The impact of industrial agrarian policies on soils:

Experiences of small-scale farmers in the rural Eastern Cape

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August 2022

Declaration

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Acknowledgements

First and foremost, I am thankful for the financial support of the Mellon Foundation and the Tiso Foundation, without which I could not have completed this project. This thesis would also not have been possible without the support of many people who contributed in large and small ways. To my late brother, Reanetse Phakisi, who passed away in November 2018 while I was already at UCT – I wish you had lived longer. Continue to rest, my little bro. To my late parents and older brother, continue to rest as well – this is for you. To my late best friend Nolwazi Lubisi and my late mentor Malebohang Setai, I am where I am because of the love and support you showered me with. Without the support of the Environmental Humanities South and the patience and dedication of my supervisor, Prof. Lesley Green, this thesis would not have been possible. May the universe bless your beautiful soul.

Putting this work together has been a tough but incredible journey. To God, *Tlatlamacholo* and my ancestors, thank you for lighting the way when I thought I could take no more. Ntate Tsietsi Portas, my loving and considerate husband, thank you for supporting me all the way and for always believing in me. Thank you for looking after our son and thank you for the many sacrifices you have made for me and our family. Kea leboha Lekholokoe le letle. To my son, Mphuthing Portas, thank you for your patience. I love you, my boy. To my brother, my only remaining sibling Reabetsoe Phakisi, my sister-in-law Charmaine and my nephew and niece (Bontle and Rea) thank you *bana ba rakhali*. To sis Vivian Toleni, thank you for the friendship and kindness. Prof. Fiona Ross, thank you for reminding me over and over that I could do it. To the wonderful support system of strong women in my life – Keneuoe Setloboko, Maletsana Nkala, Thembakasi Makwakwa, Kaone Solomon (tsala yame), Rorisang Pheku, Masenate Letsie, Belina Motsoane, Matlotliso Mapota, Mosili Phakisi, Lebohang and Reitumetse Setai, Mantle Sehloho, Ellen Mokola, ausi Nthabi Molai, Belina Motsoane, Malekoatsa and Nauoe Makhanya, Makhotso Ntho, Mpatuoa Letete – thank you, ladies. To Realeboha Molaba and Motlatsi Monyake, kea leboha bashana beso. To Nicholas Lindenberg from GIS, University of Cape Town – I cannot thank you enough. More than anything, this work is for the small-scale farmers in the Eastern Cape. I see you; I recognise you, and you are important. To Janine Cole, I will never forget how you assisted me over the phone even though you did not know me. You have a beautiful soul. To my dearest friends Chukwuma Okolie and Lisah Ligono, thank you for coming through when I was helpless. To Prof. Patroba Odera, thank you for your advice, and thanks to Dr Gregory Maxaulane for agreeing to critique my work. Thank you for your tough love Chris Machelm-Peters. To Lindela and Faith, thanks guys. To all those who contributed to this study, I am thankful. To the entire Environmental

Humanities South team, thank you. Lastly, thank you Oom David van Wyk for your input and advice. I really benefit from being your mentee.

Abstract

After the end of legislated apartheid, the South African government changed old policies that had been driven by segregation against the black majority. Black small-scale farmers in rural areas were encouraged to join commercial agriculture to capitalise on state subsidies and support. Municipalities including Buffalo City Metropolitan, Great Kei, Amathole and others in the Eastern Cape, in collaboration with the Eastern Cape Department of Agriculture and agro-industry, introduced programmes such as the Massive Food Production Programme and the current Cropping Project to support rural farmers and to reduce poverty in the province. The initiatives included the introduction of genetically modified maize seeds, chemical fertilisers, chemical herbicides and pesticides, as well as herbicide-resistant and pest-resistant crops. However, joining state-funded initiatives meant farmers had to give up the farming practices and knowledge systems that had sustained them for years, and they lost the kinship they had built with the local soil and its organisms. By kinship I am referring to a symbiotic relationship that does not separate nature from society, a relationship that is mutualistic and in which there is no mastery of one party over the other.

Working with rural Eastern Cape small-scale farmers who participated in these programmes, this study employs a multidisciplinary approach to understand the changing agricultural landscape in rural South Africa, focusing on the consequences of state-funded programmes on local soil knowledge in the context of current Eastern Cape industrial agrarian policies. Navigating from small-scale farmers' voices, remote sensing technology, history, African environmentalism, soil science and the human psyche, the study examines what happens when corporations and the government encroach on traditional and small-scale agriculture. This integrative research methodology of the Environmental Humanities, framed from the Global South, compels us to reconceptualise our relationship with nature. The study argues that while agro-industrial technologies can be used with existing local practices to assist farmers, they should never be introduced as a replacement for existing local knowledge of soil fertility. Moreover, where policies focus on the financialisation of the agrarian economy, such policies risk benefitting agro-businesses instead of poor, small-scale farmers. If policies intended to stimulate rural development are to be effective, the needs of rural small-scale farmers must be taken into consideration when such policies are initiated.

Abbreviations

ANC – African National Congress

ANCYL – African National Congress Youth League

ACB – African Centre for Biodiversity

BCM – Black Consciousness Movement

BLM – Black Lives Matter

BPM – Black Power Movement

CRM – Civil rights movement

EC – Eastern Cape

ECDA – Eastern Cape Department of Agriculture

EFSA – European Food Safety Authority

EU – European Union

IFP – Inkatha Freedom Party

GMOs – Genetically modified organisms

GM – Green manure

MFPP – Massive Food Production Programme

ISMP – Improved Soil Management Practices

NDVI – Normalized Difference Vegetation Index

NNM – New Negro Movement

NPK – Nitrogen, potassium and phosphorous

NPO – Non-profit organisations

POP – Persistent organic pollutants

SA – South Africa

SASO – South African Student Organisation

PH – Potential hydrogen (soil PH)

SSF – Small-scale farmers

US – United States

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Preface

You can blow out a candle
But you can't blow out a fire
Once the flames begin to catch
The wind will blow it higher.
Peter Gabriel, "Biko"

Every generation has its battles. For black people, the struggle for equality is never-ending and intergenerational. From Toussaint Louverture, Ida B. Wells and Thomas Sankara to Steve Biko, freedom has never really been won. To be black is to constantly question your place in this world. This PhD has been an emotional journey for which I was forced to dig deep within my blackness. I would not say a journey of self-discovery as a black person, but a journey of being forced to realise what it means to be black in the world today. To realise that my society functions under a world order, and that black justice requires the dismantling of structures built on white supremacy.

At the beginning of this thesis, I was angry, in turmoil and perhaps a bit naive. I had so many questions about my black skin – my otherness. However, when I concluded the last chapter, I found I had regained a sense of peace after following and employing the works of many black scholars who had come before me. The likes of Steve Biko, Aimé Césaire, Robert Sobukwe and Frantz Fanon, who despite suffering immensely under colonialism and apartheid, still chose humanism over hate. I opted for a humanist approach whose focus extends beyond humans to include other beings too. This is despite being fully aware that both the colonial and apartheid systems are deeply embedded in how the society I live in today functions. Apartheid architects and colonial masters justified their treatment of blacks on the basis that they were superior and thus in a better position to decide how blacks should live. While the eras of apartheid and colonialism have officially ended, black people are still not necessarily free. The democratic South Africa has made it possible for blacks to be absorbed into the system, but it has not changed the system itself. The old structures founded on racism are still intact, and the core problems remain.

When I first arrived at the University of Cape Town to start this research project in 2018, it was close to the 41st anniversary of Steve Biko's death. Two years earlier, the Fees Must Fall protests had engulfed South Africa, with students holding larger-than-life placards commemorating Biko and the Black Consciousness Movement. I was in Bonn, Germany at that time, interning for an international European institution. I saw intense protests in the news, the so-called 'born-frees' fighting for decolonised, free education. I remember vividly a conversation I had at the time with a white South African man who was chair of another international organisation in the city. I asked him what he thought about the Fees Must Fall movement. He responded that it was such a waste of time for students who wanted to complete their studies, who now had to be delayed by these ongoing "senseless" protests. Here was a man who spoke from a place of privilege and had no idea about the plight of poor students at tertiary institutions. He must have noticed my disapproval, for our conversation ended as quickly as it had begun, and he disappeared into a hall filled with tipsy conference attendees. In a fancy hall in Bonn, I asked myself why the ideologies of Biko were still relevant almost 40 years later, especially to a generation who were mostly born after the first democratic elections of 1994. Good ideas never die but rise anew with every dawn.

Biko's life was cut short by the apartheid police in 1977, but his teachings of unity, black-determination, black pride, self-respect, self-reliance and psychological liberation remain relevant today. Our current leaders appear out of sync with Biko's ideology of Black Consciousness. In seeking to define African environmentalism, I navigated different disciplines, including technology, the voices of rural farmers, history and decoloniality. In this thesis, I argue that for development to take place in South Africa or on the continent, policies must align with the day-to-day experiences of the people they are intended for, and poor people must have the freedom to drive their own development. I unashamedly follow the ideology of Black Consciousness in this thesis, a central tenet of which was to unite people across racial and ethnic lines. I thus chose the rural Eastern Cape as the subject of this study. As I will discuss in the first chapter, between 1960 and 1980 the apartheid government created Homelands to marginalise and divide black people (Abel, 2019). The Homelands were ethnically distinct because the idea was to discourage unity and promote tribalism among the black population (Abel, 2019). Biko and his allies strongly opposed the Homelands for these reasons. One of my mentors advised: "You are a Mosotho, so it would be easier for you to choose the Free State, where your research subjects speak your

language", but I opted for the Eastern Cape anyway. I was not there only to collect research. I was also there to engage, learn, give a voice to and conscientise farmers to take charge of their problems – to promote the self-reliance that Biko had so passionately advocated.

Following Biko's ideologies does not make me blind to his shortcomings as a leader; he overlooked sexism as a form of oppression among black women, for example. I choose instead to stand on the shoulders of strong black women who, alongside Biko, spearheaded the Black Consciousness Movement – Mamphela Ramphele, Deborah Matshoba, Vuyelwa Mashalaba and Thenjiwe Mtintso, to name a few. I appreciate their struggle to have their voices heard in a movement that treated women's oppression as "a simple by-product of the democratic struggle" (Macqueen, 2018: 149). As a black woman living in South Africa, this thesis was personal and required a lot of introspection, and I see it as not just a PhD project but as a collaboration between myself and small-scale farmers.

Let me briefly introduce myself. My life has been nomadic, having lived in nine cities or towns. My childhood was spent in a semi-rural setting, where in summer my mother would wake me and my siblings to water, weed, and rake manure or compost over our food gardens. On school holidays my mother often shipped me off to my grandmother's rural homestead, where my cousins and I fetched water from the well, fetched wood from the forest, worked in the fields and cooked supper outside in three-legged pots. I have lived in the townships of Soweto (Johannesburg), Soshanguve (Pretoria) and Clermont (Durban), and I remember there often being no water in our area – we had to travel to an adjacent suburb to fetch water, carrying 20-litre containers. When a neighbour was extremely sick we called an ambulance, only to be told that the last ambulance sent to Soweto had been hijacked, so they would not send one. The telephone operator explained that they could not risk the lives of their paramedic staff in a crime-infested township. In Clermont, stabbing incidents at nearby taverns often resulted in death, and a four-year-old girl was raped by a man we all knew and trusted in the community. I have also lived and walked on the beautiful streets of Prague in the Czech Republic, attended United Nations meetings in Bonn, Germany, taken a boat ride in Budapest, seen the beauty of Monte Carlo at night and eaten the best croissants in the south of France.

It was extremely important to ask myself how my perspectives and world view would affect the scope of the research throughout this dissertation, not only because writing it was a process of learning, but more broadly to write in dialogue with the global Black Lives Matter movement. In decolonial social sciences research, the researcher is compelled to be aware of and address their positionality (Holmes, 2020). As a student researching local soil knowledge in the context of current industrial agrarian policies in the Eastern Cape, how would my situatedness form the study? Given my many visits to my grandmother's village when I was young, I related to the small-scale farmers of the rural Eastern Cape, many of whom are beset by poverty and vulnerability. Like them, I am black and was raised in an environment where farming and a kinship with the soil and its beings is important. Like them, I have been poor and vulnerable. Nonetheless, I assumed that they would see me as a privileged woman from the city with access to services they did not have, such as running water, roads and reliable electricity. They might also see me differently based on my ethnic group, as I am a Mosotho and they are AmaXhosa, or as an 'educated' person – although I was there to gather information and to learn from them.

So how might all of these issues – and more – affect the integrity of the study? I had become interested in this research topic after reading a similar study on the Rhodes University website (Bradfield, 2011). What interested me most was how rapidly the landscape of rural agriculture was changing. When I was young, we had food gardens and did not have to buy much. We did not use synthetic fertilisers, because we trusted our manure to enrich the soil. We also did not use pesticides, and we exchanged seeds among ourselves. The new system required farmers to buy everything – pesticides, fertilisers and even seeds, which made me concerned for the sustainability of their well-being. The old system had so many benefits and nobody struggled for a decent meal. The realisation that rural communities had been coerced by authorities to do away with a system with so many benefits did not sit well with me.

A lot has changed since my childhood, however, and I wondered if perhaps I was being unfair by ignoring the benefits of technology and not wanting the old system to change. I also resisted the urge to act as a 'representative' of the farmers and sought instead to learn about the experiences of the farmers themselves. I wanted to understand more about their experiences and evolving practices over the years and whether technological changes had affected them. Despite having

lived in the rural areas and engaged in farming practices in my younger years, I had no idea what it was like to practice farming under the contemporary conditions of climate change and the state's agricultural policies.

In preparation for my fieldwork, I decided to visit a village not far from an area I was planning to study to get a feel for the context/current experience – and to seek the guidance of those living there. Many studies claim to represent the voice of rural communities but actually foreground the voice of the researcher, and I wanted to avoid that trap. So one hot December morning, I took a taxi to the outskirts of the city. I got off in sight of a flat-topped mountain dotted with huts, kraals and green fields. By the roadside a group of women, young and old, sat selling peaches to the passing cars. I greeted the women and made my way on to their village. They seemed shocked to see this stranger with her red hairdo. I smiled politely but did not stop to explain myself.

They reminded me of my childhood in peach season. Back then, everyone had peach trees, and every February the women and their girl children formed *letsema* (a group of people working voluntarily together). We would cut the peaches and place them in canning jars to preserve them for the coming months. As I passed the maize fields, I saw men and women finishing work for the day. Again, I raised my arm and waved. This is how it is in a village – you greet everyone you meet. It was quite a walk to the village, but I enjoyed the fresh mountain breeze and tranquillity. Hoping there were no vicious dogs, I walked up to the first house I saw, where two elderly men were playing *morabaraba*, a traditional board game in southern Africa played mostly by men. I envied their laughter and the twinkle in their eyes as they moved tiny rocks strategically across a board of flat yellow rock.

They paused their game when I arrived (Image 1), and after a brief introduction I told them I was there to seek advice from the elders about a research study I was working on. "I will be observing and interviewing small-scale farmers in rural Eastern Cape about soil practices," I told them. "I want to give them the opportunity to voice their opinions about state-funded programmes that have been introduced in their areas. The programmes are based on GM technology that uses synthetic fertilisers, pesticides and seeds that have been modified. I want to find out how these new farming practices have affected their soil and old farming techniques." I paused to catch my breath, hoping

I had given enough information for the two men to understand. There was a long pause, which made me anxious. Had coming here been a mistake? They resumed their game, which requires a lot of thinking and quiet moments in between. I wasn't sure if they were shocked by the city girl with red hair pitching up out of nowhere or if my request itself had shocked them.

Image 1: Ntate Masupha and Monethi playing morabara

After what seemed like an eternity, Ntate[1] Masupha, wearing a blue overall, responded.
"My cousin who lives in Transkei told me about the 'whiteman's seeds'." To his friend, Ntate Monethi, who was wearing a white shirt, he said, "You know him – he comes here many times. He was here for Jubile's funeral."

[1] "Ntate" is used as a way of respectfully addressing older males. It is popular among Basotho and is used alone or before the name of the person being addressed.

“I think I remember him. The one who is a successful farmer?” asked Ntate Monethi.

“Yes, that one,” Ntate Masupha confirmed. “Well… I don’t know if it’s good or bad. I guess they will tell you how the white man’s technology is treating them. Here we are still using the old methods, and everything is still good except the changing weather patterns. But we are healthy and happy,” Ntate Masupha continued matter of factly.

“We plant our own maize using old seeds that we recycle or exchange. We never buy maize meal, because we take our maize to be processed at the milling manufacturer. It’s less than R100 for 50 kilograms,” Ntate Monethi added.

“Remember, we rural folks may not be educated, but we know more than you think. Let them speak, watch them closely and learn,” Ntate Masupha advised. I nodded in agreement. I had thought this too, but perhaps it was good to hear it again. He spoke slowly, but his eyes held wisdom.

Ntate Monethi did not have too much to say, but he threw in some ideas. “Watch your manners, watch your tongue. Here in the rural areas, we are still respectful with one another. That’s why God has kept us for so long. You city people don’t care about anyone but yourselves. When I was a boy, a sense of community was everything. My problem wasn’t my problem alone – it was shared among the villagers. Nobody went hungry, because we shared. You had to check on your neighbour to ensure he was eating. It is the kind of life I miss. Of course, we try to live like in the olden days, but it’s not easy. The world has changed.”

I knew this too, but it was good to be reminded, especially about manners – how to address the elderly (be respectful at all times), a dress code (no short skirts or revealing outfits, and in some areas women don’t even wear trousers) and not to act high and mighty. All these issues came up during the discussion.

I was about to leave when I noticed that Ntate Masupha was chewing what seemed like a green plant. I was curious. “What’s that?” I asked.

“It’s *modisa-pelo*, a water-based plant that helps with stress and healing a broken heart.” They laughed. “You have already passed the test. Show curiosity like you are doing now, look around and observe the surroundings and pay attention to issues other than your research topic – they might be indirectly connected to your topic. *O rata ditaba ntse ke bona* [You are nosy]. You will survive your research,” Ntate Masupha said.

They laughed again and continued their game of *morabaraba* as I headed home ahead of the afternoon traffic.

Introduction

In January 2019 I arrived in Xarhuni, a village on the outskirts of East London, where I found the local small-scale farmers confused and frustrated. “They [government officials] sprayed Roundup in my fields, now my maize is stunted. I don’t know what to do. I am angry,” an old woman farmer told me. Another old farmer was also upset but calm. She took me to her fields adjacent to a small stream at the far end of the village. “You see I use this black hosepipe to separate my fields, because the other half of this entire area doesn’t grow anything. The soil is depleted, and I think it’s Roundup and the chemicals that were used at the time when the modern way of farming was introduced to us. There is no other explanation,” she told me.

