted that historical documents show that even in ancient societies the governors and priests collected information on soil resources, fulfilling a kind of ethnopedological survey (Krasilnikov and Tabor, 2010). Moreover, cultural and environmental geographers, a few agronomists, and some soil scientists have also contributed to the rapidly increasing collection of ethnopedological studies in diverse geographic entities, agro-ecological zones, and ethnic territories of the world (e.g., WinklerPrins, 1999; Barrera-Bassols and Zinck, 2000; Barrera-Bassols, and Zinck, 2003; WinklerPrins and Barrera-Bassols, 2004; Krasilnikov and Tabor, 2010).

Barrera-Bassols and Zinck (2000) noted that in the earliest research, there are no publications in the international journals that focus on ethnopedology, it is only accessible in grey documents of limited circulation. Most of the local soil knowledge was lost due to cultural erosion where local indigenous people migrated to other places and never returned (Krasilnikov and Tabor, 2010). Despite that, ethnopedology research continues to grow and will be valuable to a wide range of researchers and practitioners if attention is paid to the following four issues (Sandor and Furbee, 1996; WinklerPrins, 1999):

- First, a greater effort needs to be made to understand the link between soil knowledge and the political and socioeconomic context in which it is used;
- Second, further attempts to expand soil knowledge studies to include the broader landscape processes need to be pursued;
- Third, there is a need to think creatively about ways in which local and scientific knowledge can inform each other and possibly be fused to make local soil knowledge an effective tool in sustainable land management strategies and;
- Fourth, sustained attention to the cosmology (i.e., the kosmos) of local people is needed (WinklerPrins and Barrera-Bassols, 2004: 141).

#### **4.3.2 Recent developments of ethnopedology**

There has been an increased interest in indigenous soil knowledge from the 20<sup>th</sup> century until the present (Barrera-Bassols, and Zinck, 2000). Many publication papers have been published by researchers that focused on ethnopedology (e.g., Sinha *et al.*, 2020; Matshameko *et al.*, 2022; Morales *et al.*, 2023; Jiménez, *et al.*, 2024). Krasilnikov and Tabor (2010) state that since the start of the third millennium, there have been approximately thousands of ethnopedological papers and reports that have been published. Barrera-Bassols and Zinck, (2000) also state that since 1989, there has been an average production of 33 studies per year about ethnopedology. West sub-Saharan Africa, West Africa, East Africa, the Himalayas, India, and Southeast Asia are some of the countries that have good ethnopedology studies (Barrera-Bassols and Zinck, 2002).

Authors have identified that ethnopedological information sources appear to have a lack of method and technique integration, contrasting with the holistic nature of the traditional

knowledge, and reveals three main research approaches: ethnographic, comparative, and integral (Barrera-Bassols and Zinck, 1998; WinklerPrins, 1999; Barrera-Bassols and Zinck, 2002). In the ethnographic approach, ethnopedological information is not compared with scientific soil information. The comparative approach seeks to discover similarities and differences between local knowledge and scientific information. The integrated approach elaborates natural resource management schemes according to local social, cultural, economic, and ecological contexts by identifying and mobilising the relationship between cultural and scientific information (Barrera-Bassols and Zinck, 2003). These research approaches have played a fundamental role in developing ethnopedological studies recently as there are publications that focus on each of these approaches (e.g., Capra1 *et al.*, 2015, 2016; Sinha *et al.*, 2020; Matshameko *et al.*, 2022; Morales *et al.*, 2023; Jiménez, *et al.*, 2024). Studies that focus on the integrated approach seem to be mostly increasing in recent times compared to the other two approaches (e.g., Rushemuka *et al.*, 2014; Diallo and Diallo, 2015; Capra1 *et al.*, 2015, 2016; Sinha *et al.*, 2020; Matshameko *et al.*, 2022; Morales *et al.*, 2023; Jiménez, *et al.*, 2024).

Barrera-Bassols and Zinck (2003) have identified the main research fields of ethnopedology include:

- Beliefs, myths, rituals, and other symbolic meanings, values, and practices related to land management and soil quality evaluation;
- Local classification nomenclatures, and soil and land taxonomies;
- Local soil and land resource perception, and explanation of the structure, distribution, properties, processes, and dynamics of the soil mantle;
- Local knowledge of soil and land relationships with other biophysical factors, elements, and processes;
- Local land uses and soil management practices;
- Local adaptation, renewal, and transformation strategies of soil properties and land qualities and
- Co-validation of ethnopedological knowledge, abilities, and skills with modern soil science, geopedological survey, agroecological strategies, agricultural, and other rural practices, to promote participatory land evaluation and land use planning procedures for endogenous sustainable development (Barrera-Bassols and Zinck, 2003).

These research fields have been necessary in recent years as they can increase the studies of ethnopedology. As these knowledge fields have been disregarded in the literature, focusing on them can contribute to finding the diverse set of knowledge that local people possess, mainly the old ways of managing natural resources. In this study, the focus is based on local knowledge concerning soil management which is one of the Barrera-Bassols and Zinck (2003) identified main research fields of ethnopedology. A study conducted in arid Patagonia among the Mapuche-Creole community by Morales *et al.* (2023) found that horticulturalists utilise an ethno-classification system emphasising practical applications. This system categorises soil types based on their morphological attributes, incorporating criteria such as texture, structure, colour, and the presence of specific plant species as ethno-indicators. This approach not only enhances local knowledge systems but also supports sustainable soil management and development efforts in the region (Morales *et al.*, 2023). Jiménez *et al.* (2024) conducted a semi-structured survey recently among smallholder farmers in the Ecuadorian highlands to explore their perceptions of soil management practices and indicators of productivity. The study revealed that farmers possess a practical understanding of soil fertility and its key influencing factors, largely acquired from their relatives. The findings suggest that integrating local soil knowledge with scientific insights can enhance the overall comprehension of soil fertility, particularly benefiting small-scale farmers. Key soil attributes emphasised include texture, colour, depth, stoniness, and workability (Jiménez *et al.*, 2024).

Figure 4.1 shows a diagram of ethnopedology as a hybrid discipline that was developed by Barrera-Bassols, and Zinck (2000) and how they define and view ethnopedology. This is in line with what Barrera-Bassols and Zinck (2003) noted, as they stated that ethnopedology aims to understand the indigenous approaches to soil perception, classification, and appraisal (Barrera-Bassols and Zinck, 2003). With regards to the main research fields of ethnopedology, there have been published work that focuses on these fields already developed recently (e.g., Capra1 *et al.*, 2015, 2016; Sinha *et al.*, 2020; Matshameko *et al.*, 2022; Morales *et al.*, 2023; Jiménez, *et al.*, 2024). However, most of the ethnopedological studies have focused only on one field of research, there are limited studies that have tried to include more than one research field (Barrera-Bassols and Zinck, 2003). Most of the work has been seen growing in many countries, especially in Latin America which became the main important place in terms of the study of ethnopedology. Almost a quarter of all published ethnopedological studies from a worldwide perspective are from Latin America while about 30% are in Africa, 20% in Asia and others are elsewhere in the world (WinklerPrins and Barrera-Bassols, 2004). These

statistics might have changed in recent years as ethnopedological studies have increased (Matshameko *et al.*, 2022; Morales *et al.*, 2023; Jiménez, *et al.*, 2024).

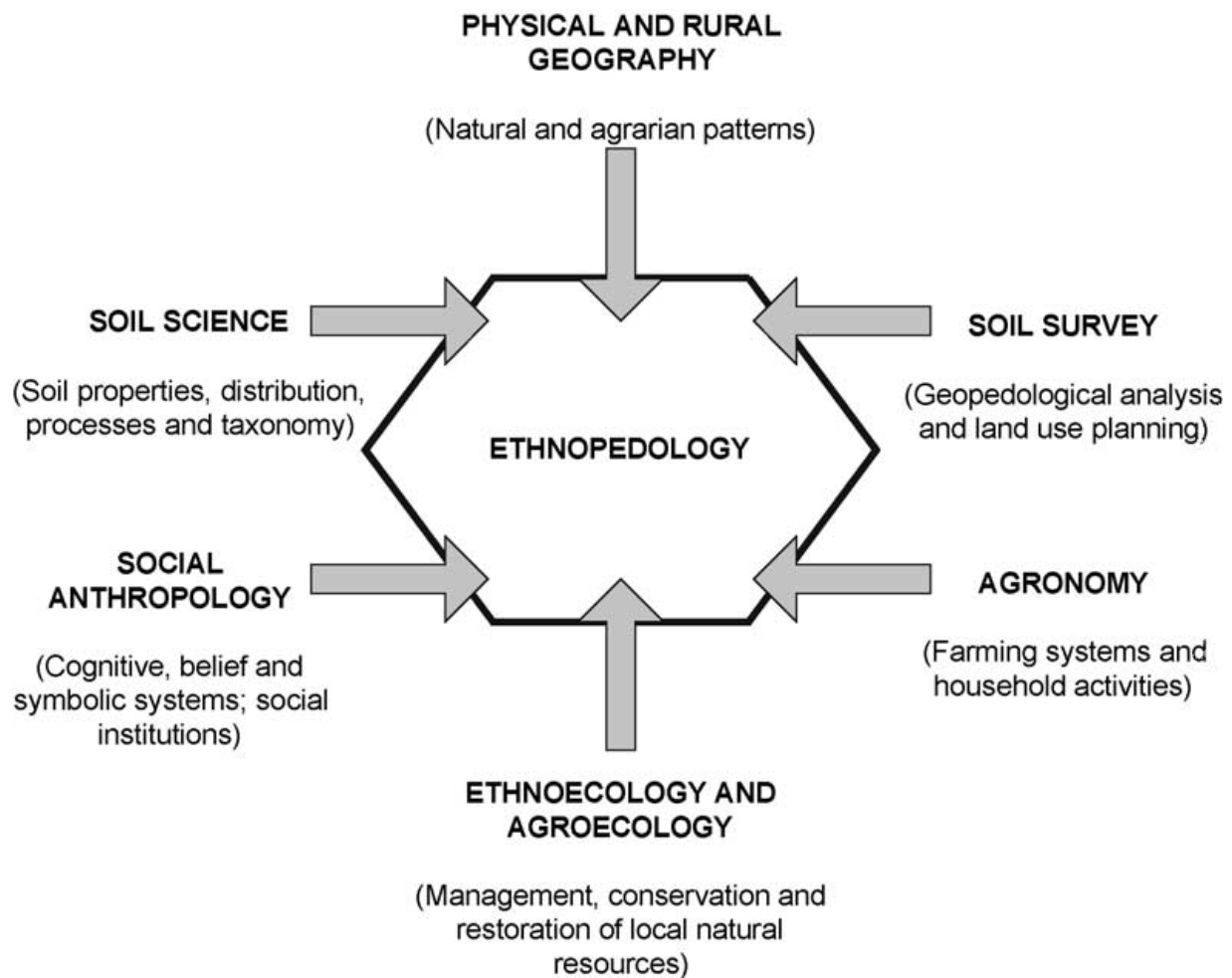


**Figure 4.1: Ethnopedology as a hybrid discipline by Barrera-Bassols, and Zinck, 2000: 12.**

Previous research in ethnopedology from various regions emphasises the significance of local knowledge in developing sustainable farming practices and mitigating soil erosion (Barrera-Bassols and Zinck, 2003; WinklerPrins and Barrera-Bassols, 2004; Barrera-Bassols *et al.*, 2006). For instance, Brinkmann *et al.* (2018) found that in Madagascar, farmers primarily classified soils based on topsoil colour and texture. A practice similar to Orobator *et al.* (2019), who identified that rural farmers in Ondo State, Nigeria, possess a strong understanding of soil colour as an indicator of fertility. Additionally, Capra *et al.* (2015) employed an integrated ethnopedological approach to investigate the significance of place names (toponyms) in both traditional and modern maps of Sardinia, Italy. Their results highlighted an effective use of an integrated ethnopedological approach in harmonising indigenous and scientific knowledge

(Capra *et al.*, 2015). Hence, this approach has shown an important role in preserving IK from being lost in academic literature.

In a recent study conducted in Ecuador, Ayala Nole *et al.* (2022) found that highland farmers possessed valuable local knowledge regarding suitable soils for crop cultivation. They relied on physical characteristics like soil colour, stoniness, workability, and the presence of certain plants to identify the best soils for planting. Additionally, these farmers recognised that less fertile soils should be left fallow and not extensively used for cultivation. Ayala Nole *et al.* (2022) advocated for the integration of local knowledge with scientifically proven information, viewing it to address soil fertility challenges effectively. This approach allows for the implementation of strategies already known to farmers, while also incorporating new technologies for optimised soil management. Notably, previous ethnopedological research, such as the Settlement Project in Brazil (da Silva *et al.*, 2019). This project demonstrated that integrating popular and scientific knowledge can foster closer relationships between these knowledge systems. This integration holds promise for addressing soil erosion issues by creating synergies between different forms of knowledge.

The recent study conducted in Manipur state, northeast India by Sinha *et al.* (2020) highlights the growing importance of ethnopedology in understanding and preserving local soil knowledge within indigenous and rural communities. This has led to increased research on local and indigenous soil conservation practices. For example, in various regions of India, farmers employ a range of soil conservation measures, including terracing with bunds, mulching with maize stalks, rock lining, field bunds, bamboo stick fences, weed residues, tree logs, and timber. Interestingly, these practices are adapted and differentiated by indigenous tribal communities to suit their specific soil conditions. Sinha *et al.* (2020) emphasise that ethnopedological studies have revealed farmers' extensive knowledge of local soil resources. This knowledge is vital and requires ongoing efforts to enhance and sustain crop production potential in rural communities. Notably, one of the primary challenges faced by Indian farmers is soil infertility, which they address through the application of animal waste, inorganic fertilisers, and crop rotation. The research suggests that an integrated ethnopedological approach, combining indigenous with scientific knowledge, holds significant promise in mitigating the loss of valuable IK, ultimately contributing to more effective soil conservation efforts (Sinha *et al.*, 2020).

The increasing number of ethnopedological studies proved that local soil knowledge remains essential and should continue in recent times as soil erosion is a contemporary environmental issue. Indigenous people have since long classified soil by their appearance and characteristics (Nath *et al.*, 2015). Local soil knowledge appeared to be a valuable source of information for land management planning, especially in developing countries. In the 20<sup>th</sup> century, the value of cultural diversity was recognised, and soil knowledge was also appreciated as part of this cultural heritage. Therefore, ethnopedology provides us with an understanding of possible connections that exist between local and scientific knowledge (Capra *et al.*, 2016). Although ethnopedology by indigenous people existed years ago in practice, it has not been reflected in the management of soil erosion or rather soil science research. Despite that, there is an acceptance of different ways of knowing about the soil, especially by Western-trained scientists, and this has allowed the field of ethnopedology to flourish (Barrera-Bassols and Zinck, 2003). During the last decades, there has been a considerable increase in the number of ethnopedology studies (Barrera-Bassols and Zinck, 2002; Sinha *et al.*, 2020).

Local knowledge of soil erosion is quite complex, multifaceted, and often quite subtle in its expression but mainly it is fundamental in soil conservation (Winklerprins and Sandor, 2003; Kamla-Raj, 2004). In that case, ethnopedology focuses on local knowledge about soils and their management allowing local knowledge to be used in the management of soil erosion. Since its existence, ethnopedology has been increasingly recognised for its contribution to the evaluation of land use concerning soil quality and sustainable agriculture (Winklerprins and Sandor, 2003). Despite the good advantages associated with ethnopedology, it is also clouded with several challenges. The work on ethnopedology has been experiencing less progress in research because local soil knowledge has not been historically reflected in soil science research (Barrera-Bassols and Zinck, 2003). Barrera-Bassols *et al.* (2006) have highlighted that ethnopedological studies focus on indigenous peoples and small-farmer communities in peripheral countries. These groups are central to such research because they are the primary creators and practitioners of social theories regarding soil and land resources, which are integral to their historical heritage. With that in mind, there is a need for more research that will focus on ethnopedology to ensure that local knowledge on soil erosion management is implemented. Local soil knowledge has a strong relationship between knowledge and practice. It is not easy to separate the two. In terms of soil erosion management intervention, it is especially important to highlight areas that are intrinsically susceptible to erosion (Parwada and Van Tol, 2016).

Ethnopedology, or indigenous soil knowledge, comprises two dimensions. Firstly, the physical dimension involves knowledge derived from observable soil characteristics like colour and texture. Secondly, the perpetual dimension encompasses factors affecting soil workability, crop suitability, and land use. The growing significance of ethnopedology contributes to a better understanding of local community practices for sustainable agriculture. There is an increasing awareness of the need to preserve soil in the face of evolving social, cultural, and agricultural factors. Ethnopedology serves as a valuable tool for documenting local knowledge, aiding indigenous communities in maintaining and protecting their cultural knowledge base amid ongoing modernisation (Sinha *et al.*, 2020). Onyeka (2009) mentioned that in Enugwu it was expected that ethnopedological studies could bridge the language divide. A perceptions study conducted by Kastner-Wilcox *et al.* (2023) provides a nuanced understanding of how social-psychological factors interact to influence risk perception related to soil degradation among college students. The study offers insights into effective strategies for environmental education and awareness campaigns in academic settings. The study's model effectively explains 63% of the variance in soil degradation risk perception, highlighting the significant influence of knowledge, which directly impacts perception and mediates through affective responses (Kastner-Wilcox *et al.*, 2023).

A study by Matshameko *et al.* (2022) explores information on the criteria used by indigenous potters in classifying pottery-making soils in southern Botswana. This study revealed that local potters have classified their pottery-making soils based on IK with no verifiable scientific support. In Botswana, ethnopedology is widely accepted to have practical applications in the sustainable management of soil resources (Matshameko *et al.*, 2022). This was also the case in North East India where farmers used their knowledge to identify the soil quality of 'bamboo' and based on the agroforestry system they established the relationship of soil quality index with bamboo productivity (Nath *et al.*, 2015). However, it is generally accepted that darker soils are most often richer in organic content and therefore provide more productivity in agriculture. Farmers are knowledgeable of their landscape in terms of soil diversity and undertake practices to manage soil erosion and fertility (Teegalapalli *et al.*, 2018). Logs placed perpendicular to hillslopes effectively prevent soil erosion during crop cultivation, illustrating the practical and often scientifically informed nature of local knowledge in traditional farming communities (Teegalapalli *et al.*, 2018). Barrera-Bassols (2016) emphasised the value of integrating participatory soil landscape surveys in indigenous mountain communities in central Mexico, combining ethnopedologic and geopedologic methods. This approach revealed that using both

local and technical topsoil classifications helps farmers understand topsoil variations in space and time at plot and landscape levels. This knowledge aids in selecting suitable agro-ecological conditions, implementing land management practices, and deploying soil conservation measures (Barrera-Bassols, 2016). Pérez-Rodríguez *et al.* (2023) conducted a review focusing on the development of Ethnopedology over the last 23 years. They proposed that combining ethnopedology with connectivity research and collaborative knowledge production can enhance studies on soil security and soil sustainability, emphasising the importance of equitable participation in integrating knowledge.

Studying ethnopedology, and the local knowledge of soil is a crucial endeavour for managing soil erosion in rural areas while respecting IKS. Valuable insights can be gleaned from both historical and contemporary traditional cultures, offering relevance to modern land use. Capra *et al.* (2015) highlighted that an integrated ethnopedological approach effectively combines ancient indigenous with modern scientific knowledge, playing a pivotal role in preserving IK. Ethnopedology has garnered interest from a wide range of scientists and practitioners due to its link to sustainable development and cultural survival strategies (Barrera-Bassols and Zinck, 2003). Considering the limited success of top-down agricultural modernisation approaches in addressing soil erosion, it is imperative to explore alternative methods and programs. Soil security can be ensured by fostering bi-directional communication between technicians and producers, with ethnopedology serving as a pathway toward sustainable soil development (Pérez-Rodríguez *et al.*, 2023). Ethnopedology stands out as a critical approach, housing valuable local soil knowledge. It offers a way to engage local farmers in meaningful soil discussions, respecting their expertise and livelihood improvement aspirations through development projects (Barrera-Bassols and Zinck, 2003; Sinha *et al.*, 2020; Matshameko *et al.*, 2022; Morales *et al.*, 2023; Jiménez, *et al.*, 2024).

## **4.4 Background of local and indigenous soil knowledge**

### **4.4.1 Indigenous knowledge and indigenous knowledge systems: History and definitions**

Defining and categorising IK and IKS has been difficult because they are politically ‘loaded’ terms (Tharakan, 2015). Some people can be offended or feel excluded when separating who is indigenous and who is not (Flavier *et al.*, 1995; Warren *et al.*, 1995). The term IK is believed to have originated in agricultural research around the 1980s (Warren, 1991; Sillitoe, 1998;

Morrow, 2008). Briggs (2005) asserts that the interest in IK in the literature started around 20-25 years ago, although there is some suggestion that there are hints of the emergence of embryonic IK before then. IK is defined as the local knowledge that is unique to a given culture or society (Warren, 1991). Semali and Kincheloe (2002) argued that IK is a dynamic expression of how the inhabitants of a region perceive themselves in relation to their environment. It involves the organisation of people's knowledge about flora and fauna, cultural beliefs, and history, all of which are utilised to improve their lives. Nhemachena *et al.* (2011) in turn, defined IK as the unique, traditional, local knowledge existing within and developed around specific conditions of women and indigenous to a particular geographic area. Hence, IK is very fundamental in society as it is based on the local knowledge that exists in the community which is closely related to ethnopedology. In essence, while local knowledge or IK is a broader term encompassing all types of traditional knowledge within a community, ethnopedology specifically narrows its focus to the study of soil-related knowledge and practices within cultural contexts.