These vignettes highlight the uncertainty hanging over the agricultural landscape in rural Eastern Cape. In post-apartheid South Africa, local soil knowledge has little voice in current Eastern Cape industrial agrarian policies. In Buffalo City Metropolitan, Great Kei, Amathole and other Eastern Cape municipalities, the Eastern Cape Department of Agriculture (ECDA) and agro-industry introduced the Massive Food Production Programme (MFPP) in 2003 to reduce poverty in the province. The MFPP was one of many development projects initiated by the Eastern Cape provincial government to improve agricultural production in the province.

According to the Eastern Cape Provincial Growth and Development Plan 2004–2014[2] (Province of the Eastern Cape, 2004), the MFPP and other programmes (including Siyazondla Homestead Food Production, Integrated Nutrition and Integrated Agricultural Infrastructure) were part of the province’s emerging Integrated Food Security Plan. The MFPP was additionally initiated on the recommendation of the Provincial Growth and Development Plan and focused mainly on the annual production of 600 000 tons of maize to ensure food security in designated areas (Madyibi, 2013). Led by the Eastern Cape Department of Agriculture, the programme was allocated 50 million in the 2003/2004 financial year (Province of the Eastern Cape, 2004). The Department identified five hundred thousand hectares of land in the province to carry out the initiative (Madyibi, 2013). Furthermore, the MFPP comprised two schemes: a mechanisation scheme under which local contractors received equipment such as tractors, ploughs, etc. (similar to the apartheid

[2] See appendix C.

Betterment tractor hire scheme), and a production scheme that assisted farmers with seeds, fertilisers and pesticides (Madyibi, 2013). However, Jacobson (2013) writes that the programme experienced many setbacks, including the late disbursement of funds, which resulted in delayed planting and thus a failure to meet the targeted goals.

The motivation behind these programmes is to re-agrarianise farming in the former apartheid state's "bantustans", which they named "cultural homelands" (Mtero, 2012). The initiatives are driven by agro-industrial technology of genetically modified maize seeds, chemical fertilisers, chemical herbicides/pesticides and herbicide-resistant/pest-resistant crops (Hebinck, 2013). Participating farmers merge their fields to form large portions of land, and private contractors are hired to cultivate the fields using machinery and agrochemicals.

Hajdu et al. (2020) write that agrarian initiatives including the MFPP, the Accelerated and Shared Growth Initiative for South Africa and the Siyazondla Homestead Food Production Programme have all failed, but this has not stopped the state from introducing a similar scheme in the rural Eastern Cape that farmers call "*iproject/icropping*", the Cropping Programme/Cropping Project. The province's Food Production Policy document (Department of Agricultural Development and Agrarian Reform (DRDAR), 2018: 5) states that the Department of Agriculture will provide a subsidy to small scale-farmers, but the farmers must make a contribution "determined by annual production costs". The 15-page document mentions the Cropping Programme's objectives (improving food security and assisting small-scale farmers) and implementation and application procedures, but it is not clear about the budget and social and anthropological impacts on the targeted communities. The DRDAR's Facebook page posted a four-minute video[3] encouraging small-scale farmers to join the project, stating that the DRDAR provides beneficiaries with R3 200/ha to produce vegetables. It also states that the programme is not homogenous – different approaches are implemented in accordance with the beneficiaries' needs. The farmers interviewed for this study described their incurred costs as ranging from R1 800 to R2 400.

According to Jacobson (2013), who did an analysis of why agricultural initiatives have failed in South Africa, documents issued by the ECDA explain that modern technologies are introduced in

[3] See https://www.facebook.com/watch/?v=643610379863207

the former homelands because they are believed to be better than the traditional practices used by targeted small-scale farmers. For example, "the MFPP, while claiming to be something radically different from past schemes, still employs almost exactly the same top-down approach and introduces the same tools and practices without considering their compatibility with local, social and ecological context" (Jacobson, 2013: 209). Despite this argument, the DRDAR's policy document on food production[4] highlights that the failure of agriculture in the province is a result of small-scale farmers being unable to operate commercially at a large scale (DRDAR, 2018).

Several studies have evaluated the economic indicators of such programmes among small-scale farmers (Fischer and Hajdu, 2015; Khapayi and Celliers, 2016), but nobody has evaluated its effect on soil, despite this being the main concern for local farmers. This study therefore weaves together a ground-level understanding of the effects of agro-industrial farming practices on soil, using as its source material the voices and knowledge of small-scale farmers. It documents the ripple effect of applying technocratic solutions to spaces where local knowledge systems have sustained farmers for years.

Exploring small-scale farmers' experiences of these programmes, this study describes the many problems encountered when technocratic solutions are understood by decision-makers to be the only means to introduce agrarian reforms. The study highlights the importance of farmers' knowledge systems in soil management practices, showing how technology and local knowledge can be used together to improve small-scale farmers' soil management practices and overall farming activities. Working with the farmers' evidence-based accounts of their experiences, together with geospatial analysis, the study shows that it is important not to take for granted the corporate agrarian imaginaries.

The study has the following aims:

- Ascertain what soil means to farmers and how farmers relate to soil organisms.
- Assess the effects of GM technology on soil health (nutrients, microorganisms), based on farmers' anecdotes of their fields and remote sensing technology.

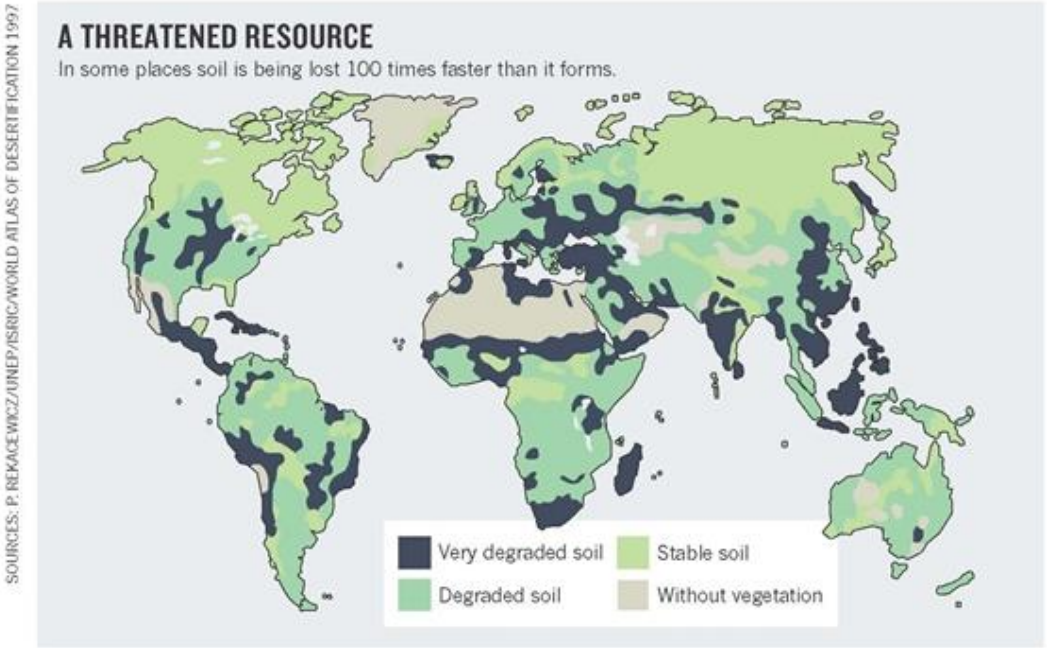
[4] See appendix D.

- Build up a soil testing kit using farmers' traditional knowledge.
- Assess the gains and losses of switching from local farming techniques to modern farming practices.

While the main aim of this research is to highlight and address rural farmers' experiences and grievances, the study manifests as many questions and answers. As an Environmental Humanities study, the account brings together technology, history, human psyche, capitalism, land and soil biology. This integrative approach to the research problem highlights the need for a multifaceted approach to any question relating to human entanglement with the natural environment.

The significance of this study: "Soil at the heart of the critical zone."

Soil degradation is explained as a process whereby human activities have reduced soil's current and future capacity to support life (Arnold & Scalenghe, 2006).



Map 1: Soil: A threatened resource (Source: Banwart, S. (2011) Save our soils. Nature (London). [Online] 474 (7350), 151–152.)

While the 21st century has been dominated by news about peak oil, peak coal, peak gold, etc., hardly any mention has been made of peak soil. Yet over the past 40 years, humans have depleted about 15% of Earth's land area and caused 30% of croplands worldwide to become unproductive

(Ahmed, 2013). The map above shows the state of soil around the globe in 2011, more than a decade ago. In 2022, the United Nations yet again cautioned that soils are continuing to degrade at an alarming rate, with 33% of soils already degraded and estimates of at least 90% of this precious resource being degraded by 2050 (Sullivan et al., 2022). Concerned scholars around the world have raised alarms about peak soil happening sooner than we have imagined.

Commemorating World Soil Day 2021, Leeds University Professor Steve Banwart (GFEI University of Leeds, 2021: online) explained that human activities place soil "at the heart of the critical zone". The critical zone is "the zone where rock meets life – a permeable layer from the tops of the trees to the bottom of the groundwater, an environment where rock, soil, water, air and living organisms interact and shape the Earth's surface" (Critical Zones Observatories, 2020: online). Due to its entanglement with humans, the critical zone is under significant pressure from humanity's ongoing demand for food and other needs (GFEI University of Leeds, 2021). As humanity persists with its destructive, capital-driven models, we inevitably face a metabolic rift (Banwart, 2011).

In all of these scenarios, rural communities are always the most vulnerable. In the capitalist system, crops and soil are commodifiable, so even 'tired' or worn-out soils are treated with chemicals and engineering technologies to encourage or increase productivity (de la Bellacasa, 2017). The idea of soil care has become a key area of interest for researchers addressing the soil crisis (de la Bellacasa, 2017; Krzywoszynska, 2016). Caring for the soil requires an acknowledgement that the human carer is dependent on the soil's capacity to be involved in other processes that are important to more than one existence – as farmers have been practicing in the Eastern Cape.

GMOs in Africa: Economically viable agriculture? Lessons from Burkina Faso

Since the beginning of the democratic era in South Africa, policymakers have leaned towards modern technologies such as genetic modification to address food security and teach the former homelands "economically viable agriculture" (Hebinck, 2013). The MFPP has already failed in the rural Eastern Cape, but the state has continued to implement projects based on similar development models (Fischer and Hajdu, 2015). The impact of these development models on soil has never been addressed, nor has the question of how these models affect local soil management

practices in the participating areas. In *Local farmers' approach to soil conservation: Lessons from Nigeria*, Oluwatoyin Kolawole (2006) concludes that African governments do not implement modern technologies appropriately, with detrimental consequences.

These consequences led Burkina Faso to phase out GM technology in 2015, a turn of events that should not be ignored by the South African government. South Africa introduced GM maize, soybeans and cotton in 1997, and Egypt and Burkina Faso followed in 2008, growing GM maize and cotton, respectively (Ndlovu, 2016). Advocates of genetic engineering hailed this as a step in the right direction for Africa (Thomson, 2002). In Makhathini Flats, KwaZulu Natal, small-scale farmers adopted Monsanto's Bt cotton in 1998, with two-thirds of the area planted with Bt cotton within three years (Moseley and Gray, 2008). Critics heralded this as a success story (Dowd-Uribe, 2014).

Meanwhile, the Burkinabe farmers continued with their locally adapted cotton varieties but would later adopt Bt cotton in 2008 (Moseley and Gray, 2008). It should be noted that for many decades, West Africa – Burkina Faso included – has been considered a powerhouse of cotton production (Soumare et al., 2021). The Burkina Faso cotton sector differs from the South African in two significant ways: in Burkina Faso, small-scale farmers dominate the cotton sector and, for many of them, cotton is their only way out of poverty. Secondly, the cotton industry is highly regulated – for example, farmers are provided with inputs by cotton companies, including seeds on credit, and they sell their produce to the same companies after harvesting, (Dowd-Uribe & Schnurr, 2016; Luna, 2020; Moseley and Gray, 2008).

In contrast, the South African state subsidises and funds programmes for its small-scale farmers, but the farmers must fend for themselves after harvest. The local agricultural sector is also dualistic by nature, comprising the commercial sector (which produces the majority of marketed output) and the subsistence sector (based in the former homelands, where agriculture accounts for less than 13% of land use) (Nieuwoudt & Groenwald, 2003). This was not always the case, though, given the inextricable link between past and current agrarian policies.

Institutional factors (e.g little support from the government including providing advice, lack of monitoring insect resistance) played a major role in the decline of Makhathini Flats cotton

production (Pschorn-Strauss, 2005). As the Makhathini Flats success story took a downward turn, in 2008 critics turned their attention to Burkina Faso, the 'new bellwether' of Bt cotton (Dowd-Uribe, 2014; Luna, 2020). In a surprise turn of events, the country ended its contract with Monsanto in 2016, citing compromised quality (Luna, 2020). The Burkinabe have always been proud of their cotton and were initially hesitant to introduce Bt cotton. While their traditional cotton variety produced long, strong fibres, Monsanto's Bt cotton produced short fibres (Dowd-Uribe & Schnurr, 2016; Luna, 2020), leading to an apparent loss of US$80 million in sales (Luna, 2020). This decline in sales and quality undermined the Burkinabe cotton industry's reputation in the international arena (Dowd-Uribe & Schnurr, 2016). Monsanto officials and pro-GM proponents initially blamed water stress and farmers' failure to use the GM technology appropriately, but Monsanto eventually chose to address the faults and do some reputational damage control (Luna, 2020; Dowd-Uribe & Schnurr, 2016).

South African policymakers can learn from the ripple effects of introducing GM technology to small-scale rural farmers. Bringing expensive technology to poor rural farmers leaves them vulnerable to debt and to big agro companies that stand to gain and monopolise the markets. The inconsistencies and disagreements among researchers about how GM technology affects the environment indicates the need for further research on both the environmental consequences of this technology, and the social consequences of introducing a new corporate legal regime in rural areas. Existing research has addressed the technology's impact on soil health, soil function and soil micro-organism biosafety (Motavalli et al., 2004; Guan et al., 2016; Lupwayi et al., 2010). To study the introduction of biotechnology to small-scale farmers, I needed to delve deeper and gain an understanding of their experiences, knowledge and expectations. To this end, this study will explore the following questions:

- How has the change in policy/introduction of GM technology affected small-scale farmers' traditional soil management and agricultural practices/knowledge systems?
- How can small-scale farmers use their local knowledge systems to improve soil management practices?
- How can modern technology be used to address crop production in the former homelands?
- What are the benefits and downsides of GM technology?

Structure of this thesis

Chapter One of this thesis, "Technology changes everything: Benefits and losses of biotechnology for soil", focuses on the economics of soil care and GM technology (small-scale farmers' costs before the technology was introduced), the costs to the environment and the loss of knowledge and loss of connection (social changes, livelihood changes, loss of working soils). Agriculture is not solely about increasing crop production, and this chapter shows the dangers of introducing technology to rural spaces without first taking into account local ways of life, knowledge systems and practices and how these relate to nature.

In the rural Eastern Cape, agriculture is the connection farmers have with their soil, how they relate to soil communities, their rituals to 'call' the rains in times of drought, and it is the preservation and exchange of seeds passed from generation to generation. When I started data collection for this study in 2019, ongoing global protests were underway against multinational agribusiness seed ownership (Wittman et al, 2010). Farmers' movements such as Izwelamafarmer (locally) and La Via Campesina (internationally) were demanding freedom of choice in what they planted, drawing attention to the need for discussion about the impact of current technologies on soil: the remarkable, component that sustains life.

In Chapter Two I introduce the complex yet critical integrative research methodology of the Environmental Humanities as framed from the global south. How can we address environmental issues in the face of capitalism and the changing climate? Should we continue to accept science as the only route to an effective solution? With the globalisation of technology, science has unquestionably become part of modern-day culture, to the extent that the phrase 'corporatised science' has arisen to describe modern science as "servicing corporate interests under the guise of objectivity" (Subramanian and Pisupati, 2010:12). Environmental Humanities South offers an alternative: interdisciplinary scholarship that compels us to question our relationship with the environment and other beings (plants, soil community, water, etc.). This interdisciplinary approach gave farmers a platform to speak about their relationship with soil in focus group interviews and gave farmers the opportunity to remember their relationship with soil in interviews. Interdisciplinary scholarship breaks epistemic borders, bringing all disciplines together in its quest

for answers and providing a platform for even the most vulnerable to be heard – not just rural small-scale farmers in the Eastern Cape, but the soil community, the environment at large.

In Chapter Three, "How did we get here? On the origins of industrial agricultural policy in small-scale farming in the rural Eastern Cape", I included a history and discussion of agrarian reforms in South Africa to provide a context for the evolution of South African agriculture. Finally, I refer to philosophers Aimé Césaire and Michel Foucault to explain the relationship between power and knowledge. The chapter weaves together many players often overlooked in discussions of rural development, particularly the role of multinational corporations, politics and the relationship between the state and vulnerable communities.

Chapter Four merges farmers' voices with remote sensing technology. The overall aim of this chapter is to explore different methods of data collection at the interstices of technology and farmers' voices. The outcome of the exploration is not to determine which method is superior but to determine what might work best for rural farmers. I use both ethnographic data and technology to assess farmers' fields. In conclusion, I urge the government and policymakers to include rural communities in their decision making and to give farmers freedom to plant what they want. I also urge the state to address environmental justice in South Africa; it is not only the vulnerable communities that need care, but the soils and water communities too. Nature matters!

Chapter Five considers soil care knowledge and practices across the participating villages, based on ethnographic and linguistic evidence gathered from qualitative interviews of how people care for soils. The chapter describes a soil testing kit that comprises the different voices of farmers and how they preserve soils. Given the opportunity, these small-scale rural farmers are experts in pedology and soil management assessment, showing that there is a dire need for scientists and rural communities such as these to find common ground. Scientists should not presume anything about their subjects or findings and should ensure reversal learning[5] when working with rural small-scale farmers (Kolawole, 2013).

[5] By reversal learning, Kolawole (2013) encourages a trade-off of knowledge between scientists and small-scale farmers in rural areas. Scientists should not assume that they know best and are only there to teach farmers. Farmers understand their farming practices and are also in a position to engage and exchange knowledge with scientists. The form of knowledge Kolawole is suggesting is discussed in Chapter Two under Paulo Freire's praxis model.

Chapter Six recognises the work of those who influenced the Black Consciousness Movement (BCM) and black activism around the globe. This chapter highlights how white supremacy and racial oppression have manifested differently over the centuries, from colonialism to apartheid to neocolonialism. The chapter weaves together the struggle for economic, psychological emancipation and for environmental justice for black people. I highlight how grassroots movements such as the BCM empower vulnerable communities by allowing them to take control of their situation, and I introduce the natural environment as a voiceless victim of capitalism and imperialism, of human mastery over nature. I also describe how land dispossession and apartheid geographies render environmental justice impossible for black South Africans. In post-apartheid South Africa, old apartheid structures such as townships still exist as the country's underbelly, where people are exposed to pollution, the toxicity of mine dumps, water contamination and other environmental injustices.

Chapter One

"Technology changes everything: Benefits and losses of biotechnology for soil"

The year 2019 began with a severe drought and torrid temperatures that made it unbearable to walk around Xarhuni, a village on the outskirts of East London. Without sunscreen, one could be sunburned in minutes. On this particular day, the first week of January, the festive mood had died down and the folks were slowly adjusting to a bleak year ahead. I sat at the back of a *ronda* in a homestead with two old farmers, Luviwe and Lonwabo. Below the local homesteads, agricultural landscapes stretched down to a stream, giving the village an aesthetic and peaceful look. The fields, inheritances from their fathers, formed part of this peaceful landscape. I had been here twice already to witness how they 'work the soils', and I wondered if the fields would retain their beauty and dark, rich soils over the next 10 or 20 years. In *Arts of living on a damaged planet,* Anna Tsing (Tsing et al., 2017: 1) writes a poignant introduction: "The winds of the Anthropocene carry ghosts … our ghosts are the traces of more-than-human histories through which ecologies are made and unmade". Five decades earlier, Rachel Carson (1965: 1) shared a similar concern in her introduction to *Silent spring*, describing a dire future as humans deplete the environment with dangerous chemicals:

> There was a strange stillness. The birds, for example – where had they gone? Many people spoke of them, puzzled and disturbed. The feeding stations in the backyards were deserted. The few birds seen anywhere were moribund; they trembled violently and could not fly. It was a spring without voices.

Carson has long since died, but it is business as usual for agrochemical industries in the 21st century. I looked at the two old farmers in their 70s and 80s – perhaps they will be long gone when their beautiful fields become nothing but memory, when only the ghosts of the Anthropocene remain. Luviwe had just finished making a natural pesticide with wild garlic, aloe and chillies in a 20-litre container – not to kill but to chase away pests in his gardens and big fields. He told me that even pests deserve to live, because they have a purpose in the natural environment. A bag full of pig manure prepared by Luviwe and other farmers was to 'feed the soil' the next day. While we waited for four more participants to join us for a focus group session, the farmers discussed the prolonged drought that had caused catastrophic damage in the Eastern Cape. They said the

province is prone to severe droughts that often result in water stress, livestock death and detrimental effects on crop production. The drought topic was ruining their mood, so I switched to the topic they love – soil and agriculture. I asked casually, "You said soil is alive and has a soul. Why?" Luviwe laughed out aloud. He liked explaining things and being the centre of attention:

"The soil is alive. That's why I have never used GMOs or herbicides all my life. Products like Blue death [pesticide], I don't use them. I make my own herbicide to chase away pests."	*"Umhlaba uyaphila yiyo lonto ndingazange ndisebenzise ii-GMOs okanye imichiza yokutshabalalisa ukhula ubomi bam bonke. Iimveliso ezifana neeBlue death (isibulali zinambuzane) andizisebenzisi. Ndizenzela i-herbicide yam egxotha izinambuzane ezihlala emhlabeni."*

Improving soil biodiversity means not killing the creatures that live in it, but capitalism is predicated on exterminating whatever stands in the way of making money (Marya and Patel, 2021). Luviwe clarifies that he does not mean that soil has a metaphorical soul – soil has a soul because of the many different organisms that keep it alive. Without plant life and many other organisms, soil is dead, Luviwe emphasises.

Here in rural Nxarhuni, farmers like Lonwabo and Luviwe can barely cling to their traditional agricultural practices. They tell me they are protecting the soil species and will never conform to modern practices. For years they have nourished the soul of their soil by maintaining a kinship with the soil organisms that help sustain the ecosystem – "Mangibona umsundululu ndiyatjabula ndife" ("When I see earthworms, I become so overjoyed.") They will not change how they farm, but they are worried about the future of agriculture in their village. They ask what will happen if more farmers join iproject (projects) and start using chemicals – "Umhlaba uzothini?" ("What about the soil?") they ask.

Technological arrogance? Capitalism and exploitation

"Even though there are government subsidies, they come with conditions." – Extension officer.

During my stay in the Eastern Cape, I visited, observed and interviewed different groups of farmers: the likes of Lonwabo and Luviwe, who want nothing to do with modern practices; those who joined the programmes; and those who decided to combine modern and traditional practices. I wanted to understand the reasons behind their choices. I first contacted the local Department of Agriculture to establish how participating farmers were selected and to get their opinion on the matter at hand. I also interviewed a retired senior extension officer who had been part of initiatives such as the MFPP and cropping project from planning to implementation.

> "We didn't ask them [farmers], we just told them. For example, we would say: You see in this place/village, we are going to introduce Massive [MFPP]. So please, let us take your names and what... We didn't make it their project. We just forced it. We saw that Massive didn't work, because farmers were not included in the implementation process. I was saddened by that."

The retired extension officer explained that the Department of Agriculture only showed interest in areas with rich soils, such as Mooiplaas, Kwelerha, Ncera and some sections of Nxahruni (Newlands). Farmers in areas such as rural Berlin were apparently told by government officials that their soils were not good enough for *iproject*.

I made an appointment with the director of the Buffalo City Metropolitan Municipality (agriculture). He seemed uncomfortable being interviewed, but I asked why farmers were not part of the planning process as the beneficiaries of the programmes. He denied that farmers were forced to join the state-funded programmes, but he could not explain their exclusion from the policy change processes. He said the state was "doing its best to assist vulnerable communities", but he contradicted himself later when he said that "There are special cases when we [the upper echelons of the department] have to make decisions on behalf of the farmers without consulting with them, because the farmers themselves don't know what they want."

Exploitation and control over groups are at the centre of biopower, and making decisions on behalf of a group because 'they don't know what they want' is a form of biopower (Foucault, 2018). In this situation, the farmers were not warned about the risks of adopting these modern technologies. According to Mbembe (2019), the state provides a moral justification when particular groups are

exploited. In this case, the director claims that they make decisions for farmers because the farmers *do not know what they want!*

In 2019, farmers in Ncera and Mooiplaas were excited about joining *iproject* – the cropping project. On joining, they were promised they would make more money, like white commercial farmers. This appealed to these previously disadvantaged and oppressed black farmers, but they received no information about the adverse effects of the technology. The late civil rights activist Kwame Ture (1973: online) said many people support capitalism because it offers an opportunity to access money to the same degree as the Rockerfellers. We are led to believe that capitalism provides equal opportunity, but on careful examination we see that it is based on exploitation.

I administered a questionnaire to determine if the farmers understood the GM technology they were using. Of the 30 random participants, fewer than 10 understood what GM technology was. Mthombeni, an elderly farmer based in Kwelerha, was resistant to joining the project, because he felt decisions were made for the farmers as if they were children. He joined the project anyway to escape the claws of poverty.

> "They never even conducted a workshop to make us aware. We are being cheated here." – Mthombeni
>
> *"Thina asizange senzelwe iworkshop. Siyarotywa apha*." – Mthombeni

I have explained that current reforms are not in line with community-based practices and that change in agrarian reforms was dominated by the same thinking that existed pre-democracy – that only white people have the capacity to legitimate knowledge (Césaire, 1972), excluding local knowledge systems (Hebinck et al., 2011). Not participating in the planning of initiatives from which they were supposed to benefit exposed these rural communities to exploitative economic conditions (Haskaj, 2018). A political power can end a war, but it does not necessarily relinquish the power of force (Foucault, 1997) – in this case, epistemic violence is left behind in the rural farming landscape. Mayra and Patel (2021) caution against interfering with ancient and interconnected relationships between humans and the natural environment, as we risk disrupting the web of life when we choose new technology over ancient practices.

Loss of power – what about seed ownership?

"Ukuba ne mbeyu uyumfazi uziva une londa." – Mamorena

"To own seeds as a woman, you feel proud." – Mamorena

Image 2: Left: To show hospitality, farmers in Berlin gave me these indigenous maize seeds. Right: In Nqonqweni I was given a huge pumpkin not just for consumption, but also to remove and preserve the seeds.

In many African communities, seeds are not just the progenitors of food chains but are also a part of traditions and customs. Farmers have always had a deep connection with seeds, and seeds were and still are used in important rituals. In rural areas, the practice of exchanging seeds is highly regarded among ethnic groups such as Basotho, AmaXhosas and AmaZulus. When we buried my younger brother in 2018, a family elder came with seeds from his seedbank. Following the old customs of my people, Basotho, the seeds were placed in the casket with my brother. Basotho used to bury a deceased man with his weapons so he could continue being a warrior; with grass to prepare a beautiful green lawn on 'the other side'; and with seeds to plant so he could continue farming in the next life (Letsitsi, 1990).

A similar ritual took place when the Zulu king, Goodwill Zwelithini, died in March 2021. A Zulu cultural expert explained that he should be 'planted' (buried) in a seated position with maize seeds and other items (Govender, 2021). It is also a Zulu custom when crossing a river with a seed to reassure the seed that it is not alone (Van Niekerk and Wynberg, 2017). These examples highlight the importance of keeping and exchanging seeds among African communities.

Among Xhosas in the Eastern Cape, seeds weave together power, social cohesion and culture. Small-scale farmers explained to me that in rural communities where people grapple with a lack of basic services and resources, keeping and exchanging seeds is an important obligation that ensures that seeds are available when needed by community members. Nonto, a farmer, explained the importance of seeds:

"We used to cut a seed and give it to a boy who was going to the mountains for initiation school. This was done to show him that a seed is the most important thing at home and it must always be there." – *Nonto*	"*Imbewu besiyicheba siyinike inkwenkwe xa isiya entabeni, lento ibisenzelwa ukuyifyndisa nokuyibonisa ukuba umbona yinto yekhaya kufuneka ihlale ikhona.*" – *Nonto*

The recent proposed amendments to the Plant Improvement Act 53 of 1976 and to the Plant Breeders' Rights Act 15 of 1976, if enacted, would restrict small-scale farmers from exchanging seeds. The word "exchange" would be incorporated in the definition of trade to forbid farmers to exchange seeds (Van der Merwe, 2017). Mariam Mayet, executive director for the African Centre for Biodiversity, explained that they will do whatever necessary to oppose the proposed amendment: "We are waiting for the state to publish regulations. We are going to have a big fight with them over it."

Some farmers are hell-bent on keeping the tradition of seed exchange and seed ownership going. In Kwazidenge, a village not far from Stutterheim, two women farmers explained the importance of seed ownership and seed exchange among rural Xhosa people. Mamorena, a Mosotho woman (married to a Xhosa man) is a retired nurse and versatile farmer who loves trying new crops. Our interview took place in early 2021 at the height of the Covid-19 pandemic. She had just planted

garlic and ginger in her container gardens because they are a remedy for flu-related diseases. She planted maize and butternut in her big fields and also had a lot of herbs and lemon trees. Babalwa, a Dimbaza-based farmer and nurse, was visiting the older woman to enquire about seeds and to exchange herbs with her.

Image 3: Left: The two farmers, Mamorena and Babalwa, exchanging herbs and sharing information. Right: Mamorena's seed bank, ranging from peanuts, beans and butternuts to maize.

I asked them why seed ownership and seed exchange were so important to them. Standing to show me her seedbank, Mamorena told me that having seeds gives you a high social standing. Her small recycled seed containers ranged from mayonnaise bottles to lotion cream tubs.
Mamorena agreed:

"If we were to get into a bartering situation, you would have something to offer. You are not that person who is forever begging. You have something to offer. You feel proud. This gives you power and pride that you are also in a position to offer something. That's the power of being able to barter." – Mamorena

"If bekuthiwa singena ku meko ye bartering, una something you can offer nawe. Awu nguye loya muntu eseloko e cela. U na something to offer. Uziva une londa. Lento ekunika e power nawe, elo londa. Yokuba nawe ukwi position yokuba you can offer something. Leyo power of being able to barter." – Mamorena

In addition to economic benefits, seed ownership provides a sense of pride from making a contribution to society. The relationship between farmers and seeds is not restricted to Africans. In Turtle Island (North America) the relationship between the native inhabitants and seeds is beyond spiritual. It is where power is centered – seeds are keepers of memory, representative of their lineage and connect the past, present and future (Marya and Patel, 2021). To disempower communities such as Turtle Island, imperialists dismantled such relationships by manufacturing and introducing their own seeds through weak governments.

I asked the two women what they think about the current state-funded programmes and why they do not participate in them.

"The government came to our village and said here is the maize variety that doesn't need to be cultivated. You see, when you tell people not to work, they think it's the right thing to do." – Mamorena	"*Urhulumente wethu ufikile kwilali yethu wathi nanku umbona ongadingi kulinywa. Uyabona, xa uxelela abantu ukuba mabangasebenzi bacinga yinto elungileyo leyo."* – Mamorena

Babalwa believed that modern agricultural practices are affecting their old traditions negatively. She felt it was important for her to promote indigenous knowledge practices so that they can be passed on to the next generation.

"This commercial way, which is westernised, is the one that makes it difficult for us. It's no longer easy to access seeds. If you want seeds, you are sent straight to sellers [corporations]. We don't want those seeds. Times have changed. It's not easy to access our indigenous seeds. Commercial seeds have taken over."	"*Lendlela yorhwebo yasentshona, yiyo eyenza kubenzima kuthi. Akusekho ukufikelela kwiimbewu, uthunyelwa ngqo kubathengisi [amaqumrhu]. Asifuni leyo imbewu. Amaxesha atshintshile. Akukho lula ukufikelela kwiimbewu zethu zemveli. Imbewu yomrhwebo ithathe indawo."*

Babalwa was explaining another example of big corporations exploiting indigenous communities for profit. Nonto, another farmer in Berlin, agreed that GM seeds have changed their humble way of living:

"It has taken away our spirit of kindness, because in those days one was able to share their crops with someone else who has no means to farm so that they, too, can have something to eat at home. But now with this new system we can't share, because there isn't enough to go around."	"*Thina kudala ndandikwazi mhlawumbi ukubiza omnye ongalimanga ukuba siyambe siyokuvuna kweya intsimi naye ukuze azolala eztyile kanti ngoku kule mbewu ikhoyo asisayikwazi lonto ngoba ayoneli kuthini, yona yasithathela Ubuntu ngoku sibeka imali phambili kwaphela nembheko kuthi kujonga unantoni nam kuqala*."

In Kwantuku, rising food costs, poverty and desperation drove farmers to accept the GM seeds they received from a government official.

"Because we didn't understand the seedling we were using, we had to like and accept them. Nobody from the Department of Agriculture had explained to us how the seedling worked. It is the first time somebody is asking me questions like you [interviewer] are doing." – Nomaswazi	"*Ngenxa yokungaqondi izithole ebesizisebenzisa besizithanda akukho mntu owakhe wazosichazela ngezithole ukuba zisebenja kanjani (from agriculture) siyaqala ukubona umntu ngawe."* – Nomaswazi

In 2019, the farmers in Peelton and Ncera made it clear that nobody had forced them to convert to GM technology and that the technology was better than their old farming practices. Wearing a white cap with a Pannar seed-company logo, an old man farmer in Peelton, Xola, informed me: "*Sisebenzisa i-pannar rhoqo. Oko sisebenzisa imbewu e-hybrid kunye ne GMOs okoko saqala ngo-2003.*" ("We use Pannar products, including GMOs and hybrid seeds since we started in 2003.") In Ncera, farmers did not know much about GM technology, but they liked their extension officer and relied on the advice she gave them. The farmers in these two villages trusted their extension officers.

"We know that we can't recycle these seeds. We use them now and we won't use them again next year. These new seeds are doing well. We grew up with organic seeds. We know them very well. There are people who still have them. Now we are used to GMOs. We get them from the famers, and we trust our farmers." – Nosipho

"*Siyazi ukuba asiyityhaleli amaxesha amaninzi. siyayisebenzisa ngoku kwaye asisayisebenzisi kwakhona kunyaka olandelayo. Isiphatha kakuhle le mbewu intsha. Sikhule ngembewu ye-organic. Siyazi kakuhle. Kukho abantu abasenayo. Ngoku ndiqhele amaGMOs. Eza nabalimi and siyabathemba abalimi bethu."* – Nosipho

By February 2021, however, farmers in these two villages were changing their tune. There were complaints about the price of seeds, fertilisers and pesticides, and one farmer said they were not as rich as they had thought they would be. The money they spent was not providing the returns they had been promised, but the seed and agrochemical companies continued to benefit from the sale of seeds, fertilisers and pesticides. One farmer said that the best thing about their old farming practices was that they spent very little money – recycled seeds, kraal manure and homemade pesticides did not cost anything. They had been convinced that their old practices were holding them back from making money, but some farmers could already see that the GM technology was costing them too much money to be sustainable.

"This new project is expensive. We don't have money. It's better to do traditional farming. The money that we spent on traditional farming was not much compared to what we are paying right now. We used to use compost and mix it with 2:3:2 fertiliser, just a small portion of it. Even the following year you could still use it. The maize that we are getting now is not okay. It must be the fertilisers. The other problem is that we only specialise in maize and nothing else." – Nomathemba

"Iduru le project. Asinamali. Kungcono ukwenza ngesiXhosa. imali esiyibhatalayo xa selima ibencinci. Sasisebenzisa umgquba ne-packet eyi-one ye 2:3:2, si-mix(a) kancinci nomgquba. Nokuba kunyaka ozayo. Lo mbona wangoku usengayisebenzisa. Be sifumana intyabotyi na mathanga. Umbona esiwufumanayo ngoku ukrakra zezi-fertiliser sizeisebenzisayo. Enye into yile yokuba silima umbona kuphela." – Nomathemba

Césaire (1972) argues that unlike Europeans, some populations found ways to live sustainably without depleting natural resources. Problems arise when one population dehumanises and exploits others, and it is problematic and racist to tell modern-day farmers that their knowledge systems are outdated and useless – and it is even more problematic in the wake of apartheid.