It is vital to note that IK is not based on a specific tribal group or the original inhabitants of an area, nor is it confined to rural people (Njiraine *et al.*, 2010). IK is any local knowledge that exists in a particular community whether used to deal with different conditions in a particular area. This kind of knowledge is valuable as it is not only useful for a specific culture or community in which it evolves but also for scientists and planners who are dedicated to improving conditions in rural areas (Warren, 1991). Some might wonder why IK is important and valuable. Well, the answer is simple, IK is a valuable national resource that remains a useful tool to solve local problems (Warren *et al.*, 1995). IK is a practical concept that can be used to facilitate communication among people coming from different backgrounds such as researchers, extension workers, and beneficiaries (Flavier *et al.*, 1995; Warren *et al.*, 1995).

Moving to IKS, Mapara (2009) defined it as a body or bodies of knowledge of the indigenous people of geographical areas that they have survived on for a very long time. Govender *et al.* (2013) argued that IKS is a body of knowledge produced and owned by local people in their specific communities and passed on from generation to generation, through practice and oral channels. IKS is always based and rooted locally at a particular place and set of experiences, and generated by the people living in those places, while IK is often transmitted orally, or through imitation and demonstration (Tharakan, 2015). Warrant *et al.* (1995) state that IKS forms the basis for indigenous decision-making, which is operationalised through the indigenous organisation. Hence, when combining the meaning of IK and IKS they refer to

traditional, cultural, and local knowledge and knowledge systems that are unique to a given culture or society (Mapara, 2009; Ellen and Harris 1996 cited by Tharakan, 2015). Such knowledge is mostly found in rural areas where they have still not been exposed to the modern world. This kind of knowledge is the one that has failed to die despite the racial and colonial onslaught that they have suffered at the hands of Western imperialism and arrogance (Mapara, 2009). Semali and Kincheloe (2002) argued that there is an essence that IK is found in the experience of the colonised which is never restricted to the third world and other ‘tribal’ contexts. However, IK and IKS are seen as separate and different from the ‘international knowledge system’, which includes knowledge generated by universities, research institutions, and private firms (Tharakan, 2015). IK and IKS primarily revolve around the local knowledge possessed by people within their communities.

In the agricultural sector, IKS is shaped by farmers' perceptions of their natural and social environment, guiding their adoption, adaptation, and development of technologies tailored to local contexts (Ajibade, 2008). Warren (1991) contends that IK forms the basis for decision-making in various aspects of rural life, including agriculture, health care, food preparation, education, and natural resource management. Local knowledge in agriculture involves an intuitive integration of indigenous skills, systems knowledge, and appropriate technology options, stemming from direct interaction with the environment (Altieri, 1990 as cited by Barrios *et al.*, 2006). In SA, IKS policy, established in 2004, aims to support institutions in assisting communities to categorise and characterise their biological resources, innovations, practices, and technologies. The policy also seeks to establish a formal system for recording IK (Winschiers-Theophilus *et al.*, 2010). However, scientific knowledge systems have faced increasing criticism in social science literature, while IK systems are sometimes overly presented as an optimistic alternative way of knowing (DeWalt, 1994). Moreover, IK remained largely unaccounted for as a strategy that can be used to manage soil erosion and other aspects.

#### **4.4.2 Indigenous knowledge systems and scientific knowledge: Critiques**

In recent years IKS has received increasing attention from researchers, especially in Africa. However, some differences and critiques have emerged around IKS. The definition of IK by Semali and Kincheloe was very clear, and it is widely used by most scholars (Ajibade, 2008; Njiraine *et al.*, 2010). However, Morrow (2008) argued that Semali and Kincheloe have insufficient knowledge about the implications of the IK approach for alternative development

strategies, other than expressing great optimism about the potential for reviving IK. Morrow believed that IK's primary objective was to challenge scientific knowledge. It is not surprising as the IK agenda is seen as liable to misunderstanding (Sillitoe, 2017). It is no secret that most of the critiques of IKS come from scientific researchers. Sillitoe (2017) has criticised this act by scientists for underrating IKS and warned that it can breed defiant localism, even conflict if those in power deny the validity of place-centred knowledge. Formal knowledge or rather international knowledge and scientific knowledge can collaboratively work better together as they both complement each other, unlike IK (Grenier, 1998). There are also differences in the methodology, some social scientists prefer the quantitative method rather than the qualitative method (Safakish, 2015). Furthermore, there is a strong sense that researchers in academic institutions tend to prefer scientific knowledge and tend to marginalise and even stigmatise IKS (NRF and CSIR, 2014). This shows the amount of criticism that IKS has received from scientists' researchers and other institutions.

IKS researchers have criticised scientific knowledge for overlooking IKS and local knowledge. DeWalt (1994) alluded that IKS is the alternative way of knowing. Therefore, there is no doubt that IKS researchers are trying to get recognition in the current era as they were ignored in the past. Some IKS researchers believe that IKS and scientific knowledge can collaboratively work together. However, 'this defensive position reflects the fact that those in the position of doing empirical research on IKS have not had the time or theoretical skills to elaborate the full implications of their work (Morrow, 2008: 91). Tharakan (2015: 56) argued that:

*We must critically examine, assess and evaluate the strengths and weaknesses of both scientific and indigenous knowledge systems, focusing on comprehensive documentation and assessment of indigenous knowledge-based technologies that have the potential for a significant impact on development.*

The emphasis should be on comprehensive documentation and assessment of technologies rooted in IKS that hold the promise of making a substantial impact on development. Hence, scientific and IKS both possess advantages and disadvantages. It is unfair and biased to think that IKS is the only approach that has weaknesses and scientific knowledge does not. No approach should be labelled as more important than the other and what has clouded the IKS in the past it was ignored and regarded as primitive, imprecise, and opposing scientific knowledge (Warren, 1991; Warren *et al.*, 1995; Semali and Kincheloe, 2002).

However, one of the main differences between IK and scientific knowledge relies on the power of their respective owners, the power that local knowledge holders lack (Safakish, 2015). The local knowledge holders are not well documented as it was ignored in the past, which is why it will be lacking when compared with scientific knowledge. Although IKS has been accepted by scientists and researchers, IK is still not well documented as it was ignored in the past and largely unprotected (Mazonde, 2007). Some academics and many natives do not believe in the separation of IK from formal or international knowledge, but they believe that IK is legitimated when it is matched with theories and classifications of scientific knowledge (Safakish, 2015). IKS and scientists should collaboratively complement each other rather than compete. The criticism between IKS and scientific knowledge does not benefit anyone. IK can provide the basis for local-level decision-making (Warren, 1991), which is why it should be considered valuable knowledge.

Morrow (2008) asserts that the resurgence of interest in and focus on indigenous and local knowledge has been driven by individuals actively involved in anthropological fieldwork and participatory agricultural research. There is no doubt that IK was mostly used in the natural resources, especially in agricultural research, and expanded to education and other sectors. In agricultural science, there has been much criticism has been raised as IK is believed to have originated in agricultural research (Briggs, 2005; Morrow, 2008). Although scientists are often blamed for ecological and inequality problems, the implication is that they need to learn the local knowledge systems of farmers within communities to gain clear insights and solutions to development challenges (DeWalt, 1994). Given the global crises that continue to rise in the contemporary era, namely, the water and sanitation situation and the miserable state of community development and poverty eradication. There is a clear need for fresh and new approaches (Tharakan, 2015; Sillitoe, 2017) that will address the current problems. In that way, IK remained one of the new approaches that are capable of addressing the current issues. Scientists will gain knowledge from the indigenous holders instead of criticising one another. As Tharakan (2015) asserted this can introduce a more effective and creative interaction and interchange between IKS and modern international scientific knowledge systems.

Local people are capable of solving their problems their way through IKS. According to (Sillitoe, 1998: 189) argued that:

*It is indisputable that local people will be well qualified to define problems, and will be 'experts' on their soils, climate, pests, and so on. Furthermore, for some problems,*

*Western scientific knowledge may not be of particular relevance, and may even worsen matters by overlooking aspects of the local system. Indigenous knowledge may be more extensive and systematic than expected and take account of complex interconnections which narrowly focused scientific disciplines may overlook, with possible unanticipated spin-offs.*

Therefore, IK needs to be considered important by scientists and see the value as it can contribute tremendously to solving local problems. IK can address local problems without interference with scientific knowledge. It is flexible, adaptive, and innovative especially in the agricultural sector (Sillitoe, 1998), as rural farmers have their indigenous ways of farming. However, IKS and scientific knowledge are different as much as they can be combined where suitable. Despite the importance of IKS, it is vital to ensure that we recognise the potential strengths and weaknesses of IKS same as scientific knowledge (DeWalt, 1994; Sillitoe, 2017).

Table 4.1 summarises the characteristics and comparison of IKS and scientific knowledge systems that have been adopted from (DeWalt, 1994: 124 and Sillitoe, 2017: 3) work. Table 4.1 above illustrates the potential strengths and weaknesses; advantages and disadvantages of IKS and scientific knowledge systems. Characterising and comparing these two pieces of knowledge has clearly shown what they are both capable of doing. DeWalt (1994) states that perhaps the greatest strength and weakness of IKS is that they are local. Indeed, IKS is locally based, and they originate in local communities, especially in rural areas. Hence, the idea of incorporating the two pieces of knowledge is possible as they both differ and carry potential. IKS tries to address or understand reality in its deepest or most radical aspect, and seeks its ultimate causes, while traditional Western sciences study specific aspects of reality, and seek more immediate or proximate causes (Onwu and Mosimege, 2004). Consequently, Safakish (2015) argued that this knowledge should be put against each other since they originate from human intelligence and wisdom in pursuing one another despite their differences.

**Table 4.1: The characteristics and comparison of indigenous knowledge systems (IKS) and scientific knowledge systems (DeWalt, 1994: 124 and Sillitoe, 2017: 3).**

| <i>Indigenous knowledge systems</i> | <i>Scientific knowledge systems</i> |
|-------------------------------------|-------------------------------------|
| General, holistic                   | Specialised, partial                |
| Based on observation                | Based on experimentation            |
| Mutable mobiles                     | Immutable mobiles                   |

| <i><b>Indigenous knowledge systems</b></i> | <i><b>Scientific knowledge systems</b></i> |
|--------------------------------------------|--------------------------------------------|
| Dependent on local resources               | Market risk                                |
| Low input                                  | High input                                 |
| Land extensive                             | Land intensive                             |
| Labour demanding                           | Labor-saving                               |
| Environmental risk                         | Market risk                                |
| Diverse adaptive strategies                | Specialised adaptive strategies            |
| Low productivity for labour inputs         | Low productivity for energy inputs         |
| Culturally compatible                      | Cultural disjunctions                      |
| Subsistence goals                          | Profit goals                               |
| Low potential for degradation              | High potential for degradation             |
| Sustainable with low population densities  | Not sustainable                            |

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**Indigenous and Scientific Knowledge (Sillitoe, 2017: 3)**

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| <i><b>Indigenous Knowledge</b></i>                                                                                                                                                                                                        | <i><b>Scientific Knowledge</b></i>                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Narrow, culturally specific                                                                                                                                                                                                               | Broad, universally generic                                                                                                                                                                                                               |
| Practical concerns                                                                                                                                                                                                                        | Intellectually ambitious                                                                                                                                                                                                                 |
| Unitarist                                                                                                                                                                                                                                 | Reductionist                                                                                                                                                                                                                             |
| Comprising system-wide understanding of broadly informed citizens                                                                                                                                                                         | Comprising an in-depth understanding of narrowly trained specialists                                                                                                                                                                     |
| Considered subjective and tacit                                                                                                                                                                                                           | Aspires to be objective and analytical                                                                                                                                                                                                   |
| Indigene is informally taught in the community where knowledge is organised in less systematic ways.                                                                                                                                      | The scientist is formally taught in institutions that are keepers of knowledge, arranged in an orderly manner by discipline.                                                                                                             |
| Indigenous practice is more inductive with the serendipitous assessment of a changeable world irregularly during everyday chance experiences (which are knowable to varying extents to others, as hotly disputed by postmodern thinkers). | The scientific method is more deductive with protocols agreed to test a consistent model of the world regularly through purposefully designed experiments (which are only predictable to varying extents, and not always going to plan). |

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Other scholars (e.g., DeWalt, 1994; Onwu and Mosimege, 2004; Sillitoe, 2017; Safakish, 2015; Tharakan, 2015) believe that it is possible to incorporate IKS into the science curriculum as it can offer the opportunity to move from dialogue or rhetoric to cooperative efforts. Both IK and

scientific knowledge are in a constant process of change, being continually influenced by new ideas (Sillitoe, 2017). Therefore, their collaboration can be beneficiary to both. However, (Morrow, 2008) has argued that IK has no hope in the power or knowledge regime of neoliberal globalisation if all definitions of knowledge can be reduced to power. Moreover, Sillitoe (2017) has made it clear that Western scientific development experts cannot remain ignorant of IK if they want their work to be not only practically effective but also less open to political manipulation at the expense of the poor. Hence, no matter how much scientists and researchers want to ignore and criticise IKS, it will remain valuable to current issues and will not be easy to ignore. The implication is that the collaboration between this knowledge is vital but some of the IKS and scientists' researchers do not believe in the incorporation of this knowledge.

The developments have emerged as a more 'entangled' view of the two knowledge systems, perhaps reflecting the realities of everyday existence (Briggs, 2005). Despite the differences, it is now possible to examine several cases that elucidate the strengths and weaknesses of science and IKS (DeWalt, 1994). So, it is not wise for these two pieces of knowledge to conflict with each other, while it is possible to incorporate them. This can benefit both by solving the current global issues that need new knowledge and approaches. Safakish (2015) believed that IKS and scientific knowledge are complementary to each other and through integrating them, the contexts of sustainable agricultural and rural development can be provided with minimal damage to the environment and lower costs. Therefore, it is vital to ensure that instead of criticism and conflicts between this knowledge, scholars should strive for the collaboration and incorporation of this knowledge as they both carry essential information that can benefit society. Those from rural communities can play a significant role in ensuring that scientific knowledge reaches local communities by passing on some of their learning to relatives and friends (Sillitoe, 2017). Likewise, scientists who work closely with local communities can do the same by being sympathetic to IK and gaining some understanding of local views in return (Sillitoe, 2017). This will demonstrate the complementary and productive relationship that should exist between scientific and IKS (DeWalt, 1994). With the minimal involvement and lack of youth in farming (Garutsa and Nekhwevha, 2018), IK is still not well studied, therefore, there is still more research that needs to be done to collect and make information available to the current generation.

## **4.5 History of rural farmer's practices in Eastern Cape**

Rural farmers from the EC were not relying on the used manure to fertilise their fields, despite its abundant availability in the kraals where cattle were kept during the night. Perhaps this was because of the sacred role of the cattle kraal in their lives as a society (Hammond-Tooke, 1993). The farmers practiced fallowing every five years (Peires, 1981) and shifting cultivation (Schapera and Goodwin 1937; Brown, 1969) which were the two main methods by which rural farmers addressed declining soil fertility and crop yields in the EC. Rural farmers in the past resorted to magical practices, such as the use of smoke from burning specific animal skins or wild plants over the field or planting particular shrubs on plot edges as charms to ensure good crops (Soga, 1931). This form of "doctoring" aimed primarily at protecting crops from various threats, including pests and diseases. Following planting, men constructed a simple shelter for the female guard and a basic fence of brushwood around the field to deter livestock and wild animals in search of food. After harvest, the fence was repurposed as firewood. Despite these practices, there is limited evidence of significant advancements in techniques or productivity among rural farmers in agriculture during the 17<sup>th</sup> and 18<sup>th</sup> centuries (Blair *et al.*, 2018; Hancock *et al.*, 2020; Moyo and Ravhuhali, 2022). Furthermore, there is scant evidence of famine or widespread impoverishment during the pre-colonial era. The well-being of rural farmers during this period centered around cattle, hunting, cropping, and gathering, with the assurance that if one activity faced challenges, others could be relied upon, even in extreme conditions (Hebinck and Van Averbek, 2007). This proves that farmers have created options for themselves to cope with setbacks that may be caused by weather conditions.

## **4.6. Methodology: Materials and methods**

### **4.6.1 Description of the study area**

The EC province in SA is dominated by soil erosion (Parwada and Van Tol, 2016; Borrelli *et al.*, 2017, 2020; Baade *et al.*, 2024) and ANDM is the area of interest for the study. The ANDM is largely a rural municipality with many rural settlements scattered around the district (Conservation South Africa, 2015). The district is considered the poorest district in the province and in the country. Within the district, the surface area has increased due to the incorporation of Mbizana Local Municipality (LM) which is now called Winnie Madikizela Mandela LM and Ntabankulu LM from 6858 to 11 119 square kilometers and is now subdivided into four local municipalities. Matatiele LM covers 4,352 km<sup>2</sup> (39% of the district area), Umzimvubu

LM spans 2,506 km<sup>2</sup> (23% of the district area), Winnie Madikizela-Mandela (Mbizana) LM encompasses 2,806 km<sup>2</sup> (25% of the district area), and Ntabankulu LM occupies 1,455 km<sup>2</sup> (13% of the district area). All these municipalities are now part of the ANDM according to the Integrated Development Plan (IDP) of 2016. The district is predominantly rural with traditional subsistence agriculture which is the main economic activity and there is a lack of infrastructure. The total population is approximately 936 462 according to census 2022 (Statistic South Africa, 2022).

ANDM is predominantly reliant on farming such as crop and livestock farming, and more than half of all households are involved in agricultural activities. It is one of the most prominent sectors that possess a lot of potential for development. The ANDM IDP of (2021-2022) states that only about 1% to 5% of agricultural output comes from smallholder farmers whose practices are deeply rooted in former homeland subsistence farming practices in the province. The other 95% or so, comes from commercial farming in EC (ANDM IDP, 2021-2022). There is a limited base for economic expansion since most of the farming is traditional subsistence or semi-commercial farming and soil erosion continues to limit agricultural activities. Despite commercial farming producing high input, the EC has the smallest commercial agricultural sector in the ANDM. It is mainly based in Cedarville village within the Matatiele LM (northeast of the district). These lands primarily consist of privately-owned farms in the vicinity of Cedarville and Ongeluksnek Nature Reserve. It is crucial to acknowledge that the rural and economically disadvantaged nature of the district's resident population often leads them to engage in informal subsistence agricultural activities. Unfortunately, these activities are generally not adequately reflected in the official records of national accounts. Erosion and flood-related damage to crop fields or rangelands could have a significant impact on local agricultural livelihoods (Conservation South Africa, 2015).

#### **4.6.2 Identification of farmers**

The study selected participants according to the soil type in each village within the local municipalities of the district. Villages with high soil erosion were prioritised. Consequently, four villages were selected in each local municipality. Within these four selected villages, 21 participants were chosen per village, accounting for a total of 84 participants per local municipality. Therefore, the study had a total sample of 336 participants for the entire district.

Participants were selected from different villages within the same soil type, especially those experiencing high soil erosion rates (see Figure 4.5).

These farmers were then selected to participate in the study, focusing on crop farmers and those who practice both crop and livestock farming. This determination was made during the fieldwork observation. The questionnaires took place (aided by the PRA method) at the participants' homes, where they were actively engaged in farming and visited during data collection. Informed consent letters, written in a language (IsiXhosa) the participants understood, were provided to them before the start of the interview. Table 4.2 below is the selection strategy that was used to identify the participants.

**Table 4.2: Selection strategy of the participants based on the soil type and erodibility**  
(Source: Department of Agriculture, Forestry and Fisheries, South Africa., 2010).

| Soil Type                                     | Soil Erodibility | Place name                                                                 | No. of Participants |
|-----------------------------------------------|------------------|----------------------------------------------------------------------------|---------------------|
| <b>Matatiele LM</b>                           |                  |                                                                            |                     |
| Rhodic Acrisols                               | Medium           | Moyeni                                                                     | 21                  |
| Dystric Regosols                              | High             | Hebron                                                                     | 21                  |
| Eutric Leptosols                              | High             | Lupindo, Bethesda,<br>Nkumpelweni,<br>eNdulini, KwaBhubesi,<br>eNyanisweni | 21                  |
| Lithic Leptosols                              | High             | Mbizeni, Sijoka                                                            | 21                  |
|                                               |                  |                                                                            | <b>84</b>           |
| <b>Umzimvubu LM</b>                           |                  |                                                                            |                     |
| Eutric Regosols                               | Medium           | Esikolweni                                                                 | 21                  |
| Dystric Regosols                              | Medium           | Mabubazi, Mpendle                                                          | 21                  |
| Rhodic Acrisols                               | Low              | Saphukanduku,<br>Sixhotyeni, Goso                                          | 21                  |
| Dystric Regosols                              | Medium and High  | Mvalweni, Dutyini,<br>Kweceni, Mnqwane                                     | 21                  |
|                                               |                  |                                                                            | <b>84</b>           |
| <b>Ntabankulu LM</b>                          |                  |                                                                            |                     |
| Rhodic Ferralsols                             | Low              | Mfula                                                                      | 21                  |
| Dystric Leptosols                             | Low              | KuManqokazi                                                                | 21                  |
| Dystric Leptosols                             | Low              | Ndwana                                                                     | 21                  |
| Rhodic Acrisols                               | Medium           | Bhungeni                                                                   | 21                  |
|                                               |                  |                                                                            | <b>84</b>           |
| <b>Mbizana (Winnie Madikizela Mandela) LM</b> |                  |                                                                            |                     |
| Rhodic Acrisols                               | Low              | Bonda                                                                      | 21                  |
| Dystric Leptosols                             | Low              | Ludeke, Mbobeni,<br>Nqabeni                                                | 21                  |
| Dystric Regosols                              | Low              | Esiqikini                                                                  | 21                  |
| Humic Umbrisols                               | Low              | Ngcingo, Kayamnandi                                                        | 21                  |
|                                               |                  |                                                                            | <b>84</b>           |
| <b>Total Participants in ANDM: 336</b>        |                  |                                                                            |                     |

#### **4.6.3 Sampling method**

Purposive sampling was used in this study to identify relevant participants in the villages. The purposive sampling technique is a form of non-probability sampling that is most effective when one needs to study a certain cultural domain with knowledgeable experts (Tongco, 2007). This method allows the selection to be based on the intended audience relevant to the study. Furthermore, this technique allows researchers to rely on their judgment when choosing members of the population to participate in the study. Campbell *et al.* (2020) emphasised that purposive sampling strategies move away from any random form of sampling and ensure that specific kinds of cases that should be included are part of the final sample in the study. Hence, purposive sampling was used to gather fundamental quantitative data information.