Loss of connection – social changes, livelihood changes, loss of working soils

Soil is life. Soil is everything to us, because soil also means how we live. Everything comes from the soil. Food comes from the soil. In short, soil is life. – Mxo	*Umhlaba bubomi. Umhlaba uyinto yonke kuthi kuba umhlaba ukwathetha indlela esiphila ngayo. Yonke into ivela emhlabeni. Ukutya kuvela emhlabeni. Ngamafutshane, umhlaba ubomi bethu.* – Mxo

Growing up, there was a saying that life starts with soil – how we treat our soils reflects in our health. So farmers are more than food producers, they are responsible for our health (Mayra and Patel, 2021). But in a capitalist system, Puig de la Bellacasa (2017) argues that the main reason we take care of soil is for crops, which are commodifiable and must therefore be 'put back to work' through engineering technologies and chemicals. None of the farmers I interviewed thought of soil as only a commodity. Even the farmers who had converted to modern technology still felt a special connection with soil. When I arrived in Kwamzongeshe, Xarhuni, one Monday morning, I found Mr Booi and other farmers weeding before planting cabbage. "*Si clean(a) umhlaba*" ("We are cleaning the soil"), they said, as though referring to a person.

Image 4: Left and right: Mr Booi 'cleaning the soil'.

Mr Booi informed me that they were not part of state-funded initiatives and were free to plant the crops they wanted. While 'cleaning' the soil, the farmers shared tales of the weekend – so-and-so was buried, so-and-so had a feast for a son who had returned from initiation school, and other stories. There was laughter and a sense of belonging. As they 'cleaned' the soil, they used hoes and sometimes their bare hands. *"Suka apha sele, sixakekile apha"* ("Get out of the way frog, we are busy here"), Mr Booi said when he came across a tiny frog hiding in the weeds.

"I can tell when the soil is not healthy, because I know how nature works. I cannot plant here, for example, because the soil is not fertile. When the soil is healthy, its colour is black and it is easy in the hand (*khafu-khafu*)." – Nomkhitha

Ndiyawubona umhlaba xa ungekho right ukuba unjani njengemveli. Ndiyawubona umhlaba onondityisa; andikwazi ukuba ndingasuka ndilime kulendawo. Ubamnyama uvuthwe ube khafu-khafu." – Nomkhitha

Nomkhosi, another farmer, explained that because she understands the natural environment, she never has to take her soil to the labs or to be treated by scientists:

"We have never taken the soil to be tested, but as a farmer, I have my own way of checking whether the soil is bad or good. I use compost so that the soil can be healthy and soft (*lafu-lafu*). When the soil is hard and has stones, then I know it is not healthy and I need to use compost to make it better."	*"Umhlaba asiwu-test but kuba ungumlimi uyele uwubone ukuba hayi u-right, ugalele umgquba pha egadini, asinanto siwu-tester ngayo sithi siyawu-tester, but siye siwubune mhlawumbi ulafu-lafu okanye une-dongwe, xa ugqinile ugalela lamgquba. Xa unamatye umhlaba uphelile umdala ugalela umgquba ubone uba ulungile kengoku xa uwu-mixer nomqguba."*

Farmers no longer 'clean' the soil in Mooiplaas. Since joining the state-funded cropping project, a tractor has been hired instead. They showed me a budget for how much they spend per the requirements of the Cropping project – it is expensive, over R100 000 per group! (See figure below.) It is a big amount for farmers who have no source of income other than their pension.

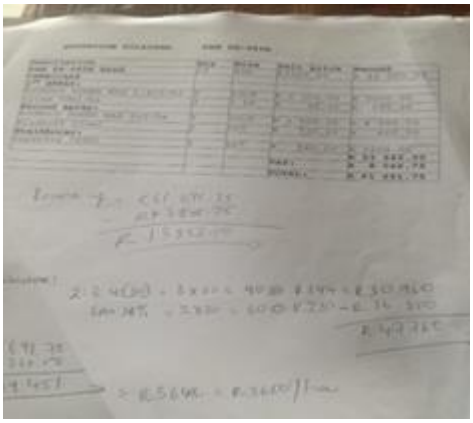


Image 5: A budget showing how much farmers in Mooiplas spend and what they buy. Roundup is on the list as a herbicide.

Image 6: Farmers hold regular meetings to discuss important farming-related issues.

As in Ncera and Peelton, the Mooiplaas farmers were optimistic about joining *iproject* when I first interviewed them in 2019. In early 2021, however, their air of optimism was fading, and they were not so sure about the future of farming. In 2019, we had shared jokes and laughed while we discussed farming, but this time the atmosphere in the *ronda* where we held a focus group interview was dull and tense. Their extension officer arrived during our focus group meeting and told them that they would not be able to plant maize, because it was too late in the year to do so. It was quiet as the extension officer made the announcement, and judging by the hostile glance I received, the extension officer was not thrilled to see me there. The farmers seemed disappointed, particularly because the rains had been consistent (they told me this after the extension officer had left), but they did not question their extension officer. Like school children at morning assembly, they obeyed. Power dynamics were at play, and it was obvious who controlled the show.

Image 7: A farmer in Mooiplaas shows what healthy soil feels like in the hand – "ulafu lafu lomhlaba".

After the focus group meeting, we walked to the fields to discuss soil management techniques. The extension officer had left and the farmers were speaking freely. They took soil from the fields to demonstrate what *lafu lafu* soil looks like. Their soil is rich, they told me. I could see it myself. They told me they would have loved to plant a variety of crops, not just maize, but the Cropping Project only allows maize. Before they joined the project, they planted maize, potatoes, pumpkins and other crops. At harvest, they sold some and kept the balance to feed their big families. Now they cannot 'connect' to the soils like they used to, because a tractor is hired and pesticides do the work for them in the fields.

"We would love to plant root crops here, but we can't because Roundup is sprayed. We can only plant maize." – Noma	"*Sibawela ukutyala ama-root crops, but asikwazi kuba kufakwa i-roundup pha. Sityala umbona kuphela."* – Noma

The situation is not that different in Kwelerha. When I first arrived in 2019, the farmers were divided about modern technology: some were optimistic, while others did not want *izinto*

zabelungu (white man's ways). In early 2021, Mr Kubutu described how it was before they started using modern farming techniques:

"Before we started using these chemicals, we would cultivate the soil and use the cow's compost."	*"Phambi kokuba sisebenzise amayeza, besikhakula kwaye sisebenzisa umgquba wenkomo."*

Mr Kubutu and his fellow farmers started using Roundup in January 2021 at the recommendation of their extension officer. I asked if they had noticed any changes in their soil since using the weed killer. Roundup has been very effective so far, they told me. Like the farmers in Mooiplaas, they complained that Roundup is expensive and has many costly restrictions:

"The other thing is that if you are using Roundup, you have to use Roundup-ready seeds. Otherwise your crops will die." – Gwebulana	*"Enye into kukuba ukuba usebenzisa i-roundup, kuya kufuneka usebenzise iroundup ready seeds. Otherwise izityalo ziyaku kufa."* –Gwebulana

Endangering the lives of other species: "Imsundululu ayiyosinda ileRoundup" ("Earthworms won't survive this Roundup")

In Kwelerha, soils are rich and teeming with earthworms. Since starting to use Roundup at the beginning of 2021, however, farmers have noticed that many earthworms are leaving the fields. Earthworms are known to be bioindicators of good soils (explained in the next chapter). Using pesticides such as Roundup is a scary transition for Kwelerha farmers, who worry that Roundup may kill other important organisms in the soil: "*Imsundululu ayiyosinda* ("Earthworms won't survive").

Image 8: A patch where Roundup was used. Farmers in Kwelerha recently saw many earthworms migrating.

A retired extension officer claimed that Roundup was changing farmers' soils:

> "I know for sure that chemicals like Roundup kill soil organisms. We could see that the soil was changing, but no one took the clock to the cat (no one was brave enough to report to their bosses at the Department of Agriculture). Yes, the chemicals are working, because the farmers are no longer hoeing the fields – but they affect the soil."

Mariam Mayet, director of ACB, says the state's recommendation that farmers in rural areas use dangerous pesticides is driven by racism and exploitation and because the Global South is regarded as a sacrifice zone and the Global North as the sacred zone.

> "In the sacrifice zones, you can contaminate our water, you can contaminate as long as you get paid for your herbicide. It's a win-win for the industries and a lose-lose for South Africa. There are deeper issues around the issue of race. We ask them: Why do you do this to the people of the South? Black people. Is this a race project? Why don't you support agro-ecologically productive food systems? Our government is causing more damage. Local solutions lie with local people. Try to support them, try to get resources to them and let them build their lives in the way that they want."

In sacrifice zones, the question of slow violence is hardly addressed. Slow violence is not instant but is a delayed destruction that in the short term would not be considered harmful (Nixon, 2011), such as the use of chemicals that cause destruction to the environment over time. Nixon (2011: 63) writes that

> The factory may have been abandoned, but the invisible poisons remain dynamic, industrious and alive – full-time workers around the clock. The far less resilient biota, however, express themselves primarily through the sensuality of absence: "Listen, how quiet," Animal observes as he wanders the factory grounds. "No bird song. No hoppers in the grass. No bee hum. Insects can't survive here."

This is the same violence described by Rachel Carson (1962) in the iconic *Silent spring*. Carson bravely addressed the disastrous effects of chemical pesticides on the environment, with specific reference to DDT (dichlorodiphenyltrichloroethane) and argued that instead of exploring solutions that are not destructive to nature, we are allowing a "chemical death rain" to fall on us.

Challenges to accessing the markets: "We are defeated by modern-day science"

Who represents the interest of rural small-scale farmers? According to the farmers themselves, no one. Gwebulana:

"They [buyers] tell us they will pay us this much!" *"Basixelele ukuba bazakusibhatala so much."*

Farmers were advised (by their extension officers) to form legal entities (cooperatives) to benefit from state-funded programmes, and I assumed that the Department of Agriculture would assist the farmers to access the markets, as is done in Burkina Faso. But at the 2021 Eastern Cape Agriculture Indaba, South African Grain Farmers Association GM Mokete Tshiame said that it is difficult for farmers to thrive, because the province is under-resourced (Arnoldi, 2021). "Our grain farmers are forced to sell immediately after harvest and therefore make them price-takers in the market," Tshiame complained.

In Mooiplaas, farmers narrated sad stories about how their maize was eaten by rodents because they did not know where to sell it and they had no storage facilities. A former extension officer told me he had raised the issue with government officials, but nobody had paid attention: "Another problem is that farmers don't have storage material. Farmers have complained about it, but the department keeps promising to bring them storage materials like tanks and other things."

Siya from Mooiplas complained that they are vulnerable and easily cheated by buyers:

"When customers arrive to buy our maize on credit, they never tell me when they will be able to pay. We get boerd because we do not get money for this maize. People want to pay little for it."	*"Xa kufika umntu esithi ufuna lombona angatsho ukuba uzobhathala nini. Siyarobheka asiyifumani imali ngalo mbhona. Abantu hlezi befuna umbhona ngemali encinci."*

In Kwelehra, the farmers also complained about access to the markets, as they do not know where to sell the maize after harvest. They have also been told that their maize is of low grade! This is similar to the cotton debacle in Burkina Faso, where buyers told Burkinase farmers who had switched to Monsanto's Bt cotton that the quality of the cotton was lower than before. The government phased out Bt cotton to protect the farmers.

"The problem with the market is that we have tried buyers [big businesses]: 1. They look at the grade of the maize. 2. Then they tell you they will pay you so much." – Gwebulana	*"I-problem ise-market apho sibethakala khona ke, sakhe sabazama umtiza: 1. bajonga i-grade yombona ukuba lombona unjani. 2. Banixelele ukuba sizokunibhatala so much."* – Gwebulana

The farmers have no say over the price of their own maize! They do not have a market to sell their maize, because buyers control the price, which is the problem in a capitalist system. The GM technology requires farmers to buy patented seeds engineered to withstand Roundup. The farmers cannot replant with the same seeds and must purchase new seeds every season, boosting seed-company profits.

A retired extension officer said he raised concerns about the quality of maize that farmers were told to plant by the Department:

> "I know some farmers are using the yellow maize and Roundup. That's a mistake on the part of the department to force some farmers to use yellow maize. Yellow maize is for animals. It is not for human consumption. But there are farmers, like in Butterworth for example, they are using white maize. I asked them [the farmers who had planted yellow maize]: Why don't you go for white maize? You see, I wasn't in that section. I informed them that they must tell their extension officer that they want white maize. On the other hand, the extension officers were forcing the farmers to buy yellow maize. In a way, the government is forcing them through extension officers … Once I was in Kwelehra and the extension officers were advising the farmers and saying this yellow maize can withstand the drought, but the farmers didn't want that maize. I asked the farmers: Why don't you tell these officers that you don't want this maize?"

Farmers in Kwelehra and others who joined the cropping project expected high yields, but they were realising that the utopia they had hoped for did not exist. Purchasing corporate seeds, fertilisers and pesticides every year was costing more than it earned.

"The farmers in Mooiplaas once got their maize taken away from them. They were given just R100 for bags of maize. That was also new that time." – Gwebulana	*"Abase Mooiplaas, bake bathathelwa umbona wabo. Wathatha inxowa zabo waba nika R100. Nayo eyiyafika ngelexesha."* – Gwebulana

The farmers say they have addressed the issue with the extension officers, but nothing has been done. They also claimed that their extension officers did not come to address their issues regularly.

"We are defeated by modern day science, because the seeds come in different types – this type and that type. Then we are told to use a particular fertiliser that goes with those seeds, then there are pesticides that we have to buy. We are told to use particular chemicals. If your maize crops don't come right, you have lost a lot – from buying seeds, fertilisers to pesticides. Just like Roundup was used here, it doesn't even end there. We are still going to pay more. Then eventually you fail to get the market to sell." – Gwebulana

"Sibethwe yi-science yalixesha because ukuba imbeyu ibezitypes, kukhona uhlobo olithile ne hlobo elithile. Bese kuthwa ufake i-fertiliser ethile, then ukusuka apha kubekhona amayeza ke ngoku, kuthwa faka ezi-chemicals. Uthenga mpela. Xa umbona ungalunganga, uqale embeweni ukulahlakelwa, waya ku-fertiliser, waya kwi-types zamayeza because njengoba kugalelwa i-roundup nje, akuphelelanga apha. Kuzakuphinda kusebenze imali right through. Then ube sele ungafumani endawo yokuthengisa." – Gwebulana

Even in Ncera, farmers had not achieved the successes they had hoped for.

"We wanted to be independent, perhaps government could fund us with tractors, disks and everything else needed, but we never reached that stage that we desired. We are not progressing or succeeding." – Nosipho

"Sasibawela kuyoyonke lonto ukuba sizimele, mhlawumbi uRhulumente asi-fund nge tractors, i-disk, iintoni ntoni but ke aside sifikelele kulonto, kwesa-stage sisibawelayo oko kengoku senza ngoluhlobo aside siphakame." – Nosipho

In Ncera, as in Mooiplaas and Kwelera, where the state-funded programmes were introduced and welcomed by many farmers, the problem is market accessibility. By joining the cropping project and paying the required amounts, the farmers complained they were not getting value for their money. When the project started, they were paying R1,800 and now they were paying R2,500 – but the main problem is access to markets. Most of them are above 60 and sacrifice the pension money that they need to survive.

"We don't have a market. We do the selling on our own to whoever is keen. And it is not going well, because there are a lot of us who happen to have the maize, and you won't have a person keen to buy. When there are no buyers, the maize ends up being damaged and I end up selling it at cheap prices – 50 rand or 100 rand, because it is getting damaged." – Nosipho	"*Asina-marketing siyazithengisela nokuba ngubani na ofuna ingxowa. Ayihambi kakuhle because if unawo lambhona abantu abazuba khona and sibaninzi sinalambona, mhlawumbi bangazi kum abantu ude utyiwe zi [inaudible] uphethe uwuthoba uthi yi 50 rand ingxowa ye 100 rand because uyamoshakala.*" – Nosipho

Some of the farmers have lost hope with the current government – so much so that they feel the oppressive apartheid regime was better than the current democratic one, because then they could at least decide how to farm. The apartheid government was not interest in them, because they did not contribute to commercial agriculture.

"Hunger came with this democracy, my sister. With this democracy you tell yourself that if you get up and go to the fields, you will be sunburned." – Mbali	*"Indlala ize nale democracy mntasekhaya, le democracy sakhetha ukuziphakamela thina, uzixelele ukuba xa ndisiya emasimini ndizakutshiswa lilanga*." – Mbali

Key policymakers continue to promote a conventional linear model of agriculture and rule by expert or technocracy (Hebinck & Cousins; 2013, Easterly, 2013). The problem with technocracy or authoritarian development is that it understands poverty as the result of a shortage of expertise that can only be solved with technical solutions (Easterly, 2013). Easterly (2013) argues that technocracy ignores other approaches to development and ignores the rights of the poor to make their own choices. A programme such as the MFPP is much like the apartheid policies imposed on black people without regard for their freedom to choose (Hebinck & Cousins, 2013).

The implementers of programmes such as the MFPP and cropping must acknowledge that they are failing small-scale rural farmers. The laws have changed, but time has stood still for black small-scale farmers in rural Eastern Cape. White farms are still better off and are favoured by the markets over black ones (Cochet et al., 2015). As Fanon (1961) observes, the problem in post-colonial

governments is that the ruling bourgeoisie, like the coloniser whose place they occupy, are driven by greed and power. Instead of helping the people, the bourgeoisie favour foreign capitalists. Capitalism has had devastating effects on the Earth's ecosystems, but governments continue to endorse toxic development despite proof that indigenous systems of resource management are vital to living in harmony with nature (Mayra and Patel, 2021). Fanon suggests that collaboration between government and its citizens is necessary to build national consciousness (Lee, 2015), but he does not have high hopes:

> During the struggle for liberation the leader awakened the people and promised them a forward march, heroic and unmitigated. Today he uses every means to put them to sleep, and three or four times a year asks them to remember the colonial period and to look back on the long way they have come since then (Lee, 2015: 167).

Conclusion

The government has convinced black rural-based farmers projects such as MFPP and Croping are convenient and easy, because the farmers do not have to work in the fields. Some farmers who support these state-funded projects told me they find it difficult to get up early to work in the fields like they used to and that changes in the climate leading to prolonged droughts affect yields and so they have to look for alternative ways to cope. But the oldest farmer in Kwetyane was in his 80s, and he attributed his longevity to getting up in the morning and working in the fields. He had a healthy routine with regular exercise and a sense of purpose. Villagers also used to have rituals to bring the rain back, but some of these rituals are dying out, because they are replaced. Beyond the significant environmental consequence of depleted soils, we do not know the long-term effects of adding foreign DNA to the human diet. It is dangerous to make permanent changes that could permanently affect our planetary food supply.

Replacing indigenous knowledge and practices does nothing to help the plight of rural farmers, but it serves the interest of the ruling bourgeoisie and multinational corporations. As much as the government does not subject these farmers to physical violence, it uses its dominance to cajole them to join its funded programmes, in a violence of necropolitical ecology. The relationship becomes like that of a toddler dependent on its mother, with decisions on how and what to farm made by government and big corporations. When farmers want to access the markets, the

government is quiet and the farmers are stranded. Only the big multinational corporations benefit from the sales of seed, fertilisers and pesticides. Like most postcolonies in Africa, it can be argued that South Africa has retained the same necropolitical mechanisms used by the apartheid regime. The farmers may think they are free, but this is neocolonialism driven by capitalists to achieve food sovereignty. Farmers need autonomy over how they farm.

The state has used apartheid-era policy to boost agriculture in rural areas, but under apartheid, white farmers were supported by discriminative policies, cheap labour, regulated markets, subsidies and access to land. It is irrational to now expect black rural farmers to thrive with only subsidies from the state. A range of issues must be addressed for black small-scale farmers to succeed in commercial farming, including improved service delivery in their areas. In light of the polarised global debate about GM technology, it is also vital not to essentialise imaginaries of what rural farmers think or want if one's aim is to produce accurate research. Through my interviews with farmers, I assessed the gains and losses of modern agriculture in the rural areas identified for this project. Among the lessons to be learned were:

Abandoning old and trusted indigenous practices is a problem, not a solution. Where people's main form of education is their indigenous knowledge, it is best to find ways to integrate old and trusted practices with modern practices rather than to abandon indigenous practices.

Farmers should be included in decision making and have the freedom to choose their own crops and practices.

Institutional dynamics play a big role in facilitating new technologies. I witnessed many instances of institutions failing to provide an enabling environment for farmers to thrive.

The cost of new technology is more than farmers can afford. Most farmers are pensioners who rely on grants intended to cater for their basic needs but that end up with multinational corporations. Homesteads in rural South Africa are set up such that extended family members share a space and are also reliant on the pension grant.

Poor service delivery – particularly in the form of bad roads, regular power cuts and water shortages – affects businesses' ability to operate in rural areas.

Large corporations are exploiting small-scale farmers. Farmers spend money to buy seeds, fertilisers and pesticides, boosting large corporations but getting insufficient returns.
The non-monetary gains of working the soils have been overlooked, with only financial gains given consideration.

Other species important to soil well-being are destroyed by chemicals, making the soil dependent on fertilisers.

Based on the voices of these farmers, the post-apartheid government has not helped communities such as these heal from the dehumanising structures and policies of apartheid. South Africa has internalised colonial and apartheid practices of exploitation, and restoring indigenous practices could help farmers reclaim their old kinships with soil communities and limit generational trauma. Agriculture is part of rural communities' social life, and assimilating rural farmers into industrial agriculture affects their social life. The destructive path of agriculture that takes but does not give also takes sacredness away from nature and tells rural communities that their belief systems are not important.

This chapter analysed what farmers gain or lose from current agrarian policies and found that there is little to gain by following the route of development. The next chapters discuss possible solutions based on indigenous practices and modern technology that can be used concurrently. This is premised on consultation with farmers to choose the models that can best help them. Not all technology is bad, but it must be used to benefit the farmers and not replace their old knowledge systems.

CHAPTER TWO

Methodology: study area and meeting farmers

Introduction

This chapter describes the methods I used in the development of this study. It follows my journey interacting with the farmers on a daily basis and working with them, planning with them and being part of their daily lives. I also discuss my interaction with other stakeholders of my research in this chapter, including government officials and non-profit organisations. The interviews with farmers, extension officers and non-profit organisations (NPOs) working in the agrarian sector provide this study with all the voices needed for me to make recommendations and form a conclusion.

Research design

One of the most important activities of any research project is how data are generated or collected. Scholarship in the environmental humanities transcends disciplines to tackle modern problems, and I knew from the beginning that this should be an interdisciplinary study. While it is challenging, interdisciplinary research allows for a combination of knowledge systems from different disciplines (Bammer, 2017). Wachsmuth (2016) explains that using different disciplines in one study helps paint a more complete picture of a situation. The overall aim of my study was to explore different knowledge systems at the interstices of technology and environmental humanities and to break epistemological borders separating science and humanities. The human element can help raise a sense of urgency around an issue that is often lacking in quantifiable data. Because the majority of the people in rural communities are often old, illiterate (by Western standards) and poor, they are seen but not heard by the policymakers. Giving them a platform helped bring to light many of the challenges they face.

For the purpose of this study, I followed the research paradigm of both qualitative and quantitative methods. Qualitatively, I used focus group interviews, semi-structured interviews, elicited photographs and made personal observations. Quantitatively, I administered questionnaires and used the normalised difference vegetation index (NDVI) to assess the health of the vegetation in the farmers' fields. Lastly, I followed the teachings of the Black Consciousness Movement (BCM) throughout the data collection process.

Incorporating Black Consciousness philosophy into the research design

I treated this research study as a method of resistance and a process of liberation, following the philosophy of the BCM and their teachings and methods as they worked alongside oppressed communities. Halisi (1991: 101) explains that the BCM philosophy weaves together three important traditions of political thought: "the complex tradition of black South African political thought, theories of anti-colonialism and racial liberation developed in Africa and in the African diaspora, and New Left student radicalism with its straightforward recognition of the legitimacy of black power politics." In their development projects, the BCM drew on Paulo Freire's *Pedagogy of the oppressed* as they worked alongside struggling communities.

Freire (2000: 65) suggests that the best way to assist the oppressed is to work with them:

> It is only when the oppressed find the oppressor out and become involved in the organised struggle for their liberation that they begin to believe in themselves. This discovery cannot be purely intellectual but must involve action; nor can it be limited to mere activism, but must include serious reflection: only then will it be a praxis.

Like Freire, the BCM did not believe in subordinating the oppressed, but their method was to provide them with the support necessary to reach their potential and grow (Pityana, 1991). Similarly, I worked alongside farmers and encouraged them to speak their truth. I do not claim to represent them but to fight alongside them in their struggle.

It was critical for the BCM to address not only racial segregation but ethnic segregation too. The homelands separated different ethnic groups with the intention of tribalising them (Halisi, 1991), causing fear and prejudice among affected ethnic groups. My aunt married a Zulu man from KwaZulu Natal in the 1950s, and she informed me on a recent visit to her home there that only now in her 80s does the community treat her like one of them. For years she was ridiculed and referred to as "that Mosotho animal" by the predominantly Zulu community where she lived with her husband and children. At one point, her rondavel was burned to the ground because a neighbour had a disagreement with her son. Hence, the BCM was not only an anti-racist movement, it was also a counter-ethnicity movement (Halisi, 1991).

One reason I chose the Eastern Cape, with a predominantly AmaXhosa population, was to work with a vulnerable group despite our ethnic differences. This also addressed many of the stereotypes that persist among different ethnic groups in South Africa. I was asked by farmers, "Is it true that you Basotho eat cats and horses?" I thought it was a joke at first, but the farmers really wanted to know if their cats were safe with me around! I invited some to dinner to show them that our staple food was not that different from theirs. We shared different soil management practices during the data collection process, and I explained how Basotho protect their soil and practice agriculture more generally. Ultimately, this project did not simply address a research topic but encouraged cooperation and knowledge-sharing as Africans. I doubt I would have been bold enough to reach out to uncharted territory if not for the influence of the BCM, and I now understand why the BCM encouraged this as a way of life rather than a passing phase. Ramphele (1991) explains that self-help at community level boosts social cohesion. The BCM also addressed issues of arts, dance and culture in general (Mzamane, 1991), encouraging black people to enact their cultural practices freely and without judgment.

Duration of data collection

Data collection commenced in January 2019. I started with questionnaires in the first week of January and conducted semi-structured interviews from the beginning of February to April 2019. I returned in the first week of January 2021 (staying until the end of February) to complete the data collection process.

Participants

The subjects of the study were small-scale farmers in the rural villages of one of the former homelands, Ciskei (now part of the Eastern Cape province). The inclusion criteria were:

Black small-scale farmers based in the Buffalo City Metropolitan Municipality and nearby municipalities. These areas were part of the bantustans/homelands in the apartheid era.
Farmers who had taken part in the Massive Food Production Programme (MFPP).
Farmers who were part of the current Cropping Project.
Farmers who had been or were still part of any government agrarian initiatives.
Farmers who had chosen not to take part in government initiatives.

Farmers who were part of corporations, or individual farmers.

Extension officers who had or currently worked with black small-scale farmers in the designated areas.

Non-profit organisations that worked with rural small-scale farmers.

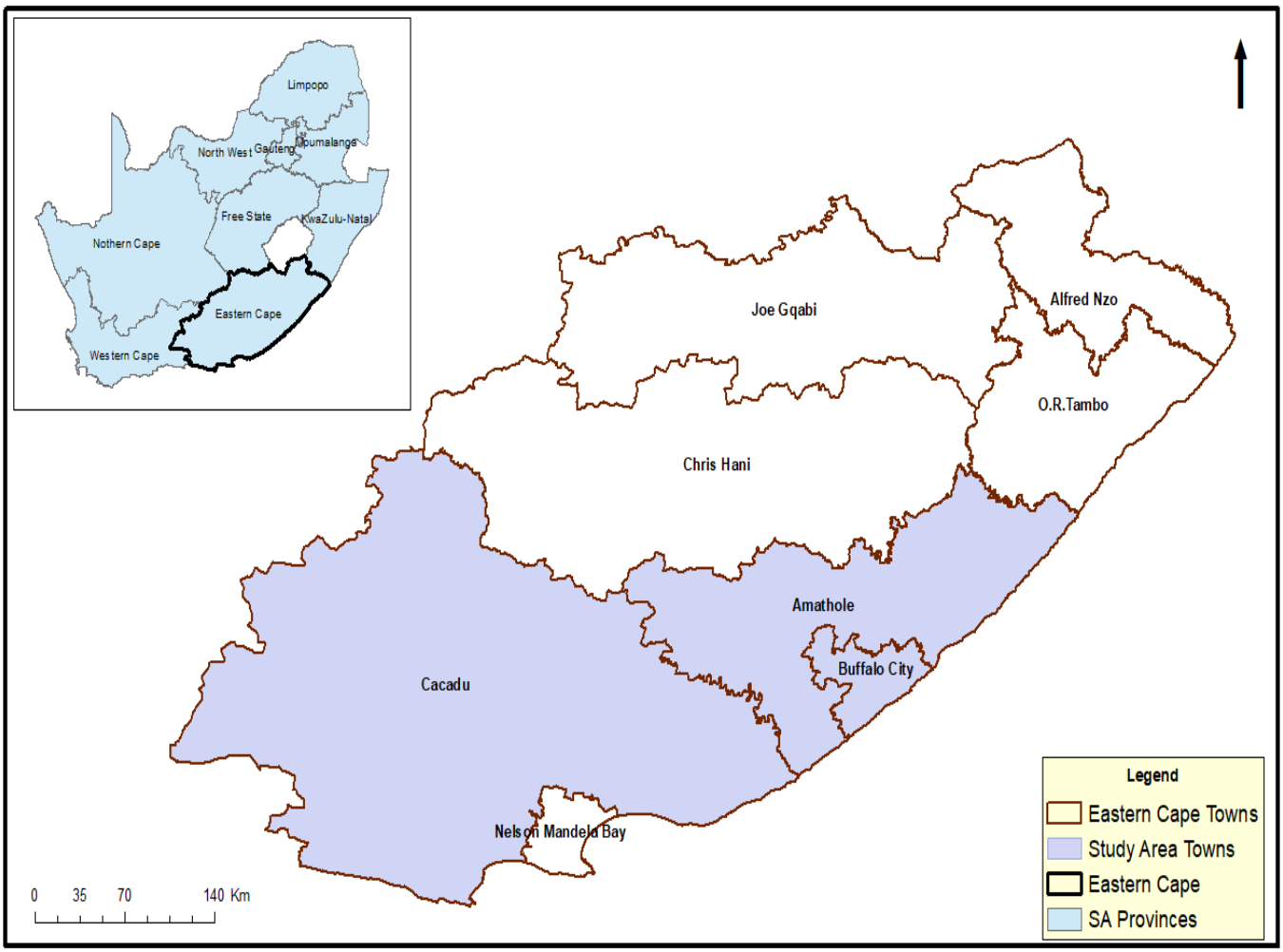
Agrarian experts based in the private or public sector.

Data were collected in the villages listed in Table 3.

Table 1: **Participating farmers/villages**

Name of village	Project	Description	Location
KwaNtuku	Not part of any government project.	Ikhwezi Project. The project has since disbanded. Farmers claim they did not get enough support from the state.	Berlin, Buffalo City Metropolitan Municipality
Mooiplas	Massive Food Production Programme; Cropping Project	Siyazama Project. The village was chosen by the government as one of its agricultural projects. Small-scale farmers are taking advantage of the agricultural projects offered by the Department of Agriculture.	Great Kei Local Municipality
Peelton	Cropping Project	Siqothindlala Project. They also receive subsidies from the government. They are maize farmers but sometimes include potatoes. They have not been part of any other farming project. Group membership has changed over time as members have grown older, cannot work or have died.	King William's Town, Buffalo City Metropolitan Municipality
Kwelera	Massive Food Production Programme; Cropping Project	Kwabasakhula Project. The participants were all men. This is the first village where women were not represented. The farmers receive a state subsidy.	Great Kei Local Municipality
Ncera	Massive Food Production Programme; Cropping Project	AmaFarmer ase Ncera Also part of the '1800' government projects. The group is more than 15 years old.	Buffalo City Metropolitan Municipality
Kwetyana	Against GMOs	Mzamoyethu Project. Farmers interviewed were knowledgable and informed about different farming techniques. They chose not to join the state-funded projects because they do not want GMOs.	Newlands, Buffalo City Metropolitan Municipality

Name of village	Project	Description	Location
KwaMpundu	Massive Food Production Programme; Cropping Project	Lingelethu. Funded by the state.	Newlands, Buffalo City Metropolitan Municipality
KwaZidenge, Fort Marie	Indigenous practices	Individual farmer. She exchanges seeds and shares knowledge with other farmers in the area. She is against GMOs.	Amahlathini Municipality
Stutterheim: Mgwali village 2, 3, 4, 5	Indigenous practices	Individual farmer. She works with Zingisa and has never used GMOs.	Amahlathini Municipality
Luxomo	Indigenous practices	Farmers are not supported by the state. They prefer indigenous practices.	Berlin, Buffalo City Metropolitan Municipality
Nqonqweni	Indigenous practices	Masizakhe Project. One of the few interviewees I met where the youth and older generation worked together as a group. Among the most successful farmers I interviewed who use indigenous practices.	Newlands, Buffalo City Metropolitan Municipality
Mxumbu	Mix traditional and GM practices	Mxumbu Youth Cooperation. A youth organisation (with one elderly member). They use both indigenous practices and GMOs.	Amathole District Municipality



Map 2: Participating areas

Other stakeholders that were part of the study are described in Table 4.

Table 2: Participants

Participants	Description
Zingisa Nelson (name changed), a senior extension officer.	A Berlin-based NGO that works with small-scale rural farmers. Thoko Mpumlwana and Nonhle Mohapi were part of the BCM and also worked for Zingisa (Pityana, 1991). Zingisa advocates for farmers' freedom to choose.
African Centre for Biodiversity (Director Mariam Mayet)	Formed as a response to the government's approval of GMOs in the country (African Centre for Biodiversity, n.d). The organisation offers legal, scientific and policy support to its partners.

Eastern Cape Department of Agriculture	Five extension officers (one retired) were interviewed. They provide support to small-scale farmers in the designated areas.
University lecturer	An interview was also conducted with an NDVI expert from the University of Cape Town.

Description of the study area and subjects of study

Setting the scene: "Take this dusty road…"

"Take this dusty road and go straight until the first village you come across," said the driver as I jumped out of an old, beaten down Toyota Corolla, similar to the 1990s model my late father used to own. It was the 'it' car in the early 90s when I was growing up, but this one now operated as a 'taxi' between the sleepy town of Berlin and nearby rural villages in the Eastern Cape, one of South Africa's nine provinces. The car was so old that none of the seatbelts worked. But nobody worries about traffic officers in this neglected part of South Africa, where even the most unroadworthy cars can roam without worry and demonstrating again how valueless black lives remain in the 21st century. I paused for a moment, then took out a handkerchief and wiped the dust off my shoes. It was pointless, though – ahead of me, a long and winding road ascended sinusoidally between the green fields like a serpent. About a kilometer ahead, an old woman carried firewood on her head.

This is the rural Eastern Cape, similar to what Frantz Fanon (1961:39) had in mind when he described a native village: "a hungry town, starved of bread, of meat, of shoes, of coal, of light. The native town is a crouching village, a town on its knees, a town wallowing in the mire." The Department of Statistics South Africa listed the province and its 39 municipalities as the lowest ranking in terms of GDP per capita (Statistics SA, 2019). Not only is the rural Eastern Cape poor, it is besieged by a lack of service delivery. The absence of basic social goods such as running water compels the villagers to sometimes share muddy water with their cattle, triggering a rural exodus. These well-known struggles have persisted from the apartheid era. Such populations are exposed to inhumane conditions that give them the "status of the living dead" (Mbembe, 2016). You do not have to shoot people or subject them to instant harm to kill them – you can simply inflict daily injustices such as these.

In 2019, when I started the first phase of my research, the villagers were being devastated by a prolonged drought. "It is the calamity of God. On days when the 'Almighty' is really angry with us, the rains never come. We do terrible things as human beings. This drought is our punishment," an elderly woman farmer in Xarhuni said. When I asked if they still pray for rain on the mountains like in the olden days, an elderly farmer in Peelton shook his head sadly: "No, my child. We no longer pray for the rain, because we have sins now. We have different beliefs now, and *Uthixo* [God] seems to be upset with us."

Image 9: A villager carrying firewood on her head in Luxomo, Berlin. This is still a common practice in the modern rural Eastern Cape.