Participants were selected based on their soil type per village within the local municipalities in the district and their involvement in agricultural activities. Therefore, crop farmers, livestock farmers, or those involved in both were chosen to participate in this study. Farmers were identified according to villages that experienced high soil erosion rates within the four local municipalities from ANDM. Participants were visited either in their homes or on their farms where they practiced farming. The sample size for the study was 84 farmers per local municipality, as shown in Table 4.2 above. The study also ensured that interviews were conducted with farmers practicing different commodities such as (cabbage, potato, sweet potato, dry bean, and yellow maize).

#### **4.6.4 Participatory rural appraisal**

Participatory Rural Appraisal (PRA) served as the primary data collection method in this research. This approach is considered one of the most effective and popular methods used to gather information in rural areas. Inglis (1992) states that PRA is a structured process of learning with and from communities about their situations and conditions of life. The purpose of the approach was to shift the paradigm from a top-down to a bottom-up approach, and from a blueprint to a learning process (Cavestro, 2003). It is a participatory approach and method that emphasises local knowledge. This approach was appropriate for the study as it contributed to collecting and understanding the experiences of local rural people from the ground. According to Cavestro (2003), PRA is a methodology that involves learning about rural life and the environment from rural people. The PRA method allowed the study to gather information that provides an understanding of the experiences of local communities and how

they manage their natural resources, such as soil erosion. PRA tools are interactive methods that engage with local communities to understand their environment. In this study, PRA tools and techniques such as questionnaires and direct observation were used to gather primary data.

#### **4.6.6 Primary data collection**

Questionnaires and observations were used to gather data on IKS and the role of local knowledge in managing soil erosion. Questionnaires collected quantifiable data for examining and generalising findings, while observation verified that participants' statements matched the reality in the district. Both methods were facilitated by Participatory Rural Appraisal (PRA), which enhanced communication and knowledge transfer.

##### **4.6.6.1 Quantitative data: Questionnaires**

Quantitative data were gathered through the administration of questionnaires in all four villages within each local municipality in the district, focusing specifically on soil types prone to significant erosion. In total, approximately 84 questionnaires were conducted within each of the four local municipalities, amounting to 336 questionnaires overall (see **Appendix 2** below showing the questionnaire interviews). These questionnaires were administered face-to-face, either at participants' homes or during their farming activities, with each session lasting around 45 minutes. Local rural farmers were visited at their locations, and interview schedules were based on their availability. The study ensured comprehensive coverage by selecting participants in a manner that encompassed all soil types susceptible to high erosion and agricultural commodities within each local municipality, village by village, as shown in Table 4.3 below.

**Table 4.3: Available crops and livestock that farmers have in ANDM**

| <b>Commodity</b> | <b>Livestock</b> |
|------------------|------------------|
| Cabbage          | Cattle           |
| Potato           | Sheep            |
| Sweet Potato     | Goats            |
| Dry Bean         | Chicken          |
| Maize            | Pigs             |

Some farmers also practiced livestock farming (see Table 4.3). These participants filled out the questionnaire and provided valuable information about soil erosion. All questionnaires were conducted face-to-face in their home language, IsiXhosa, which participants understand. These farmers were purposively selected for the study because they possess extensive local IK accumulated over generations through local experiments and innovations. They are the ones most knowledgeable about soil and likely possess extensive knowledge about soil erosion management and prevention.

#### **4.6.6.2 Direct observation**

Direct observation was conducted in four municipalities to verify the findings from questionnaires and to potentially discover solutions. This method generates on-the-spot questions through direct interaction with participants (Cavestro, 2003). The process involved walking around the selected local municipalities, focusing on community farmers and practices that contribute to soil erosion prevention and management, including those based on IKS.

Purposive sampling was employed during direct observation to ensure participants' statements corresponded with the reality in the district. According to Cavestro (2003), interview responses reflect mental constructions of activities rather than precise depictions of reality. Direct observation facilitated cross-checking and verification of information collected from participants, playing a crucial role in validating questionnaires and minimising potential disadvantages during data collection. Consequently, the observation method significantly contributed to obtaining primary data on farmers' soil management strategies.

#### **4.6.7 Secondary data**

Gathering secondary data was essential in this study to integrate and complement the existing literature with primary data. Clark (2013) defined secondary data as information that has already been collected by someone else and is available for researchers to use. Thus, the study utilised secondary data that is publicly available and accessible. Google Scholar served as the primary tool for obtaining secondary data relevant to the study. Secondary data sources included journal articles (academic reviews), literature, and academic books. Government websites were visited to access recent Integrated Development Plans (IDPs) for ANDM, as well as IDPs from the four local municipalities within the district. Additionally, newspaper articles, case studies, maps, and photographs were utilised in the study.

#### **4.6.8 Data analysis technique**

Statistical Package for Social Sciences (SPSS) version 22.0 was used in the study to analyse quantitative data. The collected questionnaires were analysed using SPSS software. SPSS is a widely recognised and powerful software for quantitative data analysis, primarily used for generating descriptive statistics and conducting bivariate analyses of datasets. The questionnaires specifically targeted rural farmers within the district under investigation to find their soil management strategies. SPSS facilitated the analysis of 336 questionnaires collected from various villages and produced the study's findings.

#### **4.6.9 Ethical considerations**

For this study, ethical clearance was obtained from the University of KwaZulu-Natal Research Ethics Committee (**HSSREC/00005087/2022**) and was attached to **Appendix 4** below. Therefore, questionnaire interviews were conducted face-to-face after obtaining permission from the ethics committee. Informed consent letters were provided to all relevant stakeholders in their language, and interviews commenced after receiving permission (see **Appendix 3** below). A gatekeeper's letter requesting permission was also obtained to conduct questionnaire interviews with local rural farmers. Additionally, communication was made with gatekeepers in the district municipality to arrange for data collection and observation visits. The gatekeeper's letter was granted for the study, and the database of local farmers in all four local municipalities within the district was obtained. After obtaining permission, questionnaires and observation were conducted.

## **4.7 Results and Discussion**

Questionnaires (336) were administered, each taking about 40 minutes to complete. Some participants, especially older farmers, requested assistance in filling out the questionnaires, while others completed them independently. The purpose was to find farmers soil erosion management techniques that they use locally in their villages.

### **4.7.1 Soil types and soil erodibility**

Figure 4.2 and Figure 4.3 below illustrate soil type distribution and soil erodibility, respectively, based on the data presented in Table 4.2 above. Figure 4.3 below provides insights into the likelihood of soil erosion across various soil types, as determined through observations and soil erodibility assessments. It was observed that Dystric Regosols, Eutric Leptosols, and Lithic Leptosols are the soil types most susceptible to high levels of soil erosion within ANDM (Department of Agriculture, Forestry and Fisheries (DFFE) South Africa, 2010). These findings are supported by the soil erodibility k-factors illustrated in Figure 4.3, which predominantly range between 0.114536 and 0.114535 for these soil types. The next highest erodibility range is relatively lower, ranging between 0.200384 and 0.256723, with another range of 0.054255. The highest soil erodibility k-factor, ranging from 0.256724 to 0.325099, is observed primarily in Mbizana LM, particularly near the coasts and in low-lying areas. These observations highlight that Dystric Regosols, Eutric Leptosols, and Lithic Leptosols face a high risk of soil erosion, due to their corresponding soil erodibility k-factors and field observations. This information can guide efforts to mitigate soil erosion in these areas. Participants were selected based on soil types and erodibility levels in conjunction with these observations.

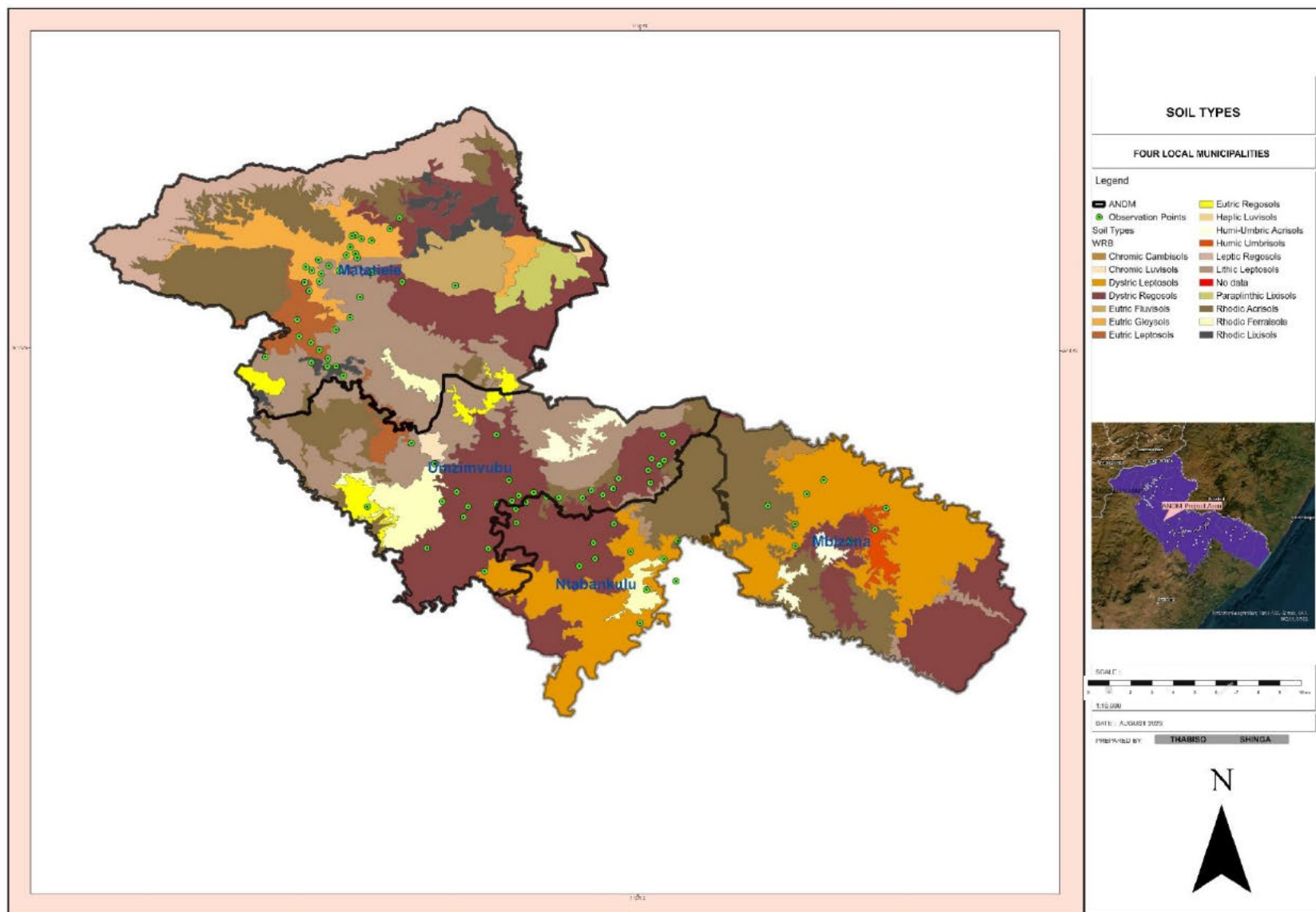


**Figure 4.2: Soil types with the observation points to the four visited local municipalities of ANDM (authors creation)**

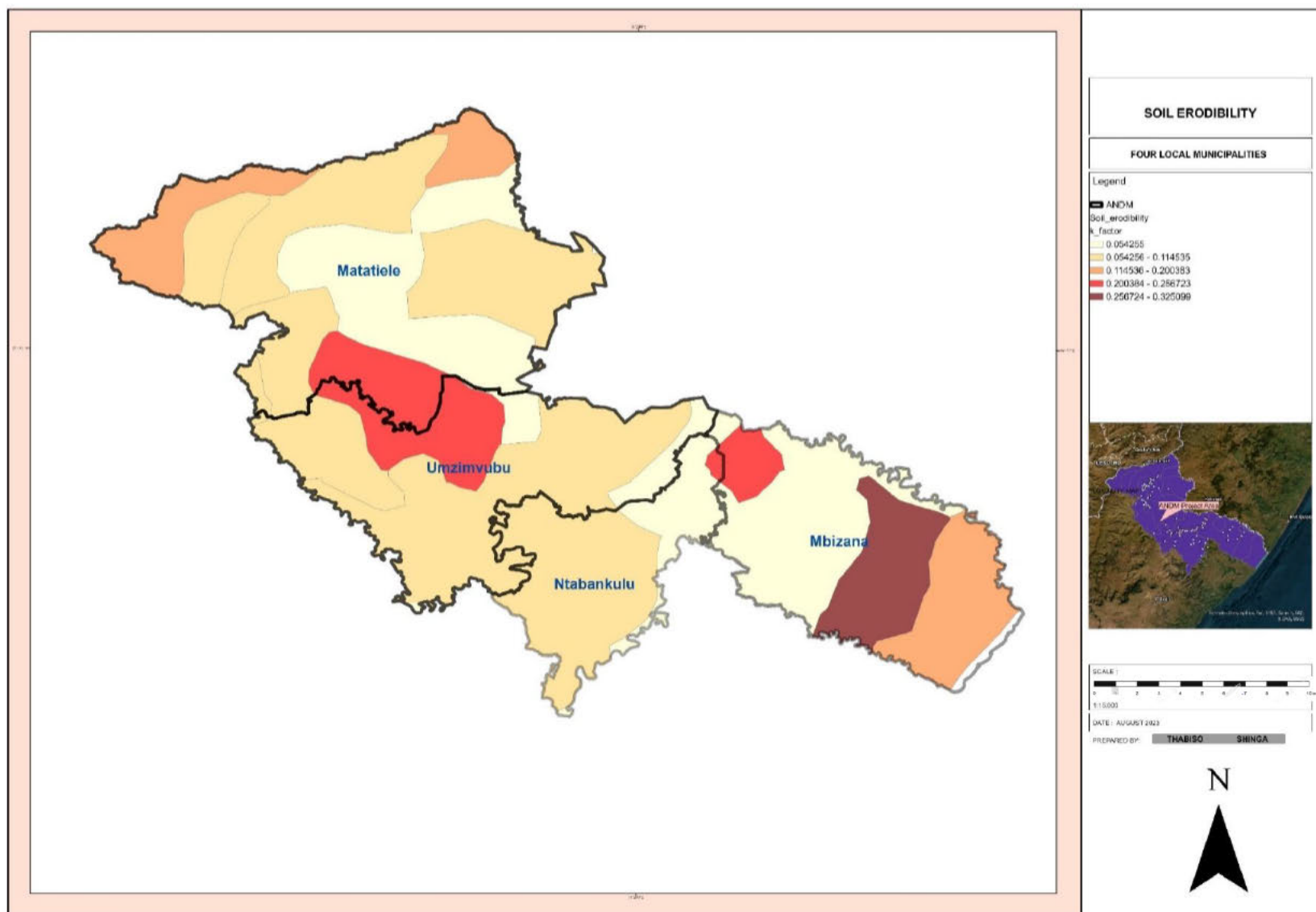


**Figure 4.3: Soil erodibility**

#### **4.7.2 The demographic analysis of rural farmers**

The demographic results in Table 4.4 showed that the majority of the participants (58.3%) were males while 41.7% were females. This indicates a larger representation of males among the selected respondents. The age group results indicated that there were 29.8% of participants were between the ages of 46 to 55 years followed by 25% who were between 56 to 65 years. There were 21.4% of participants between the ages of 36 to 45 years and 14.4% that were 66 years and older. Only 9.5% of participants were between 26 to 35 years of age which is mainly the youth. Hence, these age group results indicate that there are close to 90% of participants that were selected were more than 35 years of age while only 9.5% of the youth were between 26 and 35 years.

The results indicate a lack of youth involvement in farming within the district as there are fewer young people who are actively farming. This has also been demonstrated by the participants who were more than 35 years of age that there is a lack of youth in farming which is a concern to old age experienced farmers. It was also further demonstrated by (Garutsa and Nekhwevha, 2018) that the youth is minimally involved in farming. Furthermore, of the total of 336 participants, the majority were Black people (96.4%) while only 3.6% were coloured people. Much of the selected participant population belonged to the Black ethnic group, which is reflective of the demographics of the region, including the whole of ANDM and its local municipalities. Therefore, the selected participant's population group were mainly dominated by black people as they are the majority in the EC and the whole of ANDM including its four local municipalities. In rural areas of ANDM, most people who reside in rural areas are Black people, hence the majority of the participants were black. Overall, the demographic data provides insights into the age, gender, and ethnicity of the participants at ANDM.

**Table 4.4: Demography of experienced farmers of ANDM, Eastern Cape, South Africa**

| Demographics     | Category | Percentages (%) |
|------------------|----------|-----------------|
| Gender           | Males    | 58.3            |
|                  | Females  | 41.7            |
| Age group        | 26 - 35  | 9.5             |
|                  | 36 - 45  | 21.4            |
|                  | 46 - 55  | 29.8            |
|                  | 56 - 65  | 25.0            |
|                  | > 66     | 14.4            |
|                  |          |                 |
| Population group | Black    | 96.4            |
|                  | Coloured | 3.6             |
| <b>Total</b>     |          | <b>100</b>      |

#### **4.7.2.1 Level of education and training skills that the selected farmers possess.**

Of the total of 336 participants (see Figure 4.4), the majority (63.10%) had no formal education. Participants who went to primary school, secondary school, matriculated and tertiary were 9.52%, 11.90%, 8.33% and 4.76%, respectively. The other 2.38% specified their education status in terms of training and some have done learnerships and short courses in farming to strengthen their knowledge into farming. Therefore, the majority of participants within ANDM had no formal education and relied on their knowledge of farming.

Knowledge and education play a significant role in the rural livelihoods of the farmers. Although farming is widely known as having no formal education requirements, rural farmers need to possess agricultural knowledge about plants and animals. However, even though formal education is not a requirement for farming, rural farmers still need to possess agricultural knowledge related to plants and animals. Participants often acquire this knowledge from sources other than formal education, such as from their parents, fellow farmers, or learning through their own farming experiences. Figure 4.4 results, demonstrate that soil erosion management knowledge, in this case, was often obtained from parents, peers, and hands-on experience. This has been demonstrated by (Sillitoe, 2017; Jiménez *et al.*, 2024) that farmers largely acquire their knowledge of farming from their relatives. The data suggests that a significant majority of participants within ANDM had no formal education. Therefore, they rely heavily on their acquired knowledge and experience in farming.

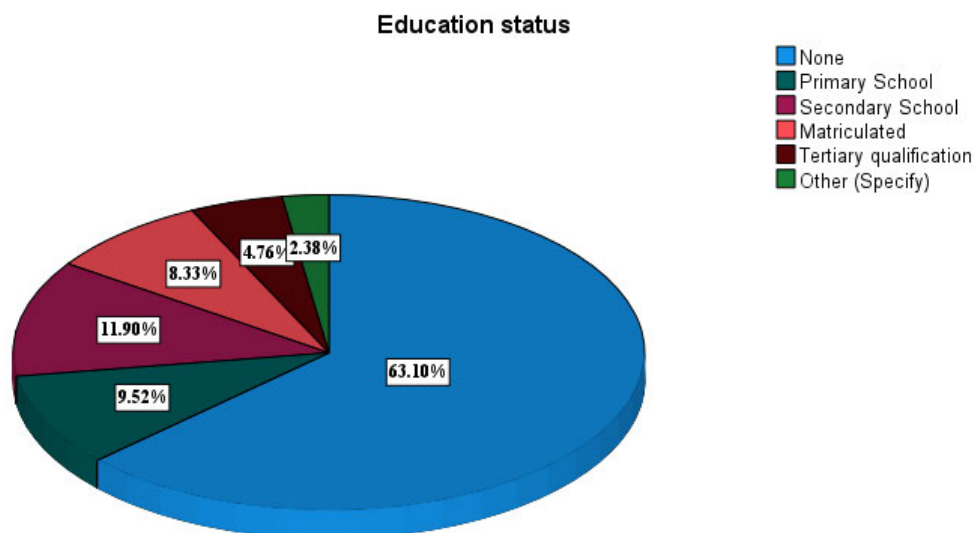


**Figure 4.4: Level of education status of the ANDM farmers**

The information provided highlights the fact that while formal education is not a prerequisite for farming, having practical agricultural knowledge is crucial for rural farmers knowledge. Participants at ANDM primarily gained farming knowledge through intergenerational transmission, interactions with other farmers, and learning by doing. This underlines the importance of local and IK in sustainable agricultural practices, particularly in contexts where formal education may be limited or inaccessible.

#### **4.7.2.2 Agricultural training that rural farmers posses**

Farmers were asked if they ever conducted agricultural training to understand their background knowledge in managing soil erosion, and a majority (75%) said they never had any agricultural training while (25%) said they did some agricultural training, (see Figure 4.5). As shown in Table 4.5 some participants were able to mention their training method and organisation where agricultural training was obtained although the majority of 256 (76.2% in red colour text below) had none. These results are in line with the observation that the majority of farmers relied on IK for farming. IKS can play a key role in the design of sustainable agricultural systems, increasing the likelihood that rural populations will accept, develop, and maintain innovations and interventions.

These results highlight that reliance on IKS for farming is common among the participants. Although the majority of the farmers had some training, the majority of farmers relied on the available local knowledge for farming. This aligns with the findings of (Mosissa *et al.*, 2017) that emphasise the importance of utilising IK for enhancing agricultural practices and development. Managing knowledge within the communities enhances agricultural development as rural communities in a developing country have extensive IKS. The majority of participants relied on IK for their farming practices. IK can play a crucial role in shaping sustainable agricultural systems, as it is often rooted in local contexts and practices. Some participants did mention receiving training from sources like schools, municipalities, and extension workers. Even among those who received some formal training, it is evident that local knowledge remains an integral part of their farming practices. The quote provided above emphasises the role of various knowledge sources, including parental guidance, school, and extension workers. In summary, the majority of farmers at ANDM, whether they received formal agricultural training or not, rely on IK for their farming practices. This underscores the significance of local knowledge in shaping soil management strategies and sustainable agricultural practices within the context of rural communities.

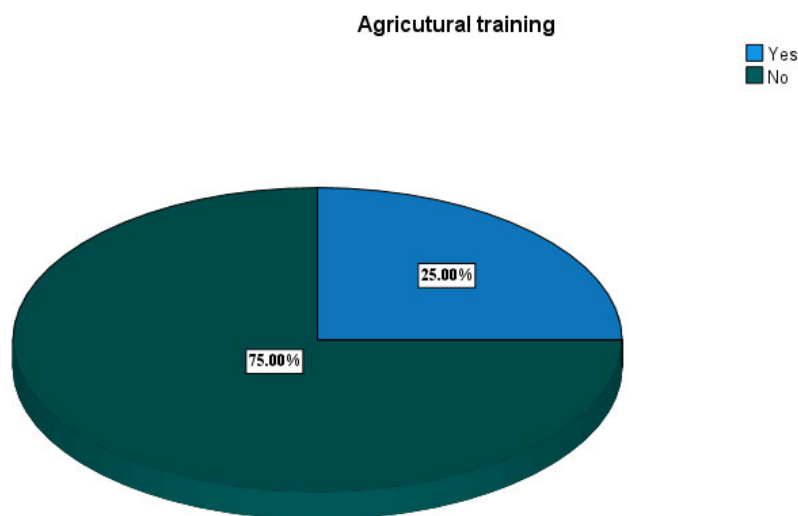


**Figure 4.5: Farmers that possess agricultural training skills to enhance or advance their knowledge in managing soil.**

**Table 4.5: Different types of agricultural training that selected farmers obtained.**

| <b>Training Type (Explain)</b> |                                                 | <b>Frequency</b> | <b>Percent</b> |
|--------------------------------|-------------------------------------------------|------------------|----------------|
| Valid                          | Agricultural Research Council (ARC)             | 4                | 1.2            |
|                                | Agricultural Training                           | 8                | 2.4            |
|                                | Agriculture by Profession                       | 4                | 1.2            |
|                                | Department of Agriculture and Rural Development | 4                | 1.2            |
|                                | Extension Workers Training                      | 16               | 4.8            |
|                                | Farming training but it has been a while        | 4                | 1.2            |
|                                | Farming Workshop Training                       | 4                | 1.2            |
|                                | Fruit farming learnership                       | 4                | 1.2            |
|                                | Learnership                                     | 4                | 1.2            |
|                                | N6 Tertiary Farming Training                    | 4                | 1.2            |
|                                | NGO Agricultural Training                       | 4                | 1.2            |
|                                | None                                            | 256              | 76.2           |
|                                | SETA Agricultural Training                      | 4                | 1.2            |
|                                | SETA Training                                   | 4                | 1.2            |
|                                | Training for planting potatoes and cabbages     | 4                | 1.2            |
|                                | Training from Cedara College of Agriculture     | 4                | 1.2            |
|                                | Training in planting tomatoes and potatoes      | 4                | 1.2            |
|                                | <b>Total</b>                                    | <b>336</b>       | <b>100.0</b>   |

#### 4.7.2.3 Socio-economic factors in the livelihoods of rural farmers

The results as shown in Table 4.6 indicate that the most participants (57.1%) in the four villages within the four local municipalities in ANDM were unemployed. The other 19% of them have indicated a number of their employment status as they have private businesses and corporations that they run as farmers. There were 11.9% of farmers were retired and only 6% were working full-time, 2.45% part-time. Some of the 3.6% were still seeking opportunities and it was mainly the youth. The high percentage of unemployment (57.1%) could be attributed to factors such as illiteracy and limited economic opportunities in the selected rural communities. Furthermore, the results for household size as shown in Table 4.6 indicate that 41.7% of the participants live in households with 1-2 members while there were 35.7% of the households have 3-4 members. Only 17.9% said they live with 5 or more members in their household while only 4.8% said they do not live with anyone in their household.

Participants who are unemployed or no longer working mentioned the use of farming to generate income and support their families. Farming is seen as a way to supplement income and meet various needs, such as education for children. This indicates that farming is viewed as a source of additional income or a way to fill the gap left by other employment opportunities.

Baade *et al.* (2024) argue that agriculture can significantly improve economic conditions and livelihoods, especially in developing countries. However, land degradation undermines these benefits by increasing socioeconomic issues, which can force rural communities to migrate and lead to conflicts over diminishing arable land (FAO, 2019). This means that they are no longer able to continue implementing their strategies for managing soil erosion within their farm. The data also indicates that household sizes vary among participants, with a significant portion living in smaller households with 1 to 4 members. Overall, the information underscores the complex relationship between employment, household size, and the role of farming in providing economic support and livelihoods within the communities studied.

**Table 4.6: Socio-economic factors**

| Socio-Economic       | Category                        | Percentages (%) |
|----------------------|---------------------------------|-----------------|
| Employment status    | Full-time                       | 6               |
|                      | Part-time                       | 2,4             |
|                      | Seeking opportunities currently | 3,6             |
|                      | Unemployed                      | 57,1            |
|                      | Retired                         | 11,9            |
|                      | Other (Specify)                 | 19              |
|                      | None                            | 4,8             |
| Number of dependents | 1 – 2                           | 41,7            |
|                      | 3 – 4                           | 35,7            |
|                      | > 5                             | 17,9            |
| <b>Total</b>         |                                 | <b>100</b>      |

#### 4.7.2.4 Farmers main source of income (Add references)

As illustrated in Table 4.7 a significant majority of rural farmers at ANDM, approximately 95.05%, indicated that farming is their primary activity for sustaining their livelihoods. This suggests that a large portion of the participants rely on farming as their main way of making a living. On the other hand, only a small percentage, around 5.95% of the participants, who stated that farming is not their primary activity, are engaged in other activities alongside farming. These individuals typically have private businesses that are unrelated to farming. The group includes mainly men, some of whom work on a full-time basis while others work part-time.

In terms of viewing farming as a source of income, about 67.86% of the participants consider farming to be their primary source of income. This finding suggests that for a significant portion

of the participants, the income generated from farming plays a crucial role in supporting their livelihoods. However, approximately 32.16% of the participants stated that farming is not their main source of income. This subgroup comprises individuals who receive social government grants, and retirement income or are employed in full-time or part-time jobs outside of farming. Overall, Table 4.7 results highlight that the majority of participants rely on farming as their main activity to sustain their livelihoods, even though a portion of them engage in other activities simultaneously. Additionally, while a significant portion considers farming as their primary source of income, there is also a notable group for whom farming is not the main income source due to factors like social grants, retirement income, or other employment opportunities. Those reliant on farming indicated that they practice sustainable farming and manage soil nutrients to sustain their livelihoods.

**Table 4.7: Presents the farmers main sources of income**

|                       | <b>Category</b> | <b>Percentages (%)</b> |
|-----------------------|-----------------|------------------------|
| Primary activity      | YES             | 94,05                  |
|                       | NO              | 5,95                   |
| Main source of income | YES             | 67,86                  |
|                       | NO              | 32,16                  |
| <b>Total</b>          |                 | <b>100</b>             |

The results for farming income as shown in Figure 4.6 indicate that 47.62% of the participants are receiving income from both crop and livestock farming. However, more participants are receiving income from crop farming (42.86%) compared to livestock farming (9.52%). Therefore, about 90% of the selected participants were mainly practicing crop farming in the ANDM as the study focused mainly on crop farmers rather than livestock. This information provides insight into the income sources of the participants and the predominant focus on crop farming within ANDM. It indicates that crop farming is a significant contributor to the livelihoods of participants in the ANDM.

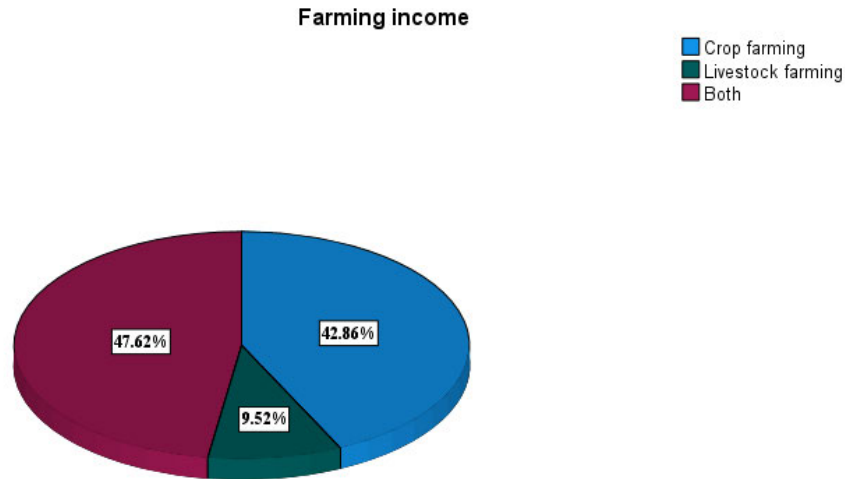


**Figure 4.6: Showing the most profitable farming enterprise for the selected farmers.**

#### **4.7.3 Perceptions of local farmers about their involvement and role in soil erosion management**

The perceptions and overall understanding of rural farmers about their involvement and role in managing soil erosion are not different significantly. However, the participants majority were small-scale farmers (67.86%) followed by subsistence farmers (26.19%) and semi-commercial farmers (5.95%) as illustrated in Figure 4.7 below. These findings are consistent with the information from the (ANDM IDP, 2021-2022), which noted that the district primarily consists of small-scale farmers. Only a few commercial farmers are located in specific areas, such as Cedarville village in Matatiele LM. This information suggests that the majority of farmers in the ANDM fall under the categories of small-scale and subsistence farming. These results align with the district's profile and emphasise the prevalence of small-scale farming practices in the area. Understanding these different farmer types and their roles in managing soil erosion can be valuable for addressing environmental challenges and developing targeted interventions within the context of ANDM.

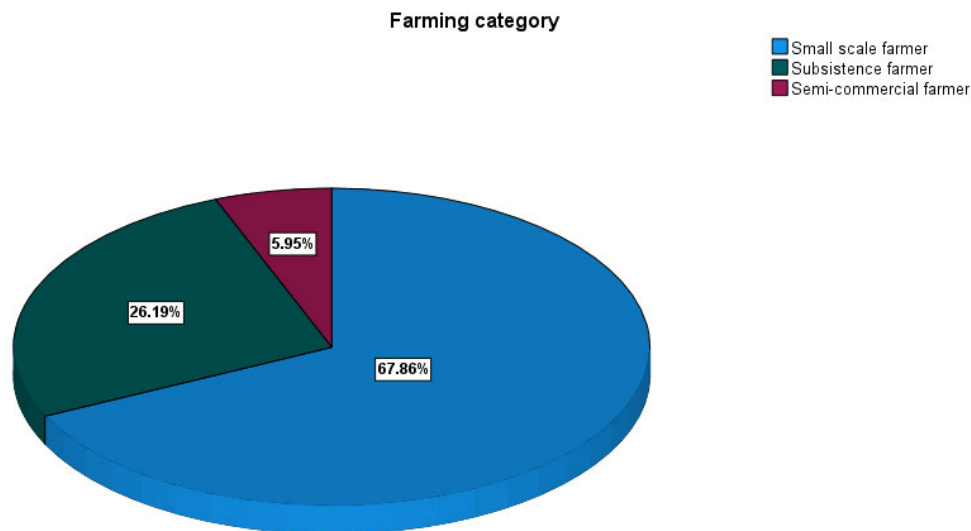


**Figure 4.7: Categories of farmers that they consider to be falling under.**

Figure 4.8 depicts the crop commodities cultivated by farmers on their land. Maize production stands out, engaging over half of the participants (59.52%), followed by vegetable production with more than a quarter (32.14%). Bean production accounted for 7.14%, while fruit production was the choice for only 1.19% of participants. These findings align with the observable trend of maize cultivation being prevalent throughout the ANDM region. The distribution of crop commodities practiced by farmers provides insight into the agricultural landscape and priorities within the ANDM. These findings underscore the dominance of maize production and the significant role of vegetable production in the farming practices of the ANDM-selected participants. The data reflects the agricultural preferences and priorities of the farmers within the context of the ANDM.

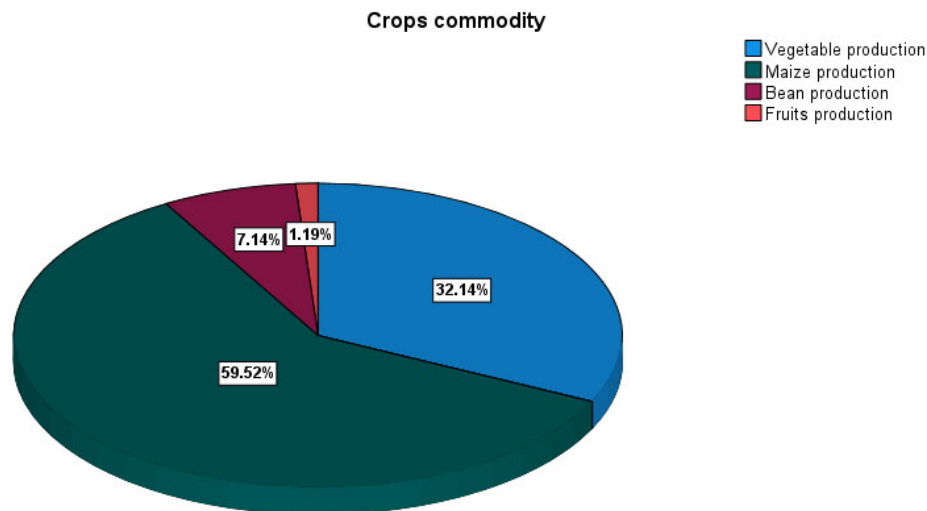


**Figure 4.8: Crops that are grown by the farmers.**

Table 4.8 below presents insightful data regarding the duration of farmers' engagement in crop farming and the land sizes they work with. As outlined in Table 4.8, a significant portion of the participants (33.35%) have been practicing farming for 21 years or more, indicating their considerable experience. Participants with 6 to 10 years of experience account for 23.8%, while those with 16 to 20 years make up 17.9%. A combined 16.7% fall into the categories of 11 to 15 years and 1 to 5 years, underlining the prevalence of experienced farmers in the study.

Moving to land size (as shown in Table 4.8 below), more than half (57.1%) of the farmers cultivate land between 1 to 5 hectares (ha) in size, highlighting the prevalence of small-scale farming practices. Those with land sizes ranging from 6 to 10 ha constitute 27.4% of participants, while a smaller percentage (8.3%) work on land exceeding 16 ha. Land sizes between 11 to 15 ha were indicated by 6% of participants, and the minority (1.2%) worked on plots smaller than 1 ha. These findings underscore the dominance of small-scale farming in the ANDM. Notably, several participants expressed concerns about land availability, with ownership often vested in traditional leaders or chiefs within their villages. The limitation of land size for smallholder farming contributes to challenges related to productivity and income. This situation perpetuates a cycle of low agricultural output and constrained economic progress among rural farmers in ANDM.

**Table 4.8: Number of periods of farmers practicing crop farming and land size**

| Number of periods<br>practicing crop<br>farming |               |            |              | Land size           | Frequency  | Percent      |
|-------------------------------------------------|---------------|------------|--------------|---------------------|------------|--------------|
|                                                 |               | Frequency  | Percent      |                     |            |              |
| Valid                                           | 1 - 5 Years   | 28         | 8.3          | < 1 Hectare         | 4          | 1.2          |
|                                                 | 6 - 10 Years  | 80         | 23.8         | 1 – 5<br>Hectares   | 192        | 57.1         |
|                                                 | 11 - 15 Years | 56         | 16.7         | 6 – 10<br>Hectares  | 92         | 27.4         |
|                                                 | 16 - 20 Years | 60         | 17.9         | 11 – 15<br>Hectares | 20         | 6.0          |
|                                                 | > 21 years    | 112        | 33.3         | > 16 Hectares       | 28         | 8.3          |
|                                                 | <b>Total</b>  | <b>336</b> | <b>100.0</b> |                     | <b>336</b> | <b>100.0</b> |

#### 4.7.3.1 Land ownership

Table 4.9 below, presented below, illuminates the distribution of land ownership. Nearly 91.7% of the land is owned by traditional authorities, signifying their dominant control. In contrast, a mere 4.4% of participants possess land ownership. A smaller portion (2.4%) specifies alternative arrangements, such as renting land from other farmers or landowners. The state's ownership represents only 1.2%, underscoring the limited role of the municipality in land ownership. This data reflects that land ownership predominantly rests with traditional authorities within the ANDM region. However, it pertains specifically to the villages selected for this study, which may not accurately represent land ownership across the entire district. This situation underscores the significance of addressing land ownership issues to provide rural farmers with the fertile and sufficient land they require for sustainable livelihoods (Schapera and Goodwin 1937; Brown, 1969). Land ownership holds paramount importance for rural farmers, serving as the foundation for their livelihoods (Blair *et al.*, 2018; Hancock *et al.*, 2020; Moyo and Ravhuhali, 2022). The farmers have expressed valid concerns about the limitations they face regarding land size and ownership, particularly as they strive to achieve a "living income" capable of supporting various essentials such as food security, nutritious sustenance, adequate housing, education, and healthcare.

**Table 4.9: Land ownership**

| <b>Land ownership</b> |                                                                | <b>Frequency</b> | <b>Percent</b> |
|-----------------------|----------------------------------------------------------------|------------------|----------------|
| Valid                 | Traditional authority land                                     | 308              | 91.7           |
|                       | State-owned land (municipal, central or provincial government) | 4                | 1.2            |
|                       | Own land                                                       | 16               | 4.8            |
|                       | Other (Specify)                                                | 8                | 2.4            |
|                       | <b>Total</b>                                                   | <b>336</b>       | <b>100.0</b>   |

#### 4.7.4 Soil conservation in crop and livestock farming

Soil conservation is a vital aspect of farming, encompassing practices that safeguard soil from degradation. In rural areas, farmers rely on a range of local IKS techniques to protect their soil and prevent erosion. Table 4.10 below outlines the prevalent soil conservation methods employed by farmers in ANDM villages. The majority of farmers (48.8%) cited contour intervals as their primary soil conservation technique, see Figure 4.16 Photo. While this technique is commonly used, farmers also implement other strategies, such as fallow/ridge planting, mulching, and crop rotation, similarly accounting for 9.5%. Similarly, planting trees/grass and constructing stone walls are employed by 6% of farmers. Less frequently used methods include incorporating crop residues/waste, animal manure, gabion walls, and associated crops, each reported by 2.4%, 1.2%, 1.2%, and 3.6% of farmers, respectively. A small fraction (2.4%) mentioned employing alternative techniques, specifying various approaches.

Mulches like leaves, grass, and plant residue-derived straw are commonly used to conserve soil and water, enhancing fertility and nutrient supply (Altieri *et al.*, 2004). Collaborating with local communities is vital for effective soil erosion management and agricultural development (Winklerprins and Sandor, 2003; Kamla-Raj, 2004). Soil conservation stands as a notable example of IKS applied by rural farmers in ANDM, aimed at bolstering food production, security, and combating soil erosion. The synergy of contouring, fallowing, organic manures, mulching, vegetation planting, stone walls (see Table 4.10), and crop rotation plays a pivotal role in soil conservation (Garutsa and Nekhwevha, 2018). Contouring, highlighted in Figure 4.12, is especially popular in various villages, a technique embraced by both men and women

farmers. Elderly individuals, as custodians of IKS, often lead in preserving them, contributing significantly to food security and sustainable farming.