The rural Eastern Cape: The "heart and soul" of agriculture

The Eastern Cape province has been the subject of many development projects to reverse the legacy of apartheid and colonialism (Hajdu et al., 2020). The province's infrastructure is underdeveloped, there is high unemployment, poor service delivery and the province has battled with unreliable water availability (Phaswana-Mafuya, 2006; Agbugba et al., 2020). The switch from apartheid to a democratic state has done little to change the plight of rural dwellers (Hajdu et al., 2020). Siphesihle and Lelethu (2020) found that approximately 78% of rural households in the

Eastern Cape rely on subsistence farming for their income, but this number has dropped in the face of challenges that include changing weather patterns (Siphesihle and Lelethu, 2020).

Having lived in Kwampundu, one of the chosen sites of my study, I can attest that agriculture is indeed the heart and soul of village life. I initially chose Buffalo City Metropolitan Municipality, and I later added other nearby municipalities to be more representative. The following villages in the Buffalo City Metropolitan Municipality participated: KwaNtuku, Peelton, Ncera, Kwetyana, Kwampudu, Kwazidenge, Luxomo and Nqonqweni. In Great Kei Local Municipality, Mooiplaas and Kwelerha participated in the study. In Amahlathini Municipality, Kwazidenge and Stutterheim and Mgwali village 2, 3, 4, 5 were selected. In Amathole Municipality, Mxumbu was chosen. Overall, 12 villages participated in the study, as shown in Table 3.

These villages were chosen because the majority of the residents are small-scale farmers. While some are part of the growing GM technology movement, others have chosen to stick to agro-ecological farming methods. Furthermore, some of these villages have been identified by the Department of Agriculture as being particularly suited to agriculture. For example, Mooiplas is considered a rain-belt area and farming tends to be successful in the area. Many farmers who participated in the study were part of the MFPP or were receiving a subsidy from the Department of Agriculture. The MFPP works like most government projects in rural areas – the key point being to encourage rural farmers to join commercial farming and adopt modern technology.

Initial contact

I learned about the introduction of GM technology in the rural Eastern Cape from a study published by Rhodes University in collaboration with Zingisa, a Berlin-based[6] NGO (Bradfield, 2011). There have been many debates since the introduction of GMOs in South Africa in the late 1990s but little about the people whose way of farming has been affected by this technology, the rural farmers. In the Rhodes University study, I got a glimpse of how some farmers felt about the technology. I read that rural farmers in Amathole Municipality were chosen to participate in the

[6] Berlin referred to here is the one located in Eastern Cape, South Africa.

MFPP, which provided farmers with GM cash crops of canola, soya beans, cotton and maize to address food security (Bradfield, 2011).

The participating farmers replaced their traditional methods, raising questions about the environmental and financial sustainability of the project (Masifunde Education and Development Project Trust, 2010). Some participating farmers complained about depleted soils, skyrocketing technology costs and said that they preferred their old practices. I knew through the newspapers and the Rhodes study that most of the villages that took part were located in Amathole Municipality and neighbouring municipalities.

Ethical clearance/permission

My department at UCT issued an ethical clearance letter for my research in November 2018, but I assumed I would also have to seek permission from village leaders or elders. My host, Mrs Phakathi, reported my arrival to her neighbours so that they would not be alarmed at a stranger in the neighbourhood. I showed my host and all the farmers who participated in my study the ethical clearance letter and proof that I was a student, explaining that the study would be published and accessible to the public.

The rights and privacy of the farmers were important to me, because vulnerable communities are easily taken advantage of and their rights trampled upon – as I discovered during my stay. Punch (2005) asserts that informed consent and confidentiality are necessary when collecting data about people to ensure the subjects' rights are respected. According to Patton (2002), informed consent protocols address: the purpose of collecting the information, who the information is for, how it will be used, what will be asked in the interview, how responses will be handled, confidentiality and what the risks and benefits are for the person being interviewed. I addressed all of these before the participatory observation and interviews with the farmers. After explaining why I was there and reading out a letter of consent, the farmers asked that I change their names so they could speak freely. Their names have been changed to honour this request.

Extension officers as gatekeepers

The extension officers at any Department of Agriculture office are a good contact for a study like this one. Every extension officer is assigned to assist groups of farmers in chosen areas who have joined state-funded programmes. Accordingly, they have contact with farmers across the Eastern Cape. I met two types of extension officers – those willing to help in any way and those who demanded to be present when the farmers were interviewed. A friend at the Department of Agriculture in Limpopo warned me that I would have to seek permission from the local Department of Agriculture in East London.

As much as I understood the important role that extension officers play in farmers' lives, I worried the farmers might not be comfortable discussing their challenges around extension officers. The farmers were not 'owned' by the Department, but I knew I would have to get permission to interview the extension officers. I went to Bisho to seek permission from the 'big bosses', where I was sent back to East London to seek permission from the director in charge.

The director requested an ethical clearance from the school and proof that I was from UCT as I claimed. Apparently a 'journalist crook' had arrived at their offices pretending to be a researcher and wrote a 'very damaging' article about the Department. The extension officers generally regard themselves as the farmers' gatekeepers, and some did not want the farmers to be interviewed in their absence. I had to be strategic and ensure that I did not get on the extension officers' bad side, but it would sometimes have been a disadvantage to interview the farmers in the presence of their extension officers. In Mooiplaas, where the farmers were scared of their extension officer, I met with the farmers without telling their extension officer and it became a big issue. Many of the extension officers at the Mdantsane branch were helpful and introduced me to the farmers they worked with.

Education as a burden and benefit

The farmers sometimes deviated from the research questions to push their own agendas. Because I was 'educated', they assumed everything would be easy for me. "Why don't you convince the Department of Agriculture to buy us tractors and fences? They will listen to you because you are educated," one elderly woman said.

While interviewing the young farmers in Mxumbu, one insisted I should help them with donor support, because they were "also helping with research questions". People in the rural areas have been lied to and promised many things by politicians, and they expect whoever comes to serve them. But education also played a big role in getting the farmers to participate in the research project. "She is educated, let's listen to what she has to say," some would say. In the rural areas, education is often associated with class, so you may be respected based solely on your educational background. The communication skills I learned as a journalist and as a corporate communication educator came in useful. So education can indeed be a benefit in such circumstances.

Meeting the farmers and collecting data

Living with the farmers

I thought it would make my study richer to get views from different farmers and to focus on many villages. I arrived at a guest house in East London in January 2019 and went to seek farmers in Xharhuni the next day. To observe them in action, I wanted to live close to them, so I rented a rondavel – or ronda, as the locals call it – from Mrs Phakathi, an elderly woman farmer there. I had my own private space and could cook if I wanted to. Mrs Phakathi's house was close to the road, where taxis passed all the time, making it easier to catch a taxi in the morning when I visited other villages for focus group interviews. Not having a car was a huge disadvantage, but I wanted to experience the everyday struggles of the farmers.

Kawulich (2005) writes that it is vital to inform the community of the researcher's reason for observing and documenting their activities. Most farmers initially thought I was there to assist them, but I made it clear that my mission was to collect data through interviews, observation, pictures and sometimes joining them in their work. Some were disappointed but later warmed to me. It helped that my host was a farmer herself and was a member of many farming organisations, such as Ilizwe la mafarmer. She had many contacts and was very popular in her area and sometimes put me in contact with farmers in other villages.

The other issue was how to conduct myself among the farmers – what was the appropriate dress code and the best way to address elderly Xhosa farmers in the rural Eastern Cape? I addressed these questions with my host. “Don’t dress provocatively. ‘Respect’ your body and the farmers will respect you. Besides, you are married. I see the ring.” I knew what she meant: I should not wear short skirts or dresses and I should address elders respectfully, as *umama, utata*. I already knew the drill. I understood the expectations of the rural folk from the many times I had visited my grandmother as a child. It was also important that I could understand and speak isiXhosa to avoid semantic barriers. I knew the language but sometimes asked for clarity for difficult or regional words.

Demographic data of the participants (Questionnaires)

When I first met the farmers in January 2019, before I conducted in-depth interviews, I randomly administered a questionnaire to 30 individual farmers in the participating villages. This convenient sampling was administered to farmers living close to me over the duration of the study. This kind of sampling does not require a pattern, and – as its name suggests – is done on the basis of convenience to the researcher. The questionnaires asked about their demographics: age group, ethnicity, educational background, farming history, farming practices and familiarity with GM technology. Rowley (2014) proposes that questionnaires be used to profile the characteristics of one’s participants. I used the questionnaires to understand the demographics and knowledge systems (related to soil management and agriculture) of the farmers before I started the in-depth interviews. Questionnaires can also help social scientists understand aspects about the research participants, such as reported behaviour, personal experiences and attitudes (Simmons, 2001). I also used the questionnaires to learn about the farming and soil management practices of my subjects.

The results are presented below.

Table 3: Demographics

Demography	Results
Ethnicity	AmaXhosa - 93.3% Other ethnicities - 6.7%
Gender	Women - 36.7% Men - 63.3%
Marital status	Single - 13.3% Married - 66.7% Divorced - 3.3% Widowed - 16.7%
Age groups	25–44 - 6.7% 45 and above - 93.3%
Education	No formal education - 33.3% Primary school - 36.7% High school - 30.0% Tertiary education - 0%

The results of the questions about seed choice and soil management practices are presented below.

Table 4: Question results

Question	Result
How long have you been a farmer?	5–10 years - 6.7% 10–20 years - 3.3% 20 years or more - 90%
Are you a full-time or part-time farmer?	Full time - 90% Part time - 10%
Kind of farming	Monocropping - 13.3% Multicropping - 86.7%
Are you part of a farming initiative?	Yes - 80% No - 20%
If yes, how long have you been part of the initiative?	5 years or less - 26.6% 5–20 years - 30% 20 years or more - 43.4%
Was the farming initiative funded?	Yes - 6.7% No - 93.3%
Do you buy seeds? If so, where?	From agro-companies - 45.3% I get them from the Department of Agriculture - 53.3% Do not buy seeds - 3.3%
Do you understand GM seeds?	Yes - 6.7% I know them but don't understand - 53.3% I don't know them - 43.3%

Question	**Result**
Your experience with GM seeds?	Good seeds -13.3% Bad seeds - 30.0% Other - 43.3%
Have you received training in GM technology?	Yes - 10% No - 90%
What do you use to keep soil healthy?	Manure - 63.3% Fertilisers - 30% Other - 6.7%
Have you attended any soil health workshops?	Yes - 26.7% No - 73.3%
Have you used herbicides? If yes, when did you start?	5 years or less - 3.3% Occasionally - 6.7% Over 20 years - 3.3% Have not used them - 26.7%
Do you receive herbicides from the state?	Yes - 36.7% No - 60% Other - 3.3%
If yes, did the officials explain how they work?	Yes - 13.3% No - 86.7%
Have you received training in how to use herbicides?	Yes - 13.3% No - 86.7%

Normalised difference vegetation index

To avoid repetition, the normalised difference vegetation index (NDVI) is explained in Chapter six, where I pair the NDVI results with farmers' anecdotes about the history of their fields and their current soil management practices.

Focus group interviews

Focus groups work best when the researcher is able to gain in-depth understanding of the issue at hand (Nyumba et al., 2018). Because I was obtaining data from selected groups of rural small-scale farmers, I facilitated discussions among different groups. Through the focus group interviews, I offered the farmers the platform to compile a soil testing kit that would help them to assess their soils in future. I encouraged them to use their indigenous practices and discuss different indicators of soil health. Most groups were initially hesitant, telling me they did not believe their traditional knowledge systems mattered or would be taken seriously. But with time, the farmers started talking and exchanging ideas about the best soil management practices, and they eventually

realised they could solve their own problems instead of relying on extension officers or the state. Helping them see that every knowledge system matters gave them the confidence to share the knowledge systems they had learned from those who had come before them. I recorded the sessions and started transcribing the data after the focus group meetings.

Image 10: Left and right: Some focus group interviews were conducted in 2021 at the height of the Covid-19 pandemic, when farmers had to keep social distancing and wear masks. This made it much more challenging than in 2019.

Semi-structured interviews

I interviewed individual farmers to understand their perspectives on farming and I encouraged them to express their views freely. I questioned them about their farming experiences and perspectives through semi-structured interviews, which allow the researcher to drive the interview (Willig, 2013). I found these interviews rewarding, because a group's voice may differ from an individual's voice – in groups, people are often afraid to speak freely and may hide behind more outspoken members. I have represented individual's voices as much as group voices in the study. Some farmers informed me that they felt under pressure to join state-funded programmes because their neighbours and friends had joined them. When asked what they understood about the

programmes and the technology, they had no idea how to respond. Many farmers were knowledgeable about the traditional system of farming, however.

Image 11: Left and right: Photos from one-on-one semi-structured interviews with different farmers.

Participatory observation

Kawulich (2005) defines participant observation as "the process enabling researchers to learn about the activities of the people under study in the natural setting through observing and participating in those activities." I normally arrived before sunrise, when most farmers were waking up to work in the fields. I watched how they interacted with the soil, observing every activity. They often forgot I was there as a researcher, because I became part of them and, like them, I worked. It was sometimes important to observe without interrupting to see them in action.

As much as this entire study is based on agriculture, its crux is soil and the interactions therewith. Soil is also home to different organisms. This study is an exploration of the relationship of farmers and the world of soil: soil as more than dirt and as a carrier of life, as a soul and a living entity. It goes beyond agriculture to a relationship of symbiosis, where farmers view soil as something greater than simply where plants grow. The focus on soil management practices was thus paramount.

Through the participatory approach of interviews and questionnaires, I discovered that farmers had never been included as stakeholders in the conceptualisation, planning and implementation process of state-funded programmes such as the MFPP. It was important to present myself to the farmers as someone who wanted to give them a voice and understand their experiences, which is often a challenge at the beginning of this method. This is among the most vulnerable groups in the country – victims of apartheid and victims after apartheid. They were not used to having a platform to express their opinions, which I had to bear in mind before I started the data collection process.

Participatory observation validated what the farmers said. I observed their actions and practices when they interacted with soil, and I benefitted not only from their words but from their actions. Agriculture is embedded in the culture of rural communities in Africa, so employing this method helped me to identify behaviours, situations and information that could not be obtained solely through methods such as interviews (Kawulich, 2005).

Photo elicitation

Images helped capture moments that farmers could not convey in words during the interviews. Images arouse a deeper element of consciousness, and such interviews utilise more human brain capacity than words without pictures (Harper, 2002). I took many pictures during focus group meetings and participatory observation when farmers were in action and sometimes unaware they were being photographed. The pictures allowed me to access aspects of the interactions that would otherwise have remained inaccessible.

Conclusion

This chapter provides a comprehensive step by step of the methodology I used to collect data. The chapter demonstrates why it was important that I chose a multidisciplinary approach and why it matters to treat vulnerable populations as partners in the research project, not just research subjects. To further explain how researchers can work together with vulnerable groups without treating them as passive subjects, I refer to the philosophy of the Black Consciousness Movement.

CHAPTER 3

How did we get here? On the origins of industrial agricultural policy in small-scale farming in the rural Eastern Cape

To begin the conversation, it is useful to review the history of agrarian policies in South Africa. The state can take action and allocate resources to the public through policies (Hebink and Cousins, 2013), and insofar as policies are concerned, the question of who controls the economy is paramount. At the foot of the African continent, South Africa is shaped by a long history of conquest, and it is not possible to understand the genesis of the country's agrarian policies without considering the history of the land. The conquest of the South African land and its people can be traced back more than 300 years, to 1652 to be precise. Through colonial expansion, the Europeans seized land and subjugated indigenous communities (Ngcukaitobi, 2018; Mashele and Qobo, 2014), enabled by a string of policies and legislations that restructured the agrarian landscape of the local communities. To elaborate this conquest, in the opening of his recent book: *The land is ours: South Africa's first black lawyers and the birth of constitutionalism*, prominent lawyer Tembeka Ngcukaitobi (2018: 11) quotes the novel *Heart of darkness (1899):*

> The conquest of the earth, which mostly means the taking it away from those who have a different complexion or slightly flatter noses than ourselves, is not a pretty thing when you look into it too much. What redeems it is the idea only. An idea at the back of it; not a sentimental pretence but an idea; and an unselfish belief in the idea – something you can set up, and bow down before, and offer a sacrifice to.

The fact that Ngcukaitobi used this quote from Joseph Conrad's novel can be seen as symbolic or can be challenged depending on how one analyses it. In a scathing attack, Achebe (2016) accused the novel of racial overtones. Achebe wrote that Africa's representation in the novel is that of otherness, the dark world where Africans are depicted as 'black shadows of disease and starvation'. Sigh (1978), who also accused the novel of 'colonialistic bias' wrote that Africans are described in 'wilderness' terms – citing *Heart of darkness* in page 136: "She stood looking at us without a stir, and like the wilderness itself, with an air of brooding over an inscrutable purpose". Whether the novel is racist or not is a topic for another day. My view is that Ngcukaitobi used the passage from the novel to explain the colonialists' perceptions of Africa at the time.

A tale of two nationalist governments: Afrikaner nationalism and African nationalism

For the purpose of this section, I have situated my argument in the premise of two nationalist regimes: Afrikaner nationalism and African nationalism (Mbeki, 2022). But before the main discussion of agrarian policies, it is necessary to consider a chronology of historical events to support my argument. According to political economist Moeletsi Mbeki (2019; 2022), to understand South Africa economically and politically, we should look carefully at the dominance of nationalism in the country's political landscape. By nationalism, Mbeki means a political movement that is highly motivated by a strong sense of grievance: "Population groups become aggrieved when they feel a strong sense of exclusion from enjoying the political, social and economic benefits in a given society."

In addition to examining nationalism, as Mbeki suggests, I also consider social class and elitism as variables that influence both nationalisms and their respective agrarian policies. I argue that class played a predominant role in the rise of these nationalist movements. In *Black nationalism in South Africa: A short history* (1976) and *The rise of African Nationalism in South Africa* (1971)), Peter Walshe writes that the rise of nationalism among Africans, which led to the formation of the South African National Native Congress (SANNC) in 1912, was driven by a strong sense of grievance against discriminatory legislation imposed by the British empire (the colonial government at the Cape). For both black Africans and Afrikaners, British imperialism was the matrix out of which nationalism rose.