These findings resonate and align with ethnopedology's view (Winklerprins and Sandor, 2003; Barrera-Bassols and Zinck, 2002; Barrera-Bassols and Zinck, 2003; Ajibade, 2008; Brinkmann *et al.*, 2018; Morales *et al.*, 2023), asserting that local soil erosion knowledge is intricate, multifaceted, and vital in conservation. Regrettably, the use of modern inputs like fertilisers and pesticides has diminished indigenous soil conservation practices, leading to degradation (Garutsa and Nekhwevha, 2018). Reviving IKS is pivotal for sustainable soil resource management (Matshameko *et al.*, 2022; Baade *et al.*, 2024; Pangapanga-Phir *et al.*, 2024), necessitating their promotion within rural areas.

**Table 4.10: Soil conservation in crop farming**

|       | <b>Soil conservation in crop farming</b> | <b>Frequency</b> | <b>Percent</b> |
|-------|------------------------------------------|------------------|----------------|
| Valid | Contour intervals                        | 164              | 48.8           |
|       | Planting trees/grass                     | 20               | 6.0            |
|       | Stone walls                              | 20               | 6.0            |
|       | Fallow/ridge planting                    | 32               | 9.5            |
|       | Incorporate crop residues/waste          | 8                | 2.4            |
|       | Incorporate animal manure                | 4                | 1.2            |
|       | Gabion wall                              | 4                | 1.2            |
|       | Mulching                                 | 32               | 9.5            |
|       | Associated crops                         | 12               | 3.6            |
|       | Crop rotation                            | 32               | 9.5            |
|       | Other (Specify)                          | 8                | 2.4            |
|       | <b>Total</b>                             | <b>336</b>       | <b>100.0</b>   |

Table 4.11 below presents the utilisation of IKS in livestock-based soil conservation strategies for soil fertility enhancement in ANDM. Notably, 13.1% of farmers were not engaged in livestock farming, leaving 292 participants (86.9%) out of the total 336 questionnaire respondents. Among them, a range of IKS methods were employed, including changing grazing lands, planting trees/grass, constructing stone walls, implementing fencing, and controlling livestock numbers. The dominant technique employed by farmers who had livestock was changing grazing lands, accounting for 46.4%, highlighting its significance in preventing soil erosion. Fencing emerged as the second most used method, adopted by 16.7% of farmers. Comparatively less prevalent were techniques such as planting trees/grass, building stone

walls, and limiting livestock numbers, constituting 6%, 4.8%, and 4.8% respectively. A subset of farmers (8.3%) cited alternative methods, specifying their usage.

A noteworthy observation is the crossover between soil conservation strategies in crop and livestock farming. Techniques like planting trees/grass and constructing stone walls are applied by farmers in both contexts to combat soil erosion, see photos illustrated from Figure 4.9 to 4.12. Changing grazing practices emerged as a crucial strategy, facilitating vegetation regrowth and livestock feeding, thereby mitigating soil erosion risks. Therefore, engaging local communities remains pivotal for effective soil erosion management, agricultural development, and conservation (Kamla-Raj, 2004). The practice of changing grazing lands is fundamental for soil preservation, and resonates with the practical wisdom of the farmers, reinforcing the value of combining IKS with modern strategies for sustainable agriculture and land use.

**Table 4.11: Soil conservation strategies in livestock farming**

| Soil conservation strategies in livestock farming |                                  | Frequency  | Percent      |
|---------------------------------------------------|----------------------------------|------------|--------------|
| Valid                                             | Changing grazing lands           | 156        | 46.4         |
|                                                   | Planting trees/grass             | 20         | 6.0          |
|                                                   | Stone walls                      | 16         | 4.8          |
|                                                   | Fencing                          | 56         | 16.7         |
|                                                   | Limiting the number of livestock | 16         | 4.8          |
|                                                   | Other (Specify)                  | 28         | 8.3          |
|                                                   | Total                            | 292        | 86.9         |
| Missing                                           | System                           | 44         | 13.1         |
| <b>Total</b>                                      |                                  | <b>336</b> | <b>100.0</b> |



**Figure 4.9: The stone wall (left) in Matatiele LM and the type of vegetation (vetiver grass) that is planted in grazing lands to prevent soil erosion (right) in Umzimvubu LM.**

The predominant adoption of IKS by farmers for soil fertility conservation is attributed to its ease of implementation. Many farmers find these traditional practices accessible and straightforward to execute. Moreover, the economic rationale is apparent, as inorganic fertilisers can be costly. In contrast, the materials and facilities required for IKS are readily available to farmers and are more economical compared to modern methods. Farmers' preference for IKS practices is grounded in their affordability and ecological compatibility. The practices of yesteryears are seen as financially advantageous, leading to their sustained utilisation. This aligns with the notion that IKS practices offer cost-effective solutions, which resonates with earlier findings by Kamla-Raj (2004). The practical and economic benefits of traditional practices underscore their continued relevance in contemporary agricultural contexts.



**Figure 4.10: Two activities, fencing used by farmers on the right and land preparation for plantation on the left, near the Matatiele LM border.**



**Figure 4.11: Two scenes: a vegetable plantation on the left and the prevalent fencing types near home croplands with the ongoing questionnaire on the right, within Umzimvubu LM.**



**Figure 4.12: Two scenes: a maize plantation and soil erosion on hill slope areas on the left, and the method of contouring system to prevent soil erosion in maize plantation on the right, within Umzimvubu LM.**

#### **4.7.4.1 Soil indicators**

Figure 4.13 below portrays the soil indicators mentioned by farmers, encompassing soil type, soil monitoring, soil texture, soil depth, and topsoil/rooting. Among these indicators, soil type, which includes sand, silt, and clay (38.10%), stands as the most utilised parameter for discerning soil quality and fertility. Following closely is soil monitoring (22.62%), demonstrating its significance as a tool for assessment. Topsoil/rooting (19.05%) emerges as another prominent indicator employed by farmers to gauge soil quality. In contrast, fewer farmers mentioned considering soil depth (8.33%) and soil texture (7.14%) for assessment purposes. A modest fraction (4.76%) specified employing distinct methodologies for recognising soil quality and fertility on their farms. The results highlight the diverse set of indicators that farmers leverage to comprehend soil attributes. Among them, soil type emerges as a pivotal marker, enabling farmers to discern soil quality based on its composition. The prevalence of soil monitoring underscores its value in gauging ongoing changes in soil conditions. Farmers' acumen in selecting and interpreting these indicators reflects their deep understanding of their agricultural environment. Morales *et al.* (2023) noted that farmers incorporate criteria such as texture, structure, colour, and the presence of specific plant species as ethno-indicators. Similarly, Jiménez *et al.* (2024) identified key soil attributes emphasised by farmers, including texture, colour, depth, stoniness, and workability. This shows that ethnopedology is still relevant and practiced in the district, as people are able to identify their soil indicators.

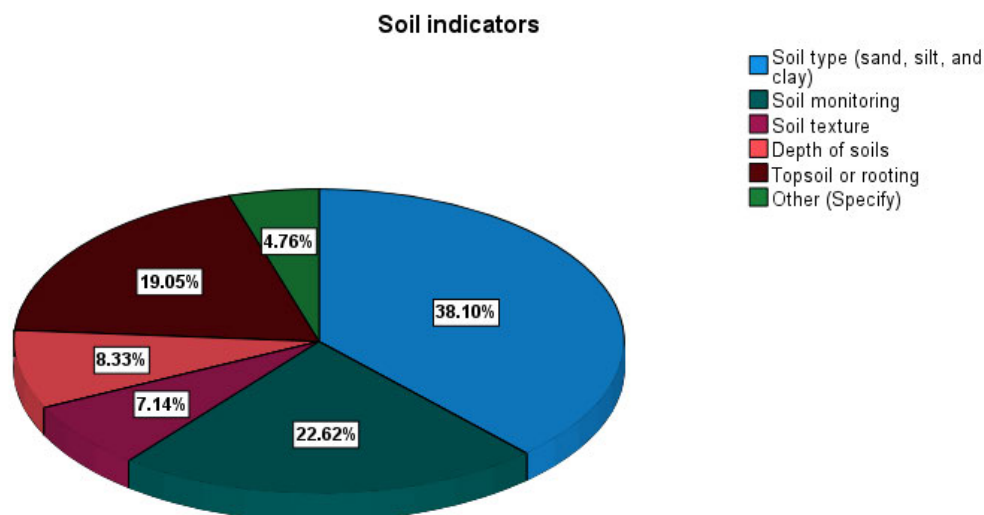


**Figure 4.13: Type of soil indicators/properties used by farmers.**

#### 4.7.4.2 Knowledge acquisition for crop farming

Table 4.12 below elucidates the various channels through which farmers acquire knowledge about soil management for crop farming. Predominantly, family elders emerge as the primary source, cited by the majority (52.4%) of farmers. Following this, 15.5% of farmers rely on their own accumulated knowledge, while 11.9% gather insights from fellow farmers. This underscores the pivotal role of intergenerational knowledge transfer, as farmers predominantly draw from the wisdom of their elders, reflecting the enduring value of ancestral practices. This has been reflected by Barrera-Bassols and Zinck (2003) noting the importance of old ways in which local knowledge concerning soil management was used. This practice not only benefits their farming endeavours but also ensures the preservation of IKS across generations.

Moreover, rural farmers display a readiness to embrace novel concepts aimed at enhancing their farming practices. Engagement in learnership programs, media, community leaders, and extension workers attests to their openness to learning. Kamla-Raj (2004) noted that rural communities exhibit a receptivity to innovative agricultural ideas. Consequently, collaborative efforts between researchers, extension workers, and farmers hold the potential to refine and integrate identified IKS practices that yield economic and environmental benefits (Sinha *et al.*, 2020; Matshameko *et al.*, 2022; Morales *et al.*, 2023; Jiménez, *et al.*, 2024; Baade *et al.*, 2024).

This proactive approach can elevate the utilisation of IKS in rural areas, fostering broader benefits for the farming community. Ultimately, such efforts have the potential to curb soil erosion, enhance crop yields, and contribute to sustainable agricultural practices.

**Table 4.12: Knowledge acquisition for crop farming**

| <b>Knowledge acquisition for crop farming</b> |                                                                                 | <b>Frequency</b> | <b>Percent</b> |
|-----------------------------------------------|---------------------------------------------------------------------------------|------------------|----------------|
| Valid                                         | Self-knowledge                                                                  | 52               | 15.5           |
|                                               | Family elders                                                                   | 176              | 52.4           |
|                                               | Other farmers                                                                   | 40               | 11.9           |
|                                               | Learnership programme                                                           | 16               | 4.8            |
|                                               | Municipal agricultural extension workers                                        | 12               | 3.6            |
|                                               | Community leaders                                                               | 12               | 3.6            |
|                                               | Media (TV/Radio broadcasting, published newspapers and books, and the Internet) | 4                | 1.2            |
|                                               | Other (Specify)                                                                 | 24               | 7.1            |
|                                               | <b>Total</b>                                                                    | <b>336</b>       | <b>100.0</b>   |

#### **4.7.5 Farmers challenges**

Farmers' testimonies during the questionnaires revealed several challenges they are facing in both crop and livestock farming. Farmers grapple with distinct challenges in both crop and livestock farming domains. The foremost predicament in crop farming pertains to the restricted water supply for irrigation and unpredictable rainfall patterns, poor access to markets and livestock trespassing constituting a significant concern to rural farmers. In livestock, theft, diseases and wild burning (fire) are the main challenges facing farmers. Notably, soil erosion emerges as a shared concern affecting both crop and livestock farmers. It directly impacts both cultivation and grazing lands. The on-site observations during field visits corroborated this, illustrating erosion's toll on open grazing lands and abandoned croplands devoid of protective vegetation cover. This ecological degradation exacerbates challenges by facilitating livestock trespass onto croplands, directly affecting crop farmers. Matatiele and Umzimvubu LM consist of the visibility of gullies and dongas erosion. This has resulted in the introduction of programs/projects for the rehabilitation of eroded soil (dongas) and gabion walls within ANDM to solve the issue of soil erosion. These programs are put in place as one of the soil management strategies that are implemented at ANDM to control soil erosion.

#### 4.7.5.1 Crop yields

Figure 4.14 below presents farmers' perspectives on their crop yields concerning the IKS practices they employ. A substantial majority (57.14%) expressed contentment with their crop yields, indicating that their efforts yielded favourable results. In contrast, 36.90% indicated partial satisfaction, implying that their yields fell short of their anticipated outcomes. A smaller fraction (5.95%) expressed dissatisfaction with their crop yields. These responses reflect the diverse outcomes experienced by farmers, where a considerable proportion are content with their yield outcomes. This finding aligns with Ighodaro *et al.* (2016), who reported that 75% of farmers in Didimana, Eastern Cape, lose about 21% of their crops annually due to erosion, affecting both crop yields and livestock, as well as household food security. Despite implementing IKS practices, a significant portion of farmers still struggle to achieve optimal yields. This variation underscores the complex interplay of factors influencing agricultural productivity, including soil health, climate, and other contextual factors. Therefore, the integration of IKS and scientific knowledge in farming is essential for promoting sustainable agriculture and addressing the dual goals of increasing crop yields and preventing soil erosion, as supported by Sillitoe (2017) and Ayala Nole *et al.* (2022). This integration has the potential to offer significant benefits to rural farmers (Mosissa *et al.*, 2017; Muthee *et al.*, 2019).

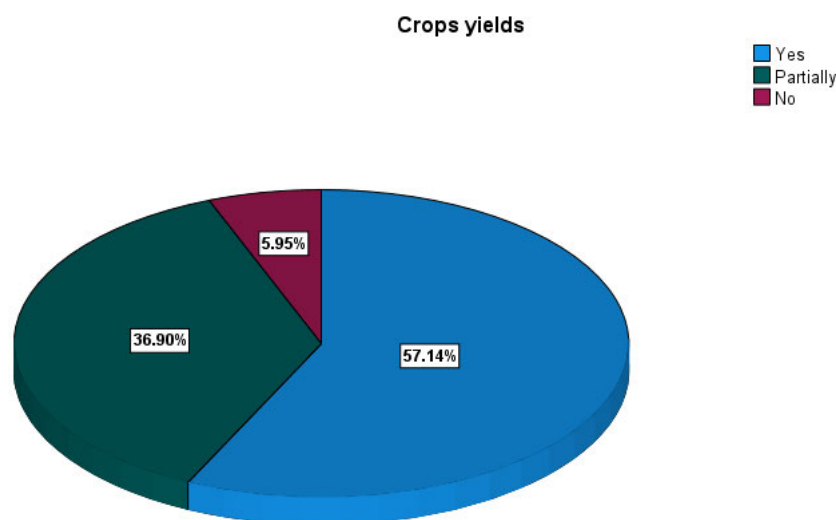


**Figure 4.14: State of soils where farmers are planting crops in relation to crop yields.**

#### 4.7.5.2 Water source challenges

Within the ANDM, the utilisation of water for crop irrigation poses a significant challenge. The primary reliance on rainfall to supply the necessary water for transpiration and evaporation presents a major constraint. This dependency is evident in Figure 4.15, where almost 80.95% of farmers rely on rainfall as their main source of irrigation water for crops. A minority utilise dam water sources (10.71%) or river irrigation systems (7.14%). Additionally, some farmers access water through pipeline systems provided by local municipalities in their area of residence. The shift towards scientifically based systems has led to the displacement of IKS in favour of new land management techniques such as chemical fertilisation, mechanised cultivation, introduction of new crops, and modern irrigation methods, aligning with evolving economic systems and global markets as reflected in a study of ethnopedology by (Krasilnikov and Tabor, 2010).

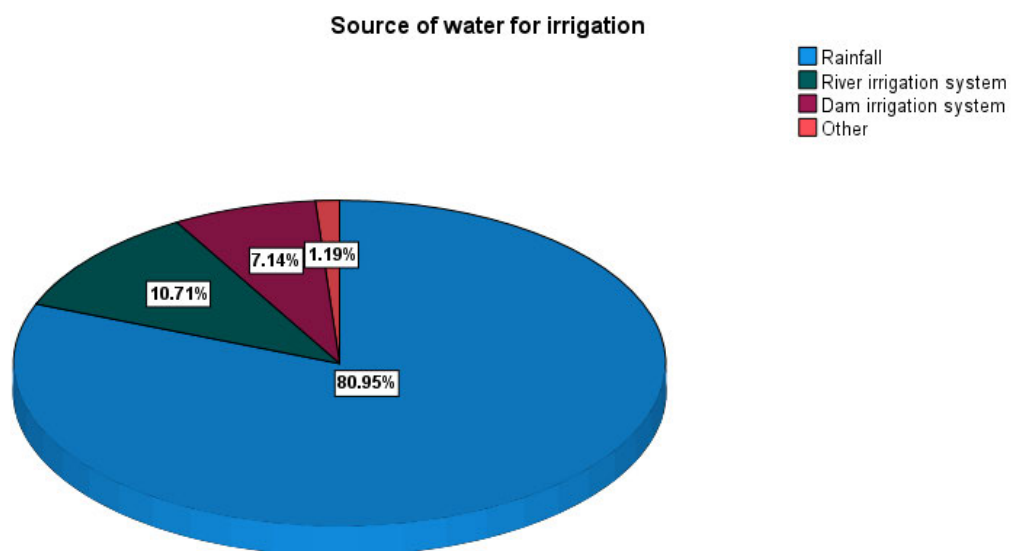


**Figure 4.15: Source of water for irrigation in crop farming.**

For livestock farming, Figure 4.16 illustrates that 49.32% of farmers adopt diverse water sources for their livestock. These sources include piped water supply, harvested rainwater, and water from nearby rivers. Approximately 31.51% depend on nearby rivers as their primary water source for livestock, while 17.81% utilise boreholes.

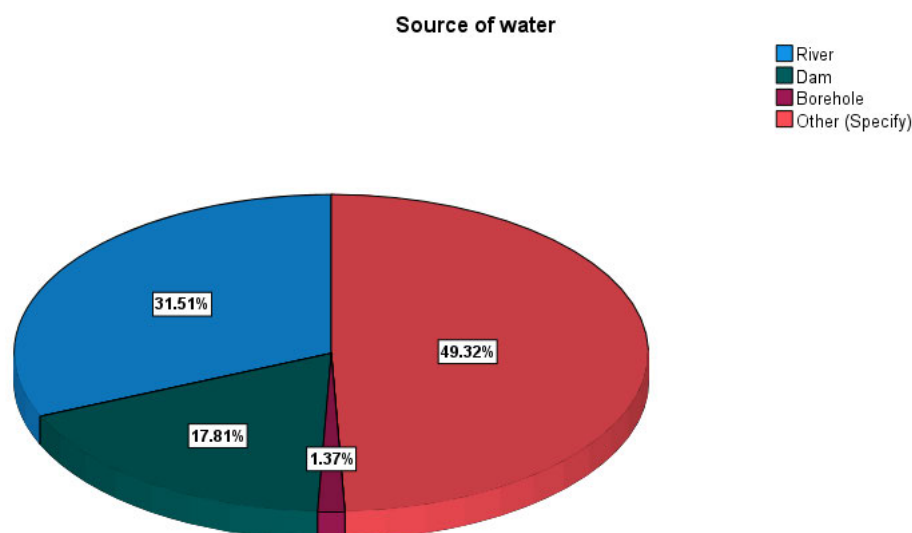


**Figure 4.16: Source of water for livestock.**

In general, the use of water for irrigation poses unique challenges for farmers in the ANDM. The heavy reliance on rainfall as the predominant water source for crop irrigation underscores the need for innovative water management strategies. Similarly, diversified water sources for livestock underline the resourcefulness of farmers in addressing water needs for livestock maintenance. However, farmers have expressed that unpredictable rainfall patterns pose a challenge as they rely on rainfall for irrigation. The critical role of water in agriculture necessitates a comprehensive approach to ensure its sustainable availability for enhanced agricultural productivity and food security. Water stands as a pivotal resource in agricultural production, assuming a vital role in ensuring food security. It serves as a fundamental element for cultivating crops, nurturing livestock, and maintaining the agricultural ecosystem. In the context of agricultural water utilisation, its applications encompass irrigation, pesticide and fertiliser dispersion, crop cooling, and frost control. The availability of water significantly influences the ability to grow a diverse array of crops, including fruits, vegetables, and feed for livestock, which constitute essential components of dietary needs. (Add reference)

#### **4.7.5.3 Inadequate local feed supply and high prices of livestock feed**

Inadequate local feed supply and high prices of livestock feed are significant challenges confronting livestock farmers in the ANDM. Farmers have voiced concerns over the limited

availability of locally sourced animal feed and the steep costs associated with purchasing commercial livestock feed. These challenges have a direct impact on livestock nutrition and, subsequently, the overall health and productivity of the animals. Inadequate access to locally produced feed options means that farmers often have to rely on expensive commercial feeds, increasing their operational costs and reducing profit margins. Addressing this issue requires a concerted effort to enhance local feed production and distribution networks. By increasing the availability of affordable and high-quality feed options, livestock farmers can improve the well-being and productivity of their animals, ultimately contributing to the sustainability of their farming operations (Blair *et al.*, 2018; Hancock *et al.*, 2020; Moyo and Ravhuhali, 2022).

Farmers are also concerned about poor soil quality, which leads to lower crop yields. Solutions may involve soil testing and improvement techniques. The cost of commercial fertilisers is a burden on farmers, impacting their ability to maintain soil fertility and increase yields. Some farmers face difficulties in securing enough labour for essential farming tasks, potentially affecting crop and livestock management. Addressing these issues is crucial for enhancing agricultural sustainability and the livelihoods of farmers in the ANDM. Summarily, crop farming challenges encompass low soil productivity, expensive commercial fertilisers, water scarcity, labour shortages, land constraints, and livestock intrusion. On the other hand, livestock farmers confront hurdles such as livestock theft, soil erosion in grazing areas, costly livestock feed, land limitations, pest and disease outbreaks, feed scarcity, and inadequate market access, among others (Parwada and Van Tol, 2016; Borrelli *et al.*, 2017, 2020; Baade *et al.*, 2024). Addressing these multifaceted challenges requires tailored strategies and holistic interventions that empower farmers in both domains.

#### **4.8 Limitations of the study**

While this study has made valuable contributions to understanding the role of local knowledge and IKS in managing soil erosion within rural communities, it is important to acknowledge certain limitations that should be addressed in future investigations. Not all villages within the study area were visited and observed. This limitation arose from constraints related to time and travel costs. While efforts were made to include a representative sample, the lack of comprehensive village coverage may have influenced the study's findings. Some participants were hesitant to share their knowledge about soil conservation, as they did not recognise the value of their skills in preventing soil erosion. This reluctance may have resulted in incomplete

or biased data, affecting the depth and accuracy of the observations. Some participants assumed that everyone possessed similar knowledge about soil conservation, potentially leading to underreporting or overlooking unique insights. This assumption may have influenced the comprehensiveness of the data collected.

The study did not extensively quantify soil erodibility or investigate the specific influence of vegetation in preventing erosion across different soil types. While not the primary focus, such data would have provided a more comprehensive picture of soil erosion dynamics. The study primarily aimed to explore perceptions and the role of local communities in soil erosion management. As such, it did not delve deeply into quantitative measurements and analysis of erosion factors. Future research should consider incorporating these aspects for a more holistic understanding. Despite these limitations, the findings of this study offer valuable insights that can benefit local, provincial, and national government authorities, as well as rural farmers. Understanding the significance of IKS in soil erosion management can enhance the planning, implementation, monitoring, and evaluation of sustainable agricultural development in rural areas. This, in turn, promotes sustainable agricultural practices and effective land use management for the long-term benefit of these communities.

#### **4.9 Recommendations**

The documentation and protection of IKS are essential for sustainable agricultural development and effective soil erosion prevention and management. Rural communities, particularly indigenous populations, have historically played a crucial role in maintaining the fertility of their land. These communities have a deep respect for their natural surroundings, which directly support their livelihoods. To ensure the continuity of IKS practices in rural communities and prevent the loss of valuable knowledge, an integrated approach is necessary and recommended (Barrera-Bassols and Zinck, 2003; Capra *et al.*, 2015; Sillitoe, 2017; Ayala Nole *et al.*, 2022). Integration should encompass both IKS and scientific knowledge, with both types of knowledge considered equally valuable. This approach will prevent the neglect of IKS and promote sustainable agricultural development and soil erosion management in rural areas, such as the ANDM. Future policies should reflect this integration, incorporating the views and expertise of local communities in land management decisions rather than relying solely on scientific knowledge. This approach will enhance transparency, foster cooperation, and facilitate knowledge sharing among rural farmers in the ANDM.

Shifting the approach from top-down to bottom-up is crucial. This change will help eliminate the exclusion of IKS and ensure the proper implementation of solutions aimed at promoting sustainable agriculture in rural areas. This consideration will result in the effective implementation of agricultural and land management measures, maximising local community involvement. The benefits of this approach include improved food security and more effective soil erosion management in rural areas. It is vital to consider the erosion control measures suggested by participants from ANDM villages. These measures should be incorporated to enhance soil erosion management in rural areas effectively.

Addressing the challenges faced by ANDM farmers in their villages requires close consultation with local authorities, particularly those within the ANDM. Engaging local communities in the development and implementation of erosion control measures tailored to their specific needs and knowledge is recommended as it is essential. Creating level areas on slopes to slow down water runoff and prevent soil erosion in steep areas should be a priority for local farmers. Additionally, combating livestock theft can be achieved through the use of software programs like "Abiri" which track and monitor livestock, providing rural communities with real-time information on the whereabouts of their animals, ensuring their protection.

To effectively combat erosion in gullies and dongas, it is essential to promote the growth of native vegetation, which plays a crucial role in stabilising the soil and preventing further erosion by capturing sediment over time. However, it is important to note that this should be done after implementing necessary solutions to address the root causes of erosion damage. Grasses, rushes, sedges and reeds are ideal for this purpose as they are adapted to local conditions. Seeds of suitable grass species can be broadcasted, preferably on a prepared seedbed. Alternatively, vegetative material such as rhizomes, sods, strips and/or divided tufts can be planted. To allow the vegetation to establish and grow, the velocity of water runoff needs to be reduced by building various structures in the gully and/or donga. Examples of gully and donga erosion control structures from Le Roux founding member of Sekela Impilo Services can be adopted by farmers in ANDM, as listed below:

- Gabion head structure build in drainage pathway to reduce water velocities and to capture silt and other sediment.
- Gabion head structure made out of geotextiles and wire mesh.
- Gabion with steps and chute to reduce water speed and channeling.
- Concrete check dam with water velocity reduction structures.

- Stone check dam with apron.
- Brush check dam capturing silt and decreasing stream velocity and uncontrolled runoff.
- Notice the additional brush packing used of alien invasive Pine cut-offs.
- Brush check dam built with logs capturing silt and decreasing stream velocity and uncontrolled runoff.
- Concrete weir which serves as a key structure.
- Straw and Bale check dam used in the early phases of gully erosion (Le Roux, 2023).

#### **4.10 Conclusion**

The selected farmers in ANDM villages possess a wealth of IK regarding their role in managing soil erosion. They have shared insights into the characteristics, limitations, potentials, and management options related to soil conservation. These farmers play a key role in preserving and passing down IKS techniques used for managing soil erosion in their communities. Crop farmers employ various practices for soil management, including contour intervals, planting trees/grass, constructing stone walls, practicing fallow/ridge planting, incorporating crop residues/waste, using animal manure, and implementing gabion walls, mulching, associated crops, and crop rotation. Livestock farmers, on the other hand, focus on changing grazing lands, planting trees/grass, building stone walls, fencing, and limiting the number of livestock. The findings of the study highlight that elderly individuals tend to possess valuable IKS practices for soil conservation. Moreover, there is a gender imbalance in farming participation, with more men than women involved in the study. However, there is limited involvement of youth in agriculture, and the ageing of rural farmers is a concern. Despite these challenges, the study reveals that local knowledge and IKS practices, such as contouring systems, crop rotation, mulching, associated crops, and planting vegetation cover, remain relevant for enhancing food production and food security in rural ANDM villages. These has been also reflected in the studies of IKS and ethnopedology that has been included in this study. Interestingly, some farmers may not fully comprehend the critical importance of these practices. The study also notes the presence of programs/projects aimed at rehabilitating eroded soil (dongas) and constructing gabion walls within ANDM to address soil erosion issues. An integrated approach is needed to develop soil conservation strategies that align with local social, cultural, economic, and ecological contexts by identifying and leveraging the connections between cultural and scientific knowledge. This will effectively combine IKS with modern scientific knowledge,

playing a pivotal role in preserving IKS while promoting sustainable agricultural development. Furthermore, policies need to be formulated in a manner of bottom-up approach instead of top-down. This will contribute to recognising the role of IKS practices in managing soil erosion in rural areas.

## **CHAPTER 5**

### **SYNTHESIS**

## 5.1 Introduction

The study titled “The role of local indigenous knowledge systems and community involvement in soil conservation and management in rural South Africa” was motivated by the various ways of farming practices that seek to prevent soil erosion in a sustainable manner. This chapter synthesises the key research findings pertaining to each objective covered across the three study papers. It offers recommendations and draws significant conclusions. The overall aim of the study was to critically assess the role of IKS and community involvement in managing soil erosion in rural areas in order to examine the effectiveness of local rural knowledge in managing soil erosion problems in the ANDM, EC. The intricate nature of the research question necessitated a multidisciplinary approach to fulfil the study's objective. Hence, the following were research objectives to be achieved:

- To review the nature and impact of soil erosion in rural areas in Sub-Saharan Africa.
- To assess the historical impact of the Bantu Authorities Act (No. 68) of 1951 on soil erosion and agricultural land abandonment in the Eastern Cape province.
- To evaluate the local farmers' perceptions on the indigenous knowledge systems and their role in managing soil erosion in the Eastern Cape.
- To provide recommendations on the impact and potential of indigenous knowledge systems and local community involvement in managing soil erosion.

The review of the literature provided the background of the role of local IKS and community involvement in managing soil erosion in SSA. The review covered objectives one and two which are to determine the nature and impact of soil erosion in rural areas in Sub-Saharan Africa; and identify and assess existing soil erosion management strategies in rural areas, respectively. However, the review also included recommendations that address aspects of the final objective. The investigation of the effects of the Bantu Authorities Act (No. 68) of 1951 on abandoned agricultural lands and soil erosion at ANDM covered objective three of the study. The paper emerged as the perceptions of rural community farmers in the ANDM during SSI that were conducted mainly on the older participants. Objective three seeks to find the perceptions of the local rural community about their involvement and role in soil erosion management. The study used SSI to find the perceptions of rural community farmers on the effects that BAA has caused in their communities. Moreover, the investigation of IKS about the rural farmers' perspectives on soil management strategies in the ANDM covered objectives three, four and five. Objective four, which was to evaluate the level of IKS and rural community

involvement in managing soil erosion, was covered in this paper. Lastly, objective four which is based on recommendations for improving IKS and local rural community involvement in managing soil erosion in SA, was also covered. The upcoming subsections outline the attainment of each research objective and offer corresponding recommendations together with the last conclusion.

#### **5.1.1 The role of local indigenous knowledge systems and community involvement in managing soil erosion in sub-Saharan Africa: a review.**

This study section serves as a literature review, with its primary objective being to engage with pertinent literature related to the main themes of the study. The main themes were based on key terms such as soil erosion, soil erosion management, IKS, rural areas and community involvement. The first objective sought to determine the nature and impact of soil erosion in rural areas. The second objective sought to identify and assess existing soil erosion management strategies in rural areas. These two objectives were achieved thoroughly in Chapter 2 by reviewing the literature on SSA countries. In this review, systematically reviewed existing literature on the role of local IKS and community involvement in managing soil erosion within SSA. The primary objectives were to provide a comprehensive overview of the current state of local IKS in rural SSA communities concerning soil erosion management and to identify gaps in the literature for future research. To gather data, the study used several main databases to obtain this information from related academic literature, which included Google Scholar, SCOPUS, and Web of Science.

The review was mainly based on rural communities of SSA where it started with the contribution of IKS on soil erosion management followed by soil erosion in rural SSA themes. Furthermore, local rural communities IKS of soil erosion conservation and management measures in SSA was also the main theme in the results and discussion section. In this sub-theme, this is where indigenous soil conservation techniques emerged and were discussed thoroughly. Moreover, the review provided future direction and recommendations for the improvement of IKS. It was evident from the findings that SSA IKS has long been disregarded and abandoned by researchers and developers, especially in the space of scientific knowledge. The results gathered in the review were sufficient to identify the role that rural communities play in SSA to manage soil erosion. Several studies from various countries have explored the role of communities in conserving soil erosion through their IKS.

There were several ways that are employed by local communities in SSA although a notable limitation was the reliance on studies conducted over 25 to 30 years ago, raising concerns about the currency and relevance of these practices in contemporary SSA. Furthermore, the recent literature, although limited, failed to provide concrete evidence of the current implementation and success of IKS practices in local communities. There were several ways that are employed by local communities in SSA, such as stone walls, terracing, mulching, organic manure, crop rotation, shifting cultivation, trash burning, and bush fallow. Furthermore, the recent literature, although limited, failed to provide concrete evidence of the current implementation and success of IKS practices in local communities. The effectiveness of these practices in addressing soil erosion, contributing to local incomes, and enhancing food security remained inadequately demonstrated. In light of these findings, the review showed that there is a clear need for updated and robust research that evaluates the current status, effectiveness, and socio-economic impact of IKS practices in SSA's rural communities. This will not only contribute to addressing soil erosion challenges but also provide valuable insights into the sustainability and practicality of these IKS practices in contemporary agricultural landscapes.

In light of the findings of the review, it suggested that a holistic approach is required to study the integration of scientific and IKS for more effective soil erosion management. The review advocates and encourages researchers, experts, and policymakers should acknowledge the significance of IKS in soil and water conservation and prioritise integration over the replacement of traditional methods with new, externally imposed technologies. Despite using secondary data and finding information that was not based in rural areas in some instances, there were several articles that showed the role of local IKS and community involvement even though it was not sufficient. In light of these findings, this chapter concluded that there is a clear need for updated and robust research that evaluates the current status, effectiveness, and socio-economic impact of IKS practices in SSA's rural communities. This will not only contribute to addressing soil erosion challenges but also provide valuable insights into the sustainability and practicality of these IKS practices in contemporary agricultural landscapes.

#### **5.1.2 The legacy effect of the Bantu Authorities Act (no. 68) of 1951 on the abandoned agricultural land in Eastern Cape province: implications on food security and sustainable land management.**

Chapter 3 investigated the effects of the BAA on abandoned agricultural lands and soil erosion at ANDM using SSI in order to find the perceptions of rural community farmers on the effects

that this Act has caused in their communities. Therefore, this Chapter was based on the objective of the study which seeks to assess the historical impact of the Bantu Authorities Act (No. 68) of 1951 on soil erosion and agricultural land abandonment in the Eastern Cape province. This Chapter emerged from the perceptions of the participants of the study. The main keywords were agricultural land abandonment and the BAA in SA. Therefore, this Chapter was based in a SA context in relation to past policy implications of access to land by black people. Since the study was conducted in ANDM within EC, the historical background of the province was included to lay a foundation for the introduction of BAA.

The objectives of this Chapter were based on identifying the abandoned agricultural lands and soil erosion in rural areas of the ANDM through field observations and Google Earth imagery. Secondly, in finding the perceptions of rural community farmers about the effect of the BAA and abandoned agricultural lands in rural areas of the ANDM through SSI. Thirdly, evaluating how the BAA has contributed to the abandoned agricultural lands and soil erosion in selected rural villages of ANDM. There were 16 selected abandoned croplands within the villages and 320 SSI were conducted for this study which were administered by PRA. The results revealed the ongoing issue of severe abandoned croplands that are taking place in these selected villages before and after the introduction of the BAA. Most of them have been utilised as grazing lands by the community. Based on the participants' perspectives, it was evident that farming activities were more prevalent before the introduction of BAA. According to the majority of the farmers, land abandonment and soil erosion were caused by injustices of the legacy of the Natives Land Act No. 27 of 1913 and Bantu Authorities Act No.68 of 1951. In summary of their views, farmers expressed that the BAA disadvantaged them through facilitating (intentionally or unintentionally) conditions allowing for (1) infrastructure and property vandalism, (2) pushing black farmers away from farming and (3) ring-fenced black rural villages into institutional poverty. Thus, this situation has made it extremely challenging for small-scale black rural farmers to participate in sustainable agricultural practices, which ultimately leads to severe soil erosion and also has negative implications on their food security. These perceptions of the farmers were based on the historical and recent factors that have led to agricultural land abandonment in their villages. The historical perceptions of the farmers' factors were based on the policy implication, while the recent ones were mainly based on equipment and climate change that is affecting crop farming which has led to abandoned agricultural lands. These results demonstrated from the experienced rural farmer's perceptions show that rural farmer's

information is not only essential to farmers but has the potential to significantly transform their farming decisions and practices.

Despite the study selecting a small number of participants due to time constraints, the results demonstrated by the experienced farmers were sufficient and corresponded to the current issues faced by the district. This was due to selecting farmers according to different soil types and mainly that is more affected by soil erosion. In conclusion, the findings of this study are potentially useful for improving agricultural development planning in the district to strengthen food security and governmental policies and subsequently prevent further agricultural land abandonment. Such knowledge can be useful to agricultural development planners in the district whose aim is to strengthen food security and promote sustainable land management. This Chapter suggested that a combination of past and modern information technologies is required for the long-term monitoring and evaluation of abandoned agricultural lands. Therefore, the study recommends potentially effective agricultural development planning that can improve the quality of life and economic well-being of people living in rural areas of the district.

### **5.1.3 Indigenous knowledge systems: Rural farmers' perceptions on soil management strategies in the Alfred Nzo District Municipality.**

Chapter 4 was the main importance of the study investigated the rural farmers' perspectives on soil management and evaluated the contribution of IKS and community engagement in addressing soil erosion in the ANDM. The main objectives that were covered in this Chapter were to evaluate the local farmers perceptions on the indigenous knowledge systems and their role in managing soil erosion in the Eastern Cape; to provide recommendations on the impact and potential of indigenous knowledge systems and local community involvement in managing soil erosion. Therefore, that is why this was the important Chapter that shaped the study where IKS and ethnopedology emerged as the importance of the theoretical framework of this Chapter. This study had the overarching goal of comprehending the perceptions of rural farmers regarding soil management and appraising the impact of IKS and community engagement in addressing soil conservation within the ANDM. Specifically, the study seeks to understand the role of IKS in soil conservation in rural areas, therefore, ANDM which consists of four local municipalities was investigated. Questionnaires were used to collect data on IKS and its role in soil management which were administered by PRA.

Results revealed that local knowledge and IKS practices, such as contouring systems, crop rotation, mulching, associated crops, and planting vegetation cover, remain relevant for enhancing food production and food security in rural ANDM villages. The findings further highlighted that elderly individuals tend to possess valuable IKS practices for managing soil erosion. Moreover, there is a gender imbalance in farming participation, with more men than women involved in the study. However, there is limited youth involvement in agriculture, and the ageing of rural farmers is a concern. Interestingly, some farmers may not fully comprehend the critical importance of these practices. Despite these challenges, the study reveals that local knowledge and IKS practices are still relevant in the ANDM villages and contribute to managing soil erosion. The study also notes the presence of programs/projects aimed at rehabilitating eroded soil (dongas) and constructing gabion walls within ANDM to address soil erosion issues.

Despite the study selecting a total number of 336 questionnaires and 84 SSI from the participants within ANDM combined, the study ensured that each LM was represented equally. However, there were those instances where participants did not truly recognise the importance of adding a voice during the questionnaires. Some were not aware of the crucial importance of the role that they play in managing soil erosion within their communities. In this instance, some participants took some of the information generally as it was their daily practice. This might have withheld the vital information that was going to be important within the study. However, employing qualitative methods and observation which were administered by PRA was useful as participants were able to provide their knowledge more in a technique that there more comfortable and understanding. These participants were also selected based on the soil types that they are located in. Through the observations, it was identified that Dystric Regosols, Eutric Leptosols, and Lithic Leptosols are the soil types most susceptible to high levels of soil erosion within the ANDM. These findings are supported by the soil erodibility k-factor, which ranges predominantly between 0.114536 and 0.114535 for these soil types. The next highest erodibility range is relatively low, between 0.200384 and 0.256723, and those with a range of 0.054255. The highest soil erodibility k-factor of 0.256724 to 0.325099 only occurs in Mbizana LM near the coasts in low-lying areas. Moreover, this indicates that Dystric Regosols, Eutric Leptosols, and Lithic Leptosols are at high risk of soil erosion, primarily due to their corresponding soil erodibility k-factors and observations.

At the conclusion of this chapter, it was suggested that there is a need for an integrated approach to develop natural resource management schemes tailored to local social, cultural, economic,

and ecological contexts. This approach involves identifying and leveraging the relationship between cultural and scientific knowledge, effectively combining ancient indigenous wisdom with modern scientific understanding. Such integration plays a pivotal role in preserving IKS while promoting sustainable agricultural development. Furthermore, policies should be formulated using a bottom-up approach rather than top-down. This approach will help recognise the role of IKS practices in managing soil erosion in rural areas.

## **5.2 Recommendations for future research**

The previous subsections have summarised how each of the key research objectives was achieved in this study. This section now provides recommendations for further research. To advance the integration between IKS and scientific knowledge, several recommendations emerge from the findings. For future development and research, addressing the study's shortcomings and gaps is crucial. Based on the study's findings, integration and collaboration are proposed as primary objectives. Integration should encompass both IKS and scientific knowledge, with both types of knowledge considered equally valuable. Addressing the limitations and gaps identified in this study, the following key recommendations are crucial for fostering a deep and sustainable positive impact in bridging the gap between IKS and contemporary scientific knowledge. The recommendations are as follows:

- There is a critical need for studies that raise awareness among rural community farmers about the significant threat that soil erosion poses to food security in SSA. Enhancing awareness can lead to increased proactive measures against soil erosion. Some farmers may not even recognise the potential benefits of employing indigenous techniques for erosion prevention.
- Further research on IKS is essential that will prove and show available IKS practices that are vital and can be beneficiary to farmers. This can be achieved through the implementation of these practices followed by direct monitoring. Moreover, there is a need for research studies that will look at the role of IKS in managing soil erosion in a broader context with a large sample size to critically assess the IKS's effectiveness in managing soil erosion within rural communities. In that way, there will be more evidence or proof that IKS practices are fundamental in preventing soil erosion.
- Having proper policies is essential and is required to ensure that people have a better understanding of what they are practicing. This will ensure government involvement in ensuring that IKS practices are adopted at a local level and used to continue with

farming while promoting sustainable land management and soil prevention. This will result in high interest in farming and high production of food that will yield high income while promoting food security.