Giliomee (1987) argues that the origins of Afrikaner nationalism began in the 1870s and early 1880s, but the evidence of much earlier events suggests otherwise. I trace the rise of Afrikaner nationalism to the early European settlers in the seventeenth century; while this does not involve British imperialism, I find it important to support Mbeki's argument. As has been widely documented by historians, in 1652 the Vereenigde Oost-Indische Compagnie (VOC), or Dutch East India Company, established a refreshment station in the Cape for passing ships. The VOC ruled the Cape from 1652 to 1795 (Wilson & Thompson, 1969). Although not the company's initial intention, the station became a colony for European settlement (Wilson & Thompson, 1969; Boshoff & Fourie, 2010; Baartman & Worden, 2012). The VOC introduced burghers focused on

agriculture to provide fresh produce to the VOC's passing ships, and these burghers became the forebears of the later Afrikaner settlers who made the Cape Colony their permanent home (Baartman & Worden, 2012). To fulfil their duties as citizens, the burghers were expected to pay taxes, attend to military duties and adhere to other arbitrary decisions imposed by the company's officials (Dubow, 2012; Baartman & Worden, 2012).

W.A. van der Stel, a VOC governor who ruled the Cape between 1699 and 1707, was monopolistic in that he controlled the terms and conditions under which the burghers could farm. He built himself an estate (comprising fields, vineyards, a mill and other buildings) and hired 60 VOC staff and 200 slaves to work there (Markell et al., 1995). Not only was this against VOC rules that prohibited employees from private trade and farming, but it gave the governor an unfair advantage over the burghers farmers in the area (Wilson & Thompson, 1969). Baartman and Worden (2012) write that in 1779 over 400 burghers signed a petition against the VOC government's abuse of power, listing among their grievances unfair trade policies and judicial and administrative rights. Of significance is that the signatories to the petition did not identify themselves by their occupation, which was the norm at the time, but referred to themselves as burghers. Baartman and Worden (2012: 82) write:

> The protests that rocked the Cape settlement in the late 1770s demonstrate that the burghers regarded themselves as a distinct group with its own identity and certain privileges comparable to those of burghers of Dutch cities. Once this identity and these rights were threatened, some burghers felt that they should stand up and defend them. The general dissatisfaction among the burgher population was used by leaders in the community to try to claim greater political and economic power for their own network. In so doing, they continued a long tradition of patrimonial and faction politics, which they knew from Dutch as well as Cape history.

In *Cecil Rhodes and the Cape Afrikaners: The imperial colossus and the colonial parish pump,* Mordechai Tamarkin (1996) explains that the British occupation of the Cape Colony in the nineteenth century changed the economic, physical and social landscapes of the area. Trade restrictions that existed under the rule of the VOC were abolished. Issues that triggered the revolt and rise of Afrikaner nationalism were the increase of British capitalism and expansion (which left

both native black South Africans and white Afrikaners in the cold), the anglicising of non-British populations, including the Afrikaner communities, and the annexation of the Transvaal in 1877 (Giliomee, 1987; Barker et al., 1988; Grundlingh, 2020). In the early 1830s, disgruntled Afrikaners, migrated further inland into southern Africa in search of a land to call their own. Also known as Voortrekkers, this was their Great Trek, a significant event in Afrikaner nationalist history (Francken et al., 2022). Britain had abolished slavery (under the Emancipation Act) in the Cape Colony; without slaves, the Afrikaner farmers lost what they considered their property, and it became much harder to carry out their business activities (Barker et al., 1988; Eldredge & Morton, 1994; Luxemburg, 2003; Francken et al., 2022). Given their Calvinist views, the Voortrekkers believed that the role of blacks or non-whites was as servants and subordinates to the white masters (Eldredge & Morton, 1994).

The British resented the fact that J.B.M. Hertzog, a former Afrikaner general in the second Anglo-Boer war, introduced the Education Act of 1908 in the Orange River Colony. This gave Afrikaans the same status as English – children had to learn Afrikaans as well as English (Mouton, 2011). The British did not think this was necessary as they regarded the Afrikaners as inferior, and this attitude further fuelled Afrikaner nationalism (Mouton, 2011).

While sharing a sense of grievances against British imperialism, distinct features set Afrikaner and African nationalistm apart. Afrikaner nationalism was based on shared culture, race and a Calvinist paradigm (Marks & Trapido, 1987; Du Toit, 1983; Wilson & Thompson, 1969). In 1843, Voortrekker Anna Steenkamp wrote a letter to her relatives explaining that the Great Trek had to happen because sharing the same rights with the emancipated slaves was against God's will (Barker et al., 1988). Events such as the Great Trek were closely aligned with the story of Exodus, in which the Israelis escaped slavery and subjugation under the pharaoh in Egypt (Du Toit, 1983); the Afrikaners were the chosen ones on a holy mission, and British imperialism was the Pharaoh. "To the Boers the Old Testament was like a mirror of their own lives. In it they found the deserts and the fountains, the droughts and the plagues, the captive and the exodus" (Du Toit, 1983: 924–925).

Conversely, African nationalism was the product of educated elites who formed the SANNC in 1912 because they had been stripped of their voting rights, economic freedom and social standing (Wilson & Thompson, 1969; Barker et al., 1988; Sithole, 2016). But organised resistance did not start with the formation of the SANNC. Different segments of the oppressed population resisted the colonial and apartheid regimes – the so-called bourgeois, petty bourgeois, urban and rural Africans, Indians and Coloured communities (Mohan, 1978). In fact, long before the formation of the SANNC (as far back as the 1600s, when land disputes between Europeans and Africans began), Khoisan, AmaXhosa, AmaZulu and other ethnic groups revolted and fought for their land and against European occupation (Barker et al., 1988).

The SANNC can be credited for unifying Africans regardless of ethnicity under a "rubric of African nationalism" (Sehume & Motaung, 2013: 85), but I argue that the discontent of most of the black elite who founded the SANNC had to do with being stripped of their voting rights and social and economic class. Theirs was an elitist movement more concerned with assimilating into the European system than fighting it. Barker et al. (1988: 208–209) explain that the educated blacks went to great lengths to assimilate into British culture:

> They believed, naively as it turned out, that if they showed how easily Africans could adapt to "white civilization", the racists of the Orange Free State, Natal and the South African Republic would look at their indigenous populations in a new light ... Their adoption of colonial values and culture affected many areas of their lives: cricket, for instance, was a favourite leisure pursuit because it was held to be the "most gentlemanly and Victorian of sporting activities".

Despite these efforts, they were not accepted as equals by the white society they were trying so hard to impress (Barker et al., 1988). And as much as some Afrikaners had left the Cape Colony to establish their own territories (Transvaal and Orange Free State), many Cape Afrikaners became anglicised and integrated into British society and bureaucracy, occupying elite positions such as advocates, medical doctors, land surveyors, accountants, etc. (Tamarkin, 1996). This is where the correlation between class and nationalism takes precedence.

Tamarkin (1996) writes that in the 1870s, some Cape Afrikaners were keen to have their children learn English – notable Afrikaners such as J H H de Waal, Jan Smuts and F S Malan even pursued tertiary education in Britain. Emerging generations of Afrikaners became part of the anglicised education system and joined the urban culture of the budding Cape Colony. Even leading members of the Afrikanerbond (discussed in the next section) were anglicised and participated in the administration and legal institutions of the Cape Colony and benefited from the British-driven economy (Tamarkin, 1996; Dubow, 1997). Problems arose when the elite's economic interests were tampered with. The botched British Jameson Raid on the Transvaal caused irreparable damage between the British and Afrikaners and led to the second Anglo-Boer War and the post-war devastation that affected Afrikaner agriculture and livelihoods (Wilkins & Strydom, 1978; Giliomee, 1983; Dubow, 1997). The main factors that drove both nationalisms were classism/elitism and assimilation into the British-driven economy.

Agrarian policies under Afrikaner nationalism

I have already stated that the agricultural industry in South Africa is dualistic. Nieuwoudt & Groenwald (2003) list two major factors for the apartheid government's support of this dualistic structure: restricting blacks to certain areas and excluding them from mainstream agriculture. The minerals revolution in the country was also closely aligned with the agrarian sector, and for this reason had a huge influence on agrarian policies (Lahiff, 2000). Nicknamed "the union of gold and maize", the compromise between the Afrikaners and Britain that led to the formation of the Union of South Africa in 1910 united the agrarian and mining sectors to exploit black labour (Lahiff, 2000). Historical events such as the Great Trek caused irreparable damage to black communities in southern Africa. In search of the so-called promised land, the Voortrekkers seized land and caused havoc among different black ethnic groups (Barker et al., 1988). The notion of depopulated and empty lands was a myth used to justify land seizure, and Voortrekkers' territorial clashes with the Ndebeles, Basotho, Zulus, etc. are well documented (Barker et al., 1988). In addition to taking their land, the apartheid economy was built on and with their labour (Luxemburg, 2003).

When the democratic government took over in 1994, approximately 60 000 white commercial farmers occupied 87 million hectares of land and were the drivers of large-scale agriculture, while 2 million blacks were engaged in small-scale and subsistence agriculture in the homelands (Cochet

et al., 2015). The local populations were stripped of their rights and land and were subjected to segregation and resettlement laws (Kloppers and Pienaar, 2014; Mabaya et al., 2011).

"My father was robbed by the white men who came to our village. Even today I don't want to see them, because I am still struggling to recover from what they did. They told him to sell his livestock. It did not matter how the livestock was sold, they just wanted it gone, and they ended up buying some cows from him, because they just wanted him gone from the land. They left him with no place to stay. It was a long time ago, around the 1950s, they took everything then." – Mr Nzo, a black small-scale farmer in Ncerha, Eastern Cape."	"*Utata wam wakhuthuzwa ngabelungu abo ke, aba endingafuni nokuba bona ngoku ndisaxakene nayo. Bamkhuthuza kwanyanzeleka ukuba makathengise iinkomo zakhe nanjani na noba kunjani na, phofu bazithenga kwabona ngenxa bemsusa pha engazi ukuba uzakuhlala kuphi na.Kwakukudala kakhulu ngonyaka opha kwi 50s bathatha yonke into ngoko."* – Mr Nzo, a black small-scale farmer in Ncerha, Eastern Cape.

The central aim of Afrikaner nationalism was to safeguard the economic interests of the Afrikaner population and to supply natural resources to Europe and the Americas (Mashele & Qobo, 2014).

Afrikaners established the Broederbond (the Brotherhood) in 1918 (it became a secret society in 1921) to promote the economic interests of Afrikaners and their culture (Baines, 2023; Grundlingh, 2020). In his review of *The Super Afrikaners: Inside the Afrikaner Broederbond* (Wilkins & Strydom, 1979), Moodie (1980) argues that the book exaggerates the power of the Broederbond. However, Wilkins and Strydom (1979) propose important issues that situate the Broederbond as a cornerstone of Afrikaner nationalism and as a predominant influence on the affairs of the apartheid government. Many prominent figures were Broederbond members, including D F Malan, who became president, as well as cabinet ministers, university chancellors, political party leaders, business executives, etc.

A letter issued by the executive of the Broederbond to its members describes its purpose thus:

> Let us focus our attention on the fact that the primary consideration is whether Afrikanerdom will reach its ultimate destiny of domination in South Africa. Brothers, our solution for South Africa's ailments is not that one party or another shall obtain the whip hand, but that the Afrikaner Broederbond shall govern South Africa. (In Wilkins & Strydom, 1979: 60)

Writing about precolonial agricultural techniques and methods among black South Africans, historian Colin Bundy (1988: 22) asks: "How good or bad were they as food raisers; how productive, how efficient and how skilled?" To answer this, we have to look at land tenure. The land provided the means through which these communities sustained themselves. Batswana, for example, were completely reliant on the land for their upkeep – using it to produce their food in the form of cattle and crops and sharing the land they occupied (Schapera, 1953). Being part of a community meant people had the right to share land and resources such as water, firewood and vegetation (Coles, 1993).

Du Plessis (2011) writes that private property was a foreign concept in precolonial Africa, a sharp contrast from the colonists' concept of private ownership of property. Africans generally used the system often known as customary land tenure or communal land tenure – a "set of rules and norms that govern community allocation, use, access and transfer of land and other natural resources" (Mailula, 2011: 79). Bundy (1988) asserts that agriculture among African communities incorporated many factors – such as understanding the natural environment (e.g flora particular to an environment), soil types and climate conditions. Most adults in the Bapedi communities knew the names of trees, shrubs and other plants in the environment and understood how nature functioned (Bundy, 1988). Even after the arrival of the European settlers and their draconian acts, subjugation and forceful taking of land, black South Africans held their own in the agricultural sector. By the 1890s, for example, white settlers were no match for African farmers, who were able to supply their produce at lower prices (Binswanger & Deininger, 1993). Binswanger & Deininger (1993) note that black farmers generated profit, supplied revenue to local traders and even won prizes at agricultural shows. In response, white farmers issued a petition to safeguard their own survival and put a damper on the success of black agriculture (Binswanger & Deininger, 1993).

Below is a brief timeline listing some of the most important acts and events that changed the agrarian landscape in South Africa, though these are by no means the only acts imposed by the colonial and apartheid governments. Although the Afrikaner-led nationalist government took over in 1948, I have mentioned an earlier act that I regard as instrumental in changing the agrarian landscape in the country.

Table 5: Old and recent agrarian reforms

Act	Description
Glen Grey Act of 1894	The main motive of this act was to control land and black labour to boost white-owned farms and mines (Barker et al., 1988).
Labour Regulation Act (No.15 of 1911)	This Act increased the availability of cheap labour for mining and agriculture industries and entrenched the migrant labour system (Cochet et al, 2015; Jeeves & Crush, 1997).
Formation of Land Bank in 1912	The state provided cheap credit to struggling white farmers; helped farmers form cooperatives and established the department of agriculture, agricultural colleges and research institutions (Hebinck & Cousins, 2013).
Act	**Description**
1913 Native Land Act	Native or homeland reserves were designated as residential areas for black people. This act also prohibited sharecropping between black and white farmers (Kloppers and Pienaar, 2014).
Administration Act 38., 1927	Forced black people from rural white land and relocated them to the homelands (Coles, 1993).
The Native Trust and Land Act 18 of 1936	Made provision for Betterment Planning, imposed on blacks to 'modernise' their agricultural practices – grouping woodlands, cropland, pasture and residential areas to be in line with a more standard land-use scheme (Cochet et al., 2015). Dealt with overcrowding to prevent land degradation (Hebinck, 2013). Individual land ownership by black people was prohibited through this act (Kloppers and Pienaar, 2014).
The Abolition of Racially Based Land Measures Act 108 of 1991	Put an end to discriminatory land acts – in particular the 1913 and 1936 Acts and other provisions that used race as the basis for land

	allocation (Hebinck et al., 2011; Kloppers and Pienaar, 2014).
White Paper on Land Reform, 1991	Addressed land reform and proposed doing away with discriminatory regulations (Coles, 1993).
White Paper on Land Reform, 1997	Based on four pillars to address land reform: restitution to compensate those who lost land under apartheid; securing land tenure for those who occupied insecure land; redistributing land to the previously disadvantaged; and supporting emerging black farmers (Gumede, 2014).
Agricultural Laws Rationalisation Act 72 of 1998	Amended past laws relating to agriculture (South African Government, 2022).
Land Redistribution for Agricultural Development (LRAD) programme, 2001	The aim of the LRAD was to help black commercial farmers without marginalising poor rural communities and to support agriculture in communal areas (Hebinck & Cousins, 2013).
Proactive Land Acquisition Strategy (PLAS)	State buys farms from white farmers and redistributes them to black farmers (Kepe & Hall, 2020)

The abovementioned acts safeguarded the future of white commercial agriculture and provided cheap labour, access to markets and financial assistance and eliminated black farmers as competitors. The Glen Grey Act of 1894 was among the most instrumental acts, because it limited farm ownership among black people and compelled them to seek off-farm employment (Hebinck, 2013; Binswanger & Deininger, 1993). With the rise of the mining sector in the late 1800s, the homelands also served as labour reserves (Lahiff, 2000). The 1913 Act compelled black farmers to neglect farming and take up wage labour instead (Coles, 1993), prevented black people from purchasing or leasing land from their white counterparts and prohibited sharecropping between whites and blacks (Coles, 1993).

Haffajee (2015) argues that to this day South Africa is scarred by the apartheid policies, singling out the 1913 Natives Land Act as one of the most nefarious. About 3.5 million blacks were stripped of agricultural land and forced out of suburbs and towns between 1913 and 1989 (Haffajee, 2015). The Native Trust and Land Act 18 of 1936, on the other hand, affected how black people farmed. Among other limitations, blacks were restricted in the number of livestock they could own, while

separating their homesteads from natural resources affected their agricultural production (Hebinck, 2013). Furthermore, this Act left black South Africans with only 13% of the land, forcing them to abandon agriculture and seek employment in white-owned farms, mines and industries (Barker at al., 1988).

White farmers demanded that the state supply cheap labour (the state already regulated production, markets and prices and offered aid to these farmers, among other support structures), and so the Labour Regulation Act entrenched the migrant labour system (Jeeves & Crush, 1997). This Act divided labour between the two sectors of mining and farming (Jeeves & Crush, 1997). In the 1940s, black workers found without a pass were sent to work in farms as punishment (Binswanger & Deininger, 1993).

By 1918, agricultural production in the homelands was down to 45% owing to aggressive policies, and by the 1950s the relocation of blacks as a result of the state's Betterment Planning had reduced agricultural production to 20% (Binswanger & Deininger, 1993). The limited space available to black farmers prohibited them from making farming a success. Black farmers could also not compete with their white counterparts because they did not receive state support. The state set the parameters for the changes in agriculture from the onset, and white farmers depended heavily on the state for market control, subsidies, labour and more (Jeeves & Crush, 1997). Other support structures for white farmers included the Land Bank, formed in 1912, which provided credit to white farmers; cheap credit to struggling white farmers; and forming cooperatives and establishing the Department of Agriculture, agricultural colleges and research institutions (Hebinck & Cousins, 2013).

White farmers were also assisted by market boards that provided them with power to buy and sell produce (Binswanger & Deininger, 1993). Land dispossession and the weakening of black agriculture led to black farmers being unable to export their produce but also to feed themselves and their families (Cochet et al., 2015). It was inevitable that the homelands would become labour reserves, and by the 1950s, farming in these communities had significantly declined, leading to overpopulation, environmental degradation, migration and poverty (Hebinck & Cousins, 2013).

With no state support, a shortage of land and policies that eliminated them as the competitors of white farmers, African farmers had to work as labour and advance white-owned enterprises (Jeeves & Crush, 1997). As a result, the total value of the country's agricultural output between 1911 and 1948 rose from USD 29 million to nearly USD 200 million (Jeeves & Crush, 1997). The Afrikaner nationalists also threw their weight behind state-owned enterprise such as the South African Broadcasting Corporation (SABC), Independent Development Corporation (IDC), Development Bank of South Africa (DBSA) and Iron and Steel Corporation (Iscor, now known as Mittal) (Mbeki, 2009).