- There is a pressing need to document IKS, as they play a vital role in addressing contemporary soil erosion issues. Despite the challenges posed by modern technology, many farmers successfully manage soil and water using traditional indigenous practices. A holistic approach is required to study the integration of scientific and IKS for more effective soil erosion management. Researchers, experts, and policymakers should acknowledge the significance of IKS in soil and water conservation and prioritise integration over the replacement of traditional methods with new, externally imposed technologies (Barrera-Bassols and Zinck, 2003; Sillitoe, 2017; da Silva *et al.*, 2019; Ayala Nole *et al.*, 2022).
- Combining indigenous and modern techniques can mitigate soil degradation and reduce the cost of maintaining soil protection structures. A cooperation between indigenous and modern techniques may be required to increase the technical efficiency (coping with degradation) as well as the returns to labour (higher incomes). Therefore, more research that accommodates the cooperation between IKS and scientific knowledge is essential to ensure that both are being recognised properly.
- Further research investigation needs to make efforts to prioritise the integration of indigenous and modern knowledge to strengthen soil conservation. Shifting the approach from top-down to bottom-up is crucial. This change will help eliminate the exclusion of IKS and ensure the proper implementation of solutions and policies aimed at promoting sustainable agriculture in rural areas.

### 5.3 Conclusion

The overall aim of this study was to critically assess the role of IKS and community involvement in managing soil erosion in rural areas, specifically to examine the effectiveness of local rural knowledge in addressing soil erosion issues in the ANDM, EC. Previous subsections provided an overview of the chapters in this research study and demonstrated how each objective was fulfilled. Achieving these objectives contributed to understanding the role of IKS and community involvement in managing soil erosion. The general introduction provided the study's background and rationale for examining the effectiveness of local rural knowledge in managing soil erosion issues in the ANDM. The literature review highlighted the

role of IKS in various countries across SSA, showcasing different techniques used to manage soil erosion, such as stone walls, terracing, mulching, organic manure, crop rotation, shifting cultivation, trash burning, and bush fallow, employed by local communities. Furthermore, the study investigated the impact of the BAA on abandoned agricultural lands and soil erosion in the ANDM using SSI to capture the perceptions of rural community farmers regarding the effects of this Act in their communities. Based on participant perceptions emerging from the SSI, the study found evidence of agricultural land abandonment occurring in selected villages both before and after the introduction of the BAA. In summary of their views, farmers expressed that the BAA disadvantaged them through facilitating (intentionally or unintentionally) conditions allowing for (1) infrastructure and property vandalism, (2) pushing black farmers away from farming and (3) ring-fenced black rural villages into institutional poverty. Thus, this situation has made it extremely challenging for small-scale black rural farmers to participate in sustainable agricultural practices, which ultimately leads to severe soil erosion and also has negative implications on their food security. Overall, the findings indicated that agricultural land abandonment is prevalent in many rural areas within the ANDM, frequently contributing to soil erosion.

Moreover, the study further assessed rural farmers' perspectives on soil management and evaluated the contribution of IKS and community engagement in addressing soil erosion in the ANDM. The majority of the farmers indicated that they still rely on indigenous techniques for soil conservation and land management strategies. According to farmers, they are all using a number of indigenous conservation techniques in their farming activities and these include contour intervals, planting trees/grass, stone walls, terrace cultivation, fallow/ridge planting, mulching, and crop rotation amongst others. Therefore, the results indicated that rural communities possess essential knowledge for preventing soil erosion within their communities. This knowledge can be utilised and integrated in collaboration with scientific knowledge to effectively control and prevent soil erosion in rural areas. There is a need for an integrated approach that elaborates natural resource management schemes according to local social, cultural, economic, and ecological contexts by identifying and mobilising the relationship between cultural and scientific information. Furthermore, policies should be formulated using a bottom-up approach rather than top-down. This approach will contribute to recognising the role of IKS practices in managing soil erosion in rural areas.

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## Appendices

### Appendix 1: List of inclusion of studies in the review chapter

| Author/s                    | Year | Journal/Publisher                                                         |
|-----------------------------|------|---------------------------------------------------------------------------|
| Beinart                     | 1984 | Journal of Southern African Studies                                       |
| Reij                        | 1986 | Free University, Centre for Development Cooperation Services (Book)       |
| Lal                         | 1987 | Science                                                                   |
| Rajasekaran <i>et al.</i>   | 1991 | Journal of International Development                                      |
| Reij                        | 1991 | International Institute for Environment and Development                   |
| Warren                      | 1991 | Agricultural Development World Bank Discussion Papers                     |
| Critchley <i>et al.</i>     | 1992 | International Fund for Agricultural Development, Rome                     |
| Hudson                      | 1993 | Journal of Soil and Water Conservation,                                   |
| Gadgil <i>et al.</i>        | 1993 | Ambio                                                                     |
| Ciesiolka <i>et al.</i>     | 1995 | Soil technology                                                           |
| Hagmann and Murwiwa         | 1996 | Geoderma                                                                  |
| Sillitoe                    | 1998 | Soil use and Management                                                   |
| Sillitoe                    | 1998 | Current anthropology                                                      |
| Antoinette and Winklerprins | 1999 | Society and Natural Resources, An International Journal                   |
| Winklerprins                | 1999 | Society and Natural Resources                                             |
| Barrera-Bassols and Zinck   | 2000 | International Institute for Aerospace Survey and Earth Sciences (Book)    |
| Barrera-Bassols and Zinck   | 2000 | International Institute for Geo-Information Science and Earth Observation |
| Toledo                      | 2000 | International Institute for Geo-information and Earth Observation         |
| Semali and Kincheloe        | 2002 | Routledge                                                                 |
| Ananda and Herath           | 2003 | Journal of Environmental Management                                       |

| Author/s                  | Year | Journal/Publisher                                                                                             |
|---------------------------|------|---------------------------------------------------------------------------------------------------------------|
| Osbah and Allan           | 2003 | Geoderma                                                                                                      |
| Teklu and Gezahegn        | 2003 | Technological and Institutional Innovations for Sustainable Rural Development. Deutscher Tropentag            |
| Warren <i>et al.</i>      | 2003 | Geoderma                                                                                                      |
| Kiage                     | 2003 | Progress in Physical Geography, SAGE Journal                                                                  |
| Barrera-Bassols and Zinck | 2003 | Geoderma                                                                                                      |
| Barrios and Trejo         | 2003 | Geoderma                                                                                                      |
| Erkossa and Ayele         | 2003 | Technological and Institutional Innovations for Sustainable Rural Development, Deutscher Tropentag, Gottingen |
| Gray and Morant           | 2003 | Geoderma                                                                                                      |
| Warren <i>et al.</i>      | 2003 | Geoderma                                                                                                      |
| WinklerPrins and Sandor   | 2003 | Geofisica Internacional                                                                                       |
| Yang <i>et al.</i>        | 2003 | Hydrological processes                                                                                        |
| Akinbamiyo and Lal        | 2003 | Journal of Sustainable Agriculture                                                                            |
| Smylie <i>et al.</i>      | 2004 | International Journal of Circumpolar Health                                                                   |
| Kolawole 2004             | 2004 | The Anthropologist                                                                                            |
| Barnhardt                 | 2005 | Anthropology and education quarterly                                                                          |
| Briggs                    | 2005 | Progress in development studies                                                                               |
| Barrios <i>et al.</i>     | 2006 | Geoderma                                                                                                      |
| Akullo <i>et al.</i>      | 2007 | In World Library and Information Congress: 73rd IFLA General Conference and Council                           |
| Le Roux and Smith         | 2007 | South African Journal of Science                                                                              |
| Ajibade                   | 2008 | Ethiopian Journal of Environmental Studies and Management                                                     |
| Lane                      | 2009 | The International Journal of African Historical Studies                                                       |
| Lane                      | 2009 | The International journal of African historical studies                                                       |
| Krasilnikov and Tabor     | 2010 | Verheye, Encyclopedia of Life Support Systems (EOLSS)                                                         |

| Author/s                            | Year | Journal/Publisher                                                                                                                         |
|-------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Njiraine <i>et al.</i>              | 2010 | Indilinga African Journal of Indigenous Knowledge Systems                                                                                 |
| Winschiers-Theophilus <i>et al.</i> | 2010 | In Proceedings of the 2010 Annual Research Conference of the South African Institute of Computer Scientists and Information Technologists |
| Lwoga <i>et al.</i>                 | 2011 | Walter de Gruyter GmbH and Co. KG                                                                                                         |
| Shiferaw <i>et al.</i>              | 2011 | Report submitted to International start secretariat                                                                                       |
| Lwoga <i>et al.</i>                 | 2011 | Libri                                                                                                                                     |
| Shiferaw <i>et al.</i>              | 2011 | Report submitted to International start secretariat                                                                                       |
| Manjoro <i>et al.</i>               | 2012 | Environmental management,                                                                                                                 |
| Ajani <i>et al.</i>                 | 2013 | Asian Journal of Agricultural Extension, Economics and Sociology                                                                          |
| Kiage                               | 2013 | Progress in Physical Geography                                                                                                            |
| Ugboma                              | 2014 | Chinese Librarianship: An International Electronic Journal                                                                                |
| Capra <i>et al.</i>                 | 2015 | PLOS One Journal                                                                                                                          |
| Tamene and Le                       | 2015 | Nutrient cycling in agroecosystems                                                                                                        |
| Tharakan                            | 2015 | African journal of science, technology, innovation and development                                                                        |
| Akinola and Oyedele                 | 2015 | Journal of Agriculture and Environment for International Development                                                                      |
| Parwada and Van Tol                 | 2016 | Soil and Plant Science                                                                                                                    |
| Diallo and Diallo                   | 2016 | African Journal of Agricultural Research                                                                                                  |
| Gomiero                             | 2016 | Sustainability                                                                                                                            |
| Ighodaro <i>et al.</i>              | 2016 | Journal of Agricultural Science                                                                                                           |
| Borrelli                            | 2017 | Nature communications                                                                                                                     |
| Nigussie <i>et al.</i>              | 2017 | Land degradation and development                                                                                                          |
| Sillitoe                            | 2017 | CAB International (Book)                                                                                                                  |
| Taye and Megento                    | 2017 | International Journal of Bonorowo Wetlands                                                                                                |
| Blake <i>et al.</i>                 | 2018 | Environmental Research Letters                                                                                                            |
| Ansong Omari <i>et al.</i>          | 2018 | Sustainability                                                                                                                            |
| Garutsa and Nekhwevha               | 2018 | South African Review of Sociology                                                                                                         |

| Author/s                       | Year | Journal/Publisher                                             |
|--------------------------------|------|---------------------------------------------------------------|
| Adeoye <i>et al.</i>           | 2019 | Journal of Experimental Agriculture International             |
| Adeoye <i>et al.</i>           | 2019 | Journal of Experimental Agriculture International             |
| Wynants <i>et al.</i>          | 2019 | Regional Environmental Change                                 |
| Sartori <i>et al.</i>          | 2019 | Land Use Policy                                               |
| UNESCO                         | 2019 | Online at: <a href="http://www.unesco.org">www.unesco.org</a> |
| Wynants <i>et al.</i>          | 2019 | Regional Environmental Change                                 |
| Xiong <i>et al.</i>            | 2019 | Geoderma                                                      |
| Zhao and Hou                   | 2019 | Scientific reports                                            |
| Nwachukwu and Alaka            | 2019 | Springer, Cham                                                |
| Sithole                        | 2020 | Southern African Journal of Environmental Education           |
| Bapfakurera and Nduwamungu     | 2020 | Journal Agricultural and Biological Sciences                  |
| Bapfakurera and Nduwamungu     | 2020 | Journal Agricultural and Biological Sciences                  |
| Materechera                    | 2021 | Springer International Publishing                             |
| Machar and Debela              | 2021 | Assessment                                                    |
| Chuma <i>et al.</i>            | 2022 | Environmental Challenges                                      |
| Negasa                         | 2023 | Applied and Environmental Soil Science                        |
| Tibasiima <i>et al.</i>        | 2023 | Frontiers in Sustainable Food Systems                         |
| Pangapanga-Phiri <i>et al.</i> | 2024 | Renewable Agriculture and Food Systems                        |

## Appendix 2: Rural farmers questionnaires and semi structured interviews



### Open-ended Questionnaires

Name: Thabiso V Shinga

Student No: 218050823

### Title: Exploring the Role of Local Indigenous Knowledge and Community Engagement in Soil Conservation and Management in Rural South Africa

**Aim of the study:** The overall aim of this study was to critically assess the role of indigenous knowledge systems and community involvement in soil conservation in rural areas in order to examine the effectiveness of local rural knowledge in managing soil erosion problems in the ANDM, Eastern Cape.

### Section 1: Introduction and Geographical Details

| GEOGRAPHIC INFORMATION |  |
|------------------------|--|
| Questionnaire Number   |  |
| Local Municipality     |  |
| Ward Number            |  |

|                    |     |   |    |   |
|--------------------|-----|---|----|---|
| Interviewer's Name |     |   |    |   |
| Start time         | H   | H | M  | M |
|                    |     |   |    |   |
| Finish Time        |     |   |    |   |
| Interview Complete | Yes |   | No |   |
|                    |     |   |    |   |

## Section 2: Demographic Details

| Q. No                      | INTERVIEWER READ OUT: I am going to start by asking you about your background personal details which some of the them will be personal and if you feel like you do not want to answer, we can move on to the next question. |                                 | Response | Skip |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----------|------|
| Q1_1_Age_group             | How old are you?                                                                                                                                                                                                            | 18 - 25                         | 1        |      |
|                            |                                                                                                                                                                                                                             | 26 - 35                         | 2        |      |
|                            |                                                                                                                                                                                                                             | 36 - 45                         | 3        |      |
|                            |                                                                                                                                                                                                                             | 46 - 55                         | 4        |      |
|                            |                                                                                                                                                                                                                             | 56 - 65                         | 5        |      |
|                            |                                                                                                                                                                                                                             | > 66                            | 6        |      |
| Q1_2_Sex                   | What is your gender?                                                                                                                                                                                                        | Male                            | 1        |      |
|                            |                                                                                                                                                                                                                             | Female                          | 2        |      |
| Q1_3_Population_group/race | What is your population group or race?                                                                                                                                                                                      | Black                           | 1        |      |
|                            |                                                                                                                                                                                                                             | Coloured                        | 2        |      |
|                            |                                                                                                                                                                                                                             | Indian                          | 3        |      |
|                            |                                                                                                                                                                                                                             | White                           | 4        |      |
|                            |                                                                                                                                                                                                                             | Other (Specify)                 | .....    |      |
| Q1_4_Education_level       | What is your highest level of education?                                                                                                                                                                                    | None                            | 1        |      |
|                            |                                                                                                                                                                                                                             | Primary School                  | 2        |      |
|                            |                                                                                                                                                                                                                             | Secondary School                | 3        |      |
|                            |                                                                                                                                                                                                                             | Matriculated                    | 4        |      |
|                            |                                                                                                                                                                                                                             | Tertiary qualification          | 5        |      |
|                            |                                                                                                                                                                                                                             | Other (Specify)                 | .....    |      |
| Q1_5_Employment_status     | What is your current employment status?                                                                                                                                                                                     | Full-time                       | 1        |      |
|                            |                                                                                                                                                                                                                             | Part-time                       | 2        |      |
|                            |                                                                                                                                                                                                                             | Seeking opportunities currently | 3        |      |
|                            |                                                                                                                                                                                                                             | Retired                         | 4        |      |
|                            |                                                                                                                                                                                                                             | Unemployed                      | 5        |      |
|                            |                                                                                                                                                                                                                             | Other (Specify)                 | .....    |      |
| Q1_6_Dependents            | How many dependents do you have?                                                                                                                                                                                            | None                            | 1        |      |
|                            |                                                                                                                                                                                                                             | 1-2                             | 2        |      |
|                            |                                                                                                                                                                                                                             | 3-4                             | 3        |      |
|                            |                                                                                                                                                                                                                             | > 5                             | 4        |      |

### Section 3: Farming Background Information

| Q. No                      | INTERVIEWER READ OUT: I would like to ask you about your farming background information. If you feel like you do not want to answer, we can move on to the next question. |                                                                | Response | Skip                                                                                                               |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|----------|--------------------------------------------------------------------------------------------------------------------|
| Q2_1_Farming_type          | What type(s) of farming do you normally practice?                                                                                                                         | Cop farming                                                    | 1        | Please complete crop farming/ livestock farming section or both sections if you are practicing both farming types. |
|                            |                                                                                                                                                                           | Livestock farming                                              | 2        |                                                                                                                    |
|                            |                                                                                                                                                                           | Both farming type                                              | 3        |                                                                                                                    |
| Q2_2_Farming_main          | Is farming the main activity?                                                                                                                                             | Yes                                                            | 1        |                                                                                                                    |
|                            |                                                                                                                                                                           | No                                                             | 2        |                                                                                                                    |
| Q2_3_Main_income           | Do you consider farming as your main source of income?                                                                                                                    | Yes                                                            | 1        |                                                                                                                    |
|                            |                                                                                                                                                                           | No                                                             | 2        |                                                                                                                    |
| Q2_4_Farming_income        | If yes above, what is your main farming source of income?                                                                                                                 | Crop farming                                                   | 1        |                                                                                                                    |
|                            |                                                                                                                                                                           | Livestock farming                                              | 2        |                                                                                                                    |
|                            |                                                                                                                                                                           | Both                                                           | 3        |                                                                                                                    |
| Q2_5_Training              | Do you have any agricultural training?                                                                                                                                    | Yes                                                            | 1        |                                                                                                                    |
|                            |                                                                                                                                                                           | No                                                             | 2        |                                                                                                                    |
| Q2_6_Training_type         | If yes above, describe what type of training and has it helped you improve your farming knowledge system?                                                                 | <div>_____</div> <div>_____</div>                              |          |                                                                                                                    |
| Q2_7_Land_ownership        | Who owns the land where you are practicing your farming activities?                                                                                                       | Traditional authority land                                     | 1        |                                                                                                                    |
|                            |                                                                                                                                                                           | State owned land (municipal, central or provincial government) | 2        |                                                                                                                    |
|                            |                                                                                                                                                                           | Renting from a private owner                                   | 3        |                                                                                                                    |
|                            |                                                                                                                                                                           | Own land                                                       | 4        |                                                                                                                    |
|                            |                                                                                                                                                                           | Other (Specify)                                                | .....    |                                                                                                                    |
| Q2_8_Land_size             | What is the size (in hectares) of the land/field where you are practicing your farming? (e.g., if 2 soccer field, = 1 ha)                                                 | < 1 Hectare                                                    | 1        |                                                                                                                    |
|                            |                                                                                                                                                                           | 1 – 5 Hectares                                                 | 2        |                                                                                                                    |
|                            |                                                                                                                                                                           | 6 – 10 Hectares                                                | 3        |                                                                                                                    |
|                            |                                                                                                                                                                           | 11 – 15 Hectares                                               | 4        |                                                                                                                    |
|                            |                                                                                                                                                                           | > 16 Hectares                                                  | 5        |                                                                                                                    |
| Q2_9_Categories_of_farmers | What kind of farming category do you consider yourself to fall under?                                                                                                     | Small scale farmer                                             | 1        |                                                                                                                    |
|                            |                                                                                                                                                                           | Subsistence farmer                                             | 2        |                                                                                                                    |
|                            |                                                                                                                                                                           | Semi-commercial farmer                                         | 3        |                                                                                                                    |

|  |  |                               |       |  |
|--|--|-------------------------------|-------|--|
|  |  | Large scale commercial farmer | 4     |  |
|  |  | Other (Specify)               | ..... |  |

## Section 4 (a): Crop Farming

| Q. No                                 | INTERVIEWER READ OUT: I would like to ask you about your crop farming, if you do not practice crop farming, please skip to the next section of livestock farming. If you feel like you do not want to answer, we can move on to the next question. |                                      | Response | Skip |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|----------|------|
| Q3a_1_Crops-<br>_commodity            | What types of crops do you grow in your field?                                                                                                                                                                                                     | Vegetable production                 | 1        |      |
|                                       |                                                                                                                                                                                                                                                    | Maize production                     | 2        |      |
|                                       |                                                                                                                                                                                                                                                    | Bean production                      | 3        |      |
|                                       |                                                                                                                                                                                                                                                    | Fruits production                    | 4        |      |
|                                       |                                                                                                                                                                                                                                                    | Other (Specify)                      | .....    |      |
| Q3a_2_Periods_into_farm-<br>ing       | How many periods in years have you been practicing crop farming?                                                                                                                                                                                   | 1 - 5 Years                          | 1        |      |
|                                       |                                                                                                                                                                                                                                                    | 6 - 10 Years                         | 2        |      |
|                                       |                                                                                                                                                                                                                                                    | 11 - 15 Years                        | 3        |      |
|                                       |                                                                                                                                                                                                                                                    | 16 - 20 Years                        | 4        |      |
|                                       |                                                                                                                                                                                                                                                    | > 21 years                           | 5        |      |
| Q3a_3_Soil_indicators/pr-<br>operties | What kind of soil properties or indicators do you use to recognise soil quality and fertility?                                                                                                                                                     | Soil type (sand, silt, and clay)     | 1        |      |
|                                       |                                                                                                                                                                                                                                                    | Soil monitoring                      | 2        |      |
|                                       |                                                                                                                                                                                                                                                    | Soil texture                         | 3        |      |
|                                       |                                                                                                                                                                                                                                                    | Depth of soils                       | 4        |      |
|                                       |                                                                                                                                                                                                                                                    | Topsoil or rooting                   | 5        |      |
|                                       |                                                                                                                                                                                                                                                    | Other (Specify)                      | .....    |      |
| Q3a_4_Crop_yields                     | Do the state of soils where you planting your crops give you good yields?                                                                                                                                                                          | Yes                                  | 1        |      |
|                                       |                                                                                                                                                                                                                                                    | Partially                            | 2        |      |
|                                       |                                                                                                                                                                                                                                                    | No                                   | 3        |      |
| Q3a_5_Source_of_water-<br>_irrigation | What is your source of water for crop production?                                                                                                                                                                                                  | Rainfall                             | 1        |      |
|                                       |                                                                                                                                                                                                                                                    | River irrigation system              | 2        |      |
|                                       |                                                                                                                                                                                                                                                    | Dam irrigation system                | 3        |      |
|                                       |                                                                                                                                                                                                                                                    | Borehole irrigation system           | 4        |      |
|                                       |                                                                                                                                                                                                                                                    | Other                                | .....    |      |
| Q3a_6_Challenges_in-<br>crops         | What sort of challenges do you face in crop farming?                                                                                                                                                                                               | Soil erosion                         | 1        |      |
|                                       |                                                                                                                                                                                                                                                    | Low soil productivity/ fertility     | 2        |      |
|                                       |                                                                                                                                                                                                                                                    | High prices of commercial fertilizer | 3        |      |

|                                     |                                                                                            |                                                                                |       |  |
|-------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------|--|
|                                     |                                                                                            | Limited water supply for irrigation /erratic rainfall patterns                 | 4     |  |
|                                     |                                                                                            | Limited labour                                                                 | 5     |  |
|                                     |                                                                                            | Limited land for planting                                                      | 6     |  |
|                                     |                                                                                            | Trespassing livestock                                                          | 7     |  |
|                                     |                                                                                            | Poor access to markets for selling                                             | 8     |  |
|                                     |                                                                                            | Other (specify)                                                                | ..... |  |
| Q3a_7_Soil_conservation_in_crop     | What kind of strategies do you use to conserve the soil where you are planting your crops? | Contour intervals                                                              | 1     |  |
|                                     |                                                                                            | Planting trees/grass                                                           | 2     |  |
|                                     |                                                                                            | Stone walls                                                                    | 3     |  |
|                                     |                                                                                            | Terrace cultivation                                                            | 4     |  |
|                                     |                                                                                            | Fallow/ridge planting                                                          | 5     |  |
|                                     |                                                                                            | Incorporate crop residues/waste                                                | 6     |  |
|                                     |                                                                                            | Incorporate animal manure                                                      | 7     |  |
|                                     |                                                                                            | Gabion wall                                                                    | 8     |  |
|                                     |                                                                                            | Mulching                                                                       | 9     |  |
|                                     |                                                                                            | Associated crops                                                               | 10    |  |
|                                     |                                                                                            | Crop rotation                                                                  | 11    |  |
|                                     |                                                                                            | Other (Specify)                                                                | ..... |  |
| Q3a_8_Knowledge_acquisition_in_crop | Where did you obtain the knowledge about soil management?                                  | Self-knowledge                                                                 | 1     |  |
|                                     |                                                                                            | Family elders                                                                  | 2     |  |
|                                     |                                                                                            | Other farmers                                                                  | 3     |  |
|                                     |                                                                                            | Learnership programme                                                          | 4     |  |
|                                     |                                                                                            | Municipal agricultural extension workers                                       | 5     |  |
|                                     |                                                                                            | Community leaders                                                              | 6     |  |
|                                     |                                                                                            | Media (TV/Radio broadcasting, published newspaper and books, and the internet) | 7     |  |
|                                     |                                                                                            | Other (Specify)                                                                | ..... |  |

## Section 4 (b): Livestock Farming

| Q. No                                           | INTERVIEWER READ OUT: I would like to ask you about your livestock farming if you have or possess any. If you feel like you do not want to answer, we can move on to the next question. | Response                              | Skip  |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-------|
| Q3b_1_Type_of_livestock                         | What types of livestock do you have?                                                                                                                                                    | Cattle (Cows)                         | 1     |
|                                                 |                                                                                                                                                                                         | Sheep                                 | 2     |
|                                                 |                                                                                                                                                                                         | Goats                                 | 3     |
|                                                 |                                                                                                                                                                                         | Chickens                              | 4     |
|                                                 |                                                                                                                                                                                         | Pigs                                  | 5     |
|                                                 |                                                                                                                                                                                         | Other (Specify)                       | ..... |
| Q3b_2_Periods_into_livestock_farming            | How many periods in years have you been practicing livestock farming?                                                                                                                   | 1 - 5 Years                           | 1     |
|                                                 |                                                                                                                                                                                         | 6 - 10 Years                          | 2     |
|                                                 |                                                                                                                                                                                         | 11 - 15 Years                         | 3     |
|                                                 |                                                                                                                                                                                         | 16 - 20 Years                         | 4     |
|                                                 |                                                                                                                                                                                         | > 21 Years                            | 5     |
| Q3b_3_Livestock_supervision                     | Who is looking after your livestock?                                                                                                                                                    | My-self                               | 1     |
|                                                 |                                                                                                                                                                                         | Hire someone (e.g., Herdsmen)         | 2     |
|                                                 |                                                                                                                                                                                         | Leave them in grazing/communal lands  | 3     |
|                                                 |                                                                                                                                                                                         | Other (Specify)                       | ..... |
| Q3b_4_Livestock_grazing                         | Does the state of soils where you are keeping your livestock give you good grazing (feed) for your livestock to grow?                                                                   | Yes                                   | 1     |
|                                                 |                                                                                                                                                                                         | Partially                             | 2     |
|                                                 |                                                                                                                                                                                         | No                                    | 3     |
| Q3b_5_Source_of_water                           | What is the source of water for your livestock?                                                                                                                                         | River                                 | 1     |
|                                                 |                                                                                                                                                                                         | Dam                                   | 2     |
|                                                 |                                                                                                                                                                                         | Borehole                              | 3     |
|                                                 |                                                                                                                                                                                         | Other (Specify)                       | ..... |
| Q3b_6_Challenges_in_livestock                   | What sort of challenges do you face in livestock farming?                                                                                                                               | Livestock Theft                       | 1     |
|                                                 |                                                                                                                                                                                         | Soil erosion in grazing lands         | 2     |
|                                                 |                                                                                                                                                                                         | High prices of livestock feed         | 3     |
|                                                 |                                                                                                                                                                                         | Limited land availability             | 4     |
|                                                 |                                                                                                                                                                                         | Pest and disease outbreaks            | 5     |
|                                                 |                                                                                                                                                                                         | Inadequate local feed supply          | 6     |
|                                                 |                                                                                                                                                                                         | Limited access to markets for selling | 7     |
|                                                 |                                                                                                                                                                                         | Veld burning (Fire)                   | 8     |
|                                                 |                                                                                                                                                                                         | Other (Specify)                       | ..... |
| Q3b_7_Soil_conservation_strategies_in_livestock |                                                                                                                                                                                         | Changing grazing lands                | 1     |

|                                          |                                                                                                                    |                                                                                |       |  |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------|--|
| k                                        | What kind of strategies do you practice to conserve the soil in grazing land where you are keeping your livestock? | Planting trees/grass                                                           | 2     |  |
|                                          |                                                                                                                    | Stone walls                                                                    | 3     |  |
|                                          |                                                                                                                    | Fencing                                                                        | 4     |  |
|                                          |                                                                                                                    | Limiting number of livestock                                                   | 5     |  |
|                                          |                                                                                                                    | Other (Specify)                                                                | ..... |  |
| Q3b_8_Knowledge_Acquisition_in_livestock | Where did you obtain the knowledge about soil management?                                                          | Self-knowledge                                                                 | 1     |  |
|                                          |                                                                                                                    | Family elders                                                                  | 2     |  |
|                                          |                                                                                                                    | Other farmers                                                                  | 3     |  |
|                                          |                                                                                                                    | Learnership programme                                                          | 4     |  |
|                                          |                                                                                                                    | Municipal agricultural extension workers                                       | 5     |  |
|                                          |                                                                                                                    | Community leaders                                                              | 6     |  |
|                                          |                                                                                                                    | Media (TV/Radio broadcasting, published newspaper and books, and the internet) | 7     |  |
|                                          |                                                                                                                    | Other (Specify)                                                                | ..... |  |

## Section 5: Semi-Structured Questions

(I would like to ask you about these Semi-Structured Questions. If you feel like you do not want to answer, we can move on to the next question).

### a) Crop Farming

1. In your perspective, what is the current states of soil where you are planting your crops?
2. Do you consider the soils of your crop fertile? If yes, please explain why?
3. What crops do you grow on fertile soils?
4. What crops do you grow on soils that you consider to be not fertile, if any?
5. Explain how do you prevent soil erosion where you are planting your crops?
6. Explain other soil erosion prevention measures that you know are used or practiced in the community?

### b) Livestock Farming

1. Explain how do you manage your livestock?
2. In your perceptions, what is the states of soil where you are keeping your livestock?
3. How do you feed your livestock during dry season?
4. Explain how do you prevent soil erosion where you are keeping your livestock?

5. What soil conservation strategies do you practice in order to prevent soil erosion in your grazing lands where you are keeping your livestock?
6. In your perception, what do you think the community can do to ensure that grazing lands are kept sustainable?

If you wish to receive feedback of the results, please provide your email address\_\_\_\_\_

**The end:** Thank you for participating in this study.

### **Appendix 3: Informed consent form in English and isiZulu**

#### **Informed Consent Form**

Date:

Dear Sir/Madam,

My name is Thabiso Vincent Shinga (student number: 218050823). I am a student studying towards a Master of Science in Environmental Sciences in the School of Agricultural, Earth and Environmental Sciences at the University of KwaZulu-Natal (UKZN), Howard College Campus.

You are invited to participate in a research study I am conducting entitled 'The role of local indigenous knowledge systems and community involvement in managing soil erosion in rural South Africa'. The aim of this study is to critically assess the role of indigenous knowledge systems and community involvement in managing soil erosion in rural areas in order to examine the effectiveness of local rural knowledge in managing soil erosion problems in the Eastern Cape.

The study is expected to enroll approximately 84 participants in total: 21 questionnaires together with semi-structured interviews of community members that are practicing farming in each local municipality (Winnie Madikizela Mandela (Mbizana), Ntabankulu, Umzimvubu and Matatiele) in the Alfred Nzo District Municipality in relation to farming. To gather some information, I am interested in asking you some questions.

Please note that:

- The interview will last approximately 55 minutes.
- Your participation is voluntary. You have a choice to participate, not participate or stop participating in the research, as well as withdrawing at any point. You will not be penalized for taking such an action.
- Your inputs will be kept confidential and will not be attributed to you in person. However, if applicable, you are aware that you may be able to be identified by virtue of your position and in these instances, your permission will be specifically sought.
- Any information given by you cannot be used against you, and the collected data will only be used for the purposes of this research study and any dissemination activities.

- Your involvement is for academic purposes only, and there are no direct benefits from participating.
- Research data will be stored securely and destroyed after 5 years.

For queries, please contact myself, my supervisor, or the UKZN Humanities and Social Sciences Research Ethics Committee.

I, Thabiso Vincent Shinga, can be contacted on: [REDACTED] [REDACTED], Email: [218050823@stu.ukzn.ac.za](mailto:218050823@stu.ukzn.ac.za).

My supervisor is Dr S.L. Nkomo who is located in the Geography discipline at the School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, Howard College Campus. She may be contacted on 031 260 1149, Email: [nkomos1@ukzn.ac.za](mailto:nkomos1@ukzn.ac.za).

You may also contact: Humanities and Social Sciences Research Ethics Administration  
Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557 - Fax: 27 31 2604609

Email: [HSSREC@ukzn.ac.za](mailto:HSSREC@ukzn.ac.za)

Thank you for your participation in the study.

### **Declaration of Consent**

I ..... have been informed about the study entitled “The role of local indigenous knowledge systems and community involvement in managing soil erosion in rural South Africa” by Thabiso Vincent Shinga.

I understand the purpose and procedures of the study.

I have been given an opportunity to ask questions about the study and have had answers to my satisfaction. I declare that my participation in this study is entirely voluntary and that I may withdraw at any time.

If I have any further questions, concerns or queries related to the study, I understand that I may contact the researcher on: [REDACTED] / [REDACTED], Email: [218050823@stu.ukzn.ac.za](mailto:218050823@stu.ukzn.ac.za) or the supervisor, Dr S.L. Nkomo, on: 031 260 1149, Email: [nkomos1@ukzn.ac.za](mailto:nkomos1@ukzn.ac.za).

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

Humanities and Social Sciences Research Ethics Administration

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557 - Fax: 27 31 2604609

Email: [HSSREC@ukzn.ac.za](mailto:HSSREC@ukzn.ac.za)

I hereby provide consent to:

Audio-record my interview YES / NO

If applicable, video-record the site for research purposes YES / NO / N/A

If applicable, to take photographs of the site for research purposes YES / NO / N/A

If applicable, I am aware that I may be able to be identified by virtue of my position and I give permission for my position to be linked to my comments: YES / NO / N/A

Email address for provision of feedback:

.....

---

**Signature of Participant**

---

**Date**

Ifomu Lesivumelwano

Usuku:

Mnumzane/madam othandekayo

Igama lami nguThabiso Vincent Shinga (inombolo yomfundi: 218050823). Ngingumfundi ofundela i-Master of Science kwiEnvironmental Sciences kwiSchool of Agricultural, Earth neEnvironmental Sciences eNyuvesi yaKwaZulu-Natali (UKZN), eHoward College Campus.

Umenywa ukuba ubambe iqhaza ocwaningweni lokucwaninga engilenzayo, isihloko salo esithi 'The role of local indigenous knowledge systems and community involvement in managing soil erosion in rural South Africa'. Inhloso ukucubungula kabanzi iqhaza lezinhlelo zolwazi lwendabuko kanye nokuzibandakanya komphakathi ekuphatheni ukuguguleka kwenhlabathi ezindaweni zasemakhaya ukuze kuhlolwe kabanzi ukusebenza kolwazi lwezindawo zasemakhaya ekuphatheni izinkinga zokuguguleka kwenhlabathi esifundazweni saseEastern Cape.

Ucwaningo kulindeleke ukuthi lubhalise cishe abahlanganyeli abangu-84 bebonke: Uhlu lwemibuzo engama-21 kanye nezingxoxo ezingahleliwe zamalungu omphakathi alimayo kumasipala ngamunye wendawo (iseWinnie Madikizela Mandela (Mbizana), Ntabankulu, Umzimvubu kanye naseMatatiele) kuMasipala wesiFunda i-Alfred Nzo mayelana nokulima. Ukuze ngiqoqe ulwazi oluthile mayelana nocwaningo, ngithanda ukukubuza imibuzo ethile.

Sicela wazi ukuthi:

- Ingxoxo izohlala cishe imizuzu engama-55.
- Ukubamba iqhaza kwakho kungukuzithandela. Unelungelo lokubamba iqhaza, ungahlanganyeli noma uyeke ukuhlanganyela ekucwaningweni, futhi uhoxise noma kunini. Ngeke ujeziswe ngokuthatha isenzo esinjalo.
- Izimpendulo zakho zizogcinwa ziyimfihlo futhi ngeke zibhekwe kuwe ngokwakho. Kodwa-ke, uma usebenza, uyazi ukuthi ungakwazi ukubonakala ngenxa yesimo sakho sokusebenza futhi kulezi zimo, imvume yakho izofunwa ngokuqondile.
- Noma yiluphi ulwazi olunikezwa nguwe alukwazi ukusetshenziswa ngokumelene nawe, futhi idatha eqoqwe izosetshenziselwa kuphela izinhloso zalolu cwaningo lokucwaninga nanoma yimuphi umsebenzi wokusabalalisa.
- Ukubandakanyeka kwakho kungenxa yezifundo kuphela, futhi azikho izinzuzo eziqondile zokubamba iqhaza.
- Idatha yokucwaninga izogcinwa ngokuphepha futhi ibhujiswe ngemuva kweminyaka emihlanu.

Ngemibuzo, sicela uxhumane nami, umphathi wami, noma iKomiti Yezokuziphatha Zokwenza Ucwaningo Lwase-UKZN.

Mina, Thabiso Vincent Shinga, ungaxhumana nami ku: [REDACTED] / [REDACTED], Email: [218050823@stu.ukzn.ac.za](mailto:218050823@stu.ukzn.ac.za).

Umphathi wami nguDkt. S.L. Nkomo osesigabeni seGeography eSikoleni Sezolimo, Umhlaba kanye Nezemvelo, eNyuvesi yaKwaZulu-Natali, i-Howard College Campus. Ungathintana naye ku-031 260 1149, i-imeyli: [nkomos1@ukzn.ac.za](mailto:nkomos1@ukzn.ac.za).

Ungaxhumana futhi: Ukuphathwa kwezokuHlaliswa koLwazi lwezEnhlahakahle  
Ihhovisi Lokucwaninga, iWestville Campus  
e-Govan Mbeki Building  
Private Bag X 54001  
Durban  
4000  
KwaZulu-Natal, ENingizimu Afrika  
Ucingo: 27 31 2604557 - Ifeksi: 27 31 2604609  
Imeyili: [HSSREC@ukzn.ac.za](mailto:HSSREC@ukzn.ac.za)

Siyabonga kakhulu ngeqhaza lakho kulolucwaningo.

Isimemezelo Semvume

Mina.....saziswa mayelana nesifundo esithi 'The role of local indigenous knowledge systems and community involvement in managing soil erosion in rural South Africa' nguThabiso Vincent Shinga.

Nginyaqonda injongo nezinqubo zesifundo.

Nginikezwe ithuba lokubuza imibuzo mayelana nokufunda futhi ngibe nezimpendulo kokwaneliseka kwami. Ngimemezela ukuthi ukubamba iqhaza kwami kulolu cwaningo kuphelele ngokuzithandela nokuthi ngizohoxisa nganoma yisiphi isikhathi.

Uma nginemibuzo eminye, ukukhathazeka noma imibuzo ehlobene nokucwaninga, nginyaqonda ukuthi ngingathintana nomcwaningi ngo: [REDACTED] / [REDACTED], I-imeyli:

[218050823@stu.ukzn.ac.za](mailto:218050823@stu.ukzn.ac.za) noma umphathi, uDkt. S.L. Nkomo, ku: 031 260 1149, i-imeyli: [nkomos1@ukzn.ac.za](mailto:nkomos1@ukzn.ac.za).

Uma nginemibuzo noma ukukhathazeka ngamalungelo ami njengomhlanganyeli wokutadisha, noma uma ngikhathazekile ngesici sesifundo noma abacwaningi ngingaxhumana kanye:

Ukuphathwa kwezokuHlaliswa koLwazi lokuHlaliswa kwabantu

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Tel: 27 31 2604557 - Fax: 27 31 2604609

Email: [HSSREC@ukzn.ac.za](mailto:HSSREC@ukzn.ac.za)

Nginikeza imvume yoku:

Umsindo-irekhodi ingxoxo yami YEBO / CHA

Uma kusebenza, i-video-irekhoda isayithi ngezinjongo zocwaningo YEBO / CHA / N / A

Uma kudingekile, ukuthatha izithombe zesayithi ngezinjongo zocwaningo YEBO / CHA / N/A

Uma kusebenza, ngiyazi ukuthi ngiyakwazi ukukhonzwa ngenxa yesimo sami futhi nginike imvume yokuba isikhundla sami sihlotschaniswe namazwana ami: YEBO / CHA / N / A

Ikheli le-imeyli lokuhlinzeka ngempendulo:

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Isignesha yoMhlanganyeli

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Usuku

## Appendix 4: Ethical clearance letter



06 June 2023

Thabiso Vincent Shinga (218050823)  
School Of Agri Earth & Env Sc  
Westville Campus

Dear TV Shinga,

**Protocol reference number:** HSSREC/00005087/2022

**Project title:** The role of local indigenous knowledge systems and community involvement in managing soil erosion in rural South Africa.

**Degree:** Masters

### Approval Notification – Expedited Application

This letter serves to notify you that your application received on 23 November 2022 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 06 June 2024.

To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

HSSREC is registered with the South African National Health Research Ethics Council (REC-040414-040).

Yours sincerely,



Professor Dipane Hlalele (Chair)

/dd

### Humanities and Social Sciences Research Ethics Committee

Postal Address: Private Bag X54001, Durban, 4000, South Africa

Telephone: +27 (0)31 260 8350/4557/3587 Email: [hssrec@ukzn.ac.za](mailto:hssrec@ukzn.ac.za) Website: <http://research.ukzn.ac.za/Research-Ethics>

Founding Campuses: ■ Edgewood ■ Howard College ■ Medical School ■ Pietermaritzburg ■ Westville

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