African nationalists inherit 'British state'

"Black capitalists need a Broederbond-type network to propel their ascent more firmly" – Robin McGregor (in Marais, 2001: 243).

The end of apartheid in the early 1990s signalled hope, not only for black farmers but for the oppressed and black majority. Every person, regardless of race, would benefit from the economy – so promised the new democratic government. But the new government did not want to restructure or replace the old system. It wanted to assimilate with it: "the opposition is not sweeping aside the old institutions of state power. It has to try and shape the terms on which it is incorporated into the state as a new ruling group" (Morris in Marais, 2001).

The ANC-led government introduced policies, acts and programmes to address the legacies of apartheid (Mabaya et. al, 2011; Eastern Cape Department of Agriculture and Rural Development, 2009). Its land reform policy addressed land tenure, land redistribution and land restitution. Additionally, the World Bank advised the government to provide previously disadvantaged farmers with cash to buy land (Nieuwoudt & Groenwald, 2003). The White Paper on South African Land Policy of 1997 (not to be confused with White Paper on South African land Policy of 1991 – see table) detailed how past injustices would be addressed, how poverty would be reduced, how land would be managed and how the state would deal with security of tenure and economic growth (Hebinck & Cousins, 2013).

Trade policy reforms took shape to achieve economic liberation, and when the country became a signatory of the Marrakesh Agreement in 1994, tariffs replaced past import and export permits that influenced price control and other regulations (Cochet et al, 2015). In the early 2000s, the agricultural sector introduced the AgriBEE programme to assist previously disadvantaged blacks to take part in the mainstream economy (Mabaya et. al, 2011). However, Cousins and Walker (2015) argue that changes in land reform have been slow and only a few black farmers have successfully entered the commercial agricultural sector.

The state's land distribution programme, which aimed to ensure that the majority of South Africans had access to land (for residential or production purposes), did not live up to expectations. The state eventually reviewed its policies between 1998 and 1999, introducing a credit facility for land reform, grants to support production and livelihoods and a Settlement/Land Acquisition Grant (SLAG) (Hebinck & Cousins, 2013). SLAG paid R15 000 per beneficiary to assist poor communities obtain agricultural land for settlement and to establish farming enterprises (MacLeod et al., 2008). To qualify for the grant, a household had to generate a maximum of R1 500 monthly (Kepe & Hall, 2020). However, SLAG failed for many reasons (e.g. the grant was quite small) and did not meet its main aim of helping poor farmers become commercially self-sufficient (MacLeod et al., 2008).

A new initiative, the Land Redistribution for Agricultural Development (LRAD) programme, was introduced in 2001 to replace SLAG. LRAD was designed for better-resourced individuals positioned to acquire agricultural enterprises to become commercial farmers (MacLeod et al., 2008). Its main objective was to make a variety of grants, ranging from R20 000 to R100 000, accessible to beneficiaries, but the beneficiaries had to contribute labour and/or cash (Nieuwoudt & Groenwald, 2003). LRAD was also intended to pave the way for black commercial farmers without marginalising poor rural communities and to support agriculture in communal areas (Hebinck & Cousins, 2013). LRAD partially replaced SLAG for projects focused only on agricultural development (Cochet et al., 2015), but it came under criticism for failing to assist low-income farmers (Mabaya et. al, 2011). Hebinck & Cousins (2013) argue that while the LRAD programme brought about an increase in redistribution projects and hectares given out, only around 250 000 hectares were transferred a year and the programme's aim of developing black commercial

farmers failed to materialise. For emerging black commercial farmers, the agricultural industry does not present a fair playing field, as the farming sector is still dominated by white farmers who have been in the game much longer (Mabaya at. al, 2011).

To address the failures of SLAG and LRAD, another land redistribution strategy was piloted in 2006 and implemented in 2011 – the Proactive Land Acquisition Strategy (PLAS) (Kepe & Hall, 2020). Under PLAS, the aim of the state was to buy farms belonging to white farmers and redistribute them, on a leasehold, to black farmers (Kepe & Hall, 2020). Kepe and Hall (2020) conducted a study in the Eastern Cape titled *Creating learning and action space in South Africa's post-apartheid land redistribution program*, to assess, among other aims, whether PLAS was meeting its land reform goals. The authors identified limitations, including low production on participating farms; farms not thriving and having poor conditions (e.g a compromised environment); and farmers not having proper documentation to occupy the land/farm.

In another study, *Land redistribution in South Africa: Towards decolonisation or recolonisation*?, Kepe and Hall (2018) note that PLAS beneficiaries must have a mentor or strategic partner to be eligible for funding. These mentors are often agri-businesses and white farmers, and small-scale farmers end up as labourers instead of partners on land of which they are designated as beneficiaries. Kepe and Hall (2018) also argue that the state's obsession through these land reform strategies is agricultural productivity, which ignores other important meanings of land. In this case, Modiri's description (2021) of South Africa as a post-conquest rather than a post-apartheid society is useful, in that it recognises that South Africa's old economic system is still in place, with a select few benefiting.

Despite a plethora of such policy changes, Hebinck and Cousins (2013) argue that post-apartheid policies have failed to make a fundamental impact on rural poverty and that the government has failed to address both land and agricultural reforms in an effective manner, e.g. policymakers favouring commercial agriculture and seeing it as superior to small-scale agricultural systems. Many development programmes have aimed to modernise African agriculture and been forced on local populations (Cochet et al., 2015). Old programmes such as Betterment Planning fell short of *teaching* black populations how to farm, but similar projects continue to be introduced after

apartheid. As evidence that some colonial and apartheid-era policies have been resurrected, I compared two schemes intended for black communities: the Betterment schemes of the colonial era and the Massive Food Production Programme introduced post-1994.

Table 6: Similarities between MFPP and Betterment schemes

Massive Food Production Programme	Betterment schemes
State sends out officials to convince rural communities to join with false promises of producing more yields and using "better technology" (see chapter one -interview with farmers and extension officers).	State sends out officials to convince rural communities to join the schemes. Those who join are promised they will be taught how to farm better and make more money ((Lahiff, 2000).
Modernise farming and increase yields in rural areas. Opportunities for small-scale rural farmers to learn about commercial production (Mtero, 2012; Hebinck & Cousins, 2013).	Meant to teach black communities how to manage and use land economically (Hebinck et al., 2012).
Imposing reforms on rural communities. Top-down approach.	Imposing reforms using the top-down approach, and benefits tended to accrue to elites (Hebinck, 2013).
Based on Eurocentrism and overlooked local knowledge systems.	Based on Eurocentrism and overlooked local knowledge systems
This expert advice is derived from the notion that modern technology will bring about positive change in the rural farming landscape (Hebinck & Cousins, 2013).	The apartheid experts believed that "peasant agriculture triggered environmental collapse" (Hebinck et al., 2011).
Farmers not involved in decision making (Mtero, 2012) or stakeholders meetings, even though these projects are meant to 'help' them.	Decisions made on behalf of black communities.
Lacked sustainability, costly and eventually failed (Mtero, 2012).	State made huge investments (e.g. irrigation schemes and machinery) to get the projects going. Programmes lacked sustainability, were expensive and failed (Hebinck, 2013).

Economist William Easterly (2013) argues that in the conventional approach to development, the quest to make poor countries richer is a technocratic illusion. Development specialists regard poverty as a technical problem that requires technical solutions, such as fertilisers, antibiotics or nutritional supplements (Easterly, 2013). This is how big organisations such as the World Bank, Gates Foundation, United Nations and others address global poverty (Easterly, 2013). I argue that this conventional approach to development, which does not consider cultures, social relations or kinship with nature, make these small-scale farmers retrogress into an apartheid-like situation.

In the opening section of this chapter, I unpacked the history of two nationalist regimes, culturally different yet similarly driven by an elitist agenda that values the accumulation of capital by any means possible – land seizure, labour coercion, bloodshed, encroachment of corporations and agrochemicals on traditional small-scale agriculture. Transformation in South Africa is symbolic and cosmetic, with little or no fundamental change having taken place. Post apartheid, poverty is still concentrated in the former homelands, and the new South Africa is nothing but an old wine in a new bottle (World Bank Group, 2018; Marais, 2001).

Because there has been no fundamental change in the economic base of the country, I argue that there has also been little change in the production of knowledge. This leads to social discontent and could result in a new form of nationalism – but perhaps one that appeals to universal equality as opposed to class distinction.

Failure to decolonise knowledge in post-apartheid South Africa

Image 12: Cartoon obtained from Kgari-Masondo (2020).

After 1994 and decades of colonial and apartheid brutality in South Africa, Eurocentric knowledge and thinking still dominate and are highly regarded. Post-apartheid South Africa has overlooked pre-existing community-based knowledge systems and backed agrarian practices rooted in colonialism and apartheid (Tropp, 2006; Hebinck et al., 2011): "Knowledge (and thus the control over what constitutes knowledge) plays a key role in any expert system. A predominantly white consultancy industry played a key role in the planning and implementation of agrarian reforms"

(Hebinck et al., 2011: 227). To put into perspective the impact of the epistemic erasure of colonised and racialised people from the peripheries, it is vital to tap into the genealogy of how knowledge is structured and what constitutes 'real' knowledge. I refer to the writing of Michel Foucault and Aimé Césaire to explain how power and knowledge are intertwined and how colonial writers and anthropologists have influenced the Eurocentric knowledge system. Marya and Patel (2021) posit that when indigenous stories are not told, their message is not transmitted to those who might benefit from them. This is especially important in relation to rural farmers' indigenous knowledge systems. Why is it that in post-apartheid South Africa, indigenous knowledge practices continue to suffer epistemic erasure? Who determines which knowledge mode is important in this country?

Foucault: Power and knowledge

It is easy to see why Foucault's anti-authoritarian rhetoric appealed to the counterculture movement of the 1960s and 70s. In describing governmentality, Foucault refers to how the state controls or governs its populations through different apparatuses or institutions, and he cites different concepts that the state uses to govern, including the relationship between power and knowledge and biopower (Lemm, 2014). Foucault argues that the state holds more power and control over people today than ever before. To do this, the state does not have to exert force, as it previously did. Now the state claims to implement laws or take action in the name of safeguarding and helping the population to thrive. For example, by introducing development projects in the rural Eastern Cape, the state claims that its mission is to help the poor and provide them with a better life. But whose interests is the state acting on behalf of? As already described, the new democratic government has introduced extractive projects that benefit multinational corporations such as Bayer, corporations making profits through the sale of seeds, pesticides and fertilisers at the expense of struggling small-scale farmers.

To govern the people effectively, the state gets to know them through statistics and demographics, and people are classified and categorised. This "knowing of the population" helped apartheid and colonial South Africa identify ethnic groups in the country and place them accordingly in the bantustans/homelands. The state also makes the population docile or submissive, as docile productive bodies are easily controlled and internalise discipline (Dwyer, 1995).

The apartheid system created the homelands as labour reserves to regulate black labour and movement. This promoted cheap labour and tribalism and discouraged nationalism or unity among ethnic groups. The purpose of the homelands was to turn blacks into wage slaves – turning people into foreigners in their own home and enslaving them to exploit them. The product of their labour thus belonged to the apartheid state and not to them.

In *Discipline and Punish*, Foucault explains how the state uses the panopticon effect to put people under surveillance: while a prisoner in a panopticon is aware that they are being watched, citizens are not aware that they are under surveillance (in McMullan, 2015): "he is seen, but he does not see; he is an object of information, never a subject in communication."

The government projects appear to assist farmers, but they rob the farmers of their independent decision making. The farmers report to extension officers – they are told how and what to farm. These projects are more of an imposition than a benefit.

Foucault et al. (2004) also write that biopolitics is about the state regulating its citizens. The state uses various strategies to make people subservient to it. The danger of state control over its citizens is that it may impose draconian laws on specific populations – based on race, for example, as was the case in colonial and apartheid South Africa. Through the Bantu Education Act, the apartheid state forced separate education onto black students, who were regarded as inferior and therefore not deserving of the same education as white students (Christie & Collins, 1982).

To understand racial disparities in knowledge production, we must first understand how racism works. Of course, there are many simplified explanations of racism, but Foucault's definition delves deeper and leads us to how power works between the state and its subjects (Brisolin, 2010: 37):

> Racism is primarily a way of introducing a break into the domain of life that is under power's control: the break between what must live and what must die. The appearance within the biological continuum of the human race of races, the distinction among races, the hierarchy of races, the fact that certain races are described as good and that others, in construct, are described as inferior: all this is a way of fragmenting the field of the

> biological that power controls. It is a way of separating groups that exist within a population. It is, in short, a way of establishing a biological type of caesura within a population that appears to be biological domination.

In *Society must be defended*, Foucault et. Al (2004) argues that racism has its roots in biopower. During apartheid, certain universities were only for black people, whose education system was founded on the notion of their inferiority. According to Foucault, racism has two functions: to cause division within a population and to rank, causing inequalities by labelling a population inferior or superior. Racism must exist to justify oppression or killing, which can be in the form of "indirect murder" or the "fact of exposing someone to death, increasing the risk of death for some people, or quite simply, political death, expulsion, rejection and so on" (Dillon and Andrew: 169). In colonial and apartheid South Africa, black students were 'overdosed' with the ideology of their oppressors (Buthelezi, 1991). The content for courses such as History, Theology, Sociology and Psychology was produced by white academics, while earlier, white missionaries disregarded black people's cultures (Sibisi, 1991). This is epistemic violence. Foucault (1997) writes that power and knowledge are cut from the same cloth: whoever is in power controls the terms of knowledge.

Alfred Milner, assigned British High Commissioner of South Africa in 1897, began an anglicisation project to impose English culture on South Africans, allocated the so-called reserves for black Africans, controlled urban influx through the introduction of pass laws, manipulated chiefs to serve the colonial state, etc. (Marks & Trapido; Tascione, 1977). This distorted the entire social and cultural system in the service of capital, with the knowledge created from that distortion benefiting the imposed system. According to scholar Ndumiso Dlala (itvnetworks, 2015) the structures of racism, founded on white supremacy, have never gone away. Like Mbeki (in the previous section), Dladla argues that the current government protects the interest of its white masters. Even the modes of knowledge are influenced by the old racist system.

Power dictates what can be known, how it can be known and to a certain extent what is true. A body of knowledge is crucial for creating a particular discourse (let us say a political discourse), and that political discourse in turn becomes part of the power structure. Foucault et al (2004) writes about disqualified knowledges or subjugated knowledges, defining them as: "a whole set of

knowledges that have been disqualified as inadequate to their task or insufficiently elaborated: naive knowledges, located low down on the hierarchy, beneath the required level of cognition or scientificity." Here, Foucault discusses epistemic violence in the context of psychology, but within the colonial and apartheid context the changing of the education system, language policies and even modes of knowledge overrode local modes of knowledge and thinking.

In post-apartheid South Africa, the so-called expert knowledge based on Eurocentrism pushes farmers' local knowledge practices to the back. The South African government is still operating in biopolitical mode long after apartheid: small-scale farmers must give up their local knowledge systems and adapt to the government's proposals or they go without state support. The latter is likely to lead to poverty, so most farmers will follow the state. The masses fall subservient to those in power who make life-altering decisions about how they should live and what knowledge systems govern them.

In South Africa we see political vanguards pushing policies that affect small-scale farmers and their farming practices. The farmers' local knowledge systems are reduced to subjugated knowledges, excluded from the domains of formal knowledge systems. In simple terms, if a person does not belong to a privileged group, their knowledge becomes subjugated (Harding, 2017). Accordingly, the knowledge systems of rural farmers, who do not belong to an elite group, become subjugated. Foucault (1997) posits that the deciding authority disqualifies certain knowledges, controlling and creating a hierarchy of knowledges to maintain control over knowledge production.

During my fieldwork in the Eastern Cape, I interviewed a retired extension officer who had worked under both the apartheid government and the current democratic one. He said that the old education system taught black children that the knowledge of their ancestors was backward and irrelevant. When he was a college student in the 1970s, his educators discouraged the multi-cropping that was practiced in his village. He was taught that if a pumpkin was growing together with maize, the pumpkin should be removed because it is a weed. Only later did he learn how important multi-cropping is for crops, soil and soil organisms.

> "You see, my father has always done that. Sometimes he would mix beans with maize or maize with pumpkins. So at home we used to eat maize, beans and pumpkins at the same

> time. When I came back from college I told my father not to do that, because we were taught at the college that it wasn't the right thing to do. My father laughed and told me he couldn't do away with his traditional knowledge. I let him be. Then after a long time, while I was still an extension officer (around 1981), we were introduced to a certain farmer here around East London concerning permaculture, a white farmer. He called his farm 'Eden'. There were trees, beans, maize – everything was there. I realised that this is the same as our indigenous knowledge."

The state controlled agriculture and how black people practiced it, which affected their relationship with soil and the natural environment. This is another example of Foucault's governmentality (Lemm and Vatter, 2014). Foucault's arguments resonate with Césaire's in that they are rooted in racial justice and overall oppression of vulnerable groups. Power is not just based on race alone but on class structure of societies. In a country where farmers belong to the poorest group, their voices, knowledge systems and experiences won't matter.

Césaire: Denouncing pseudomorphosis

Césaire (1972: 7) denounced European civilisation, arguing that colonialism was based on dehumanisation – what he called "the thingification" of the colonised by treating them as objects. The colonial system not only objectified victims but also disregarded their knowledge systems, beliefs and cultures. In *Discourse on Colonialism*, Césaire (1972) blames journalists, academics, ethnographers and theologians for inventing the myth of European civilisation in which only white people are capable of producing valid scientific knowledge. Their mission was not to spread the word of God or enlightenment or to change the world for the better but to imperialise and steal resources. If anything, this was a demonstration of a lack of enlightenment. Europeans reduced the colonised to objects to justify their exploitation.

Césaire (1972) mentions Reverend Placide Tempels, whose approach to "Bantu philosophy", Césaire argued, serves as a justification of the horror suffered by Congolese under Belgian colonial rule. For Césaire, this approach allows Reverend Tempels to claim that the Congolese did not object to or see anything wrong with being enslaved and mistreated. Césaire (2000: 71) also quotes anthropologist Roger Caillois: "The only ethnography is white. It is the West that studies the

ethnography of others, not the others who study the ethnography of the West." Caillois chose to ignore that chemistry, arithmetic, geometry, astronomy and more were invented by non-whites. Psychoanalyst Dominique-Octave Mannoni argues that Africans had to be conquered because they had a dependency complex (Césaire, 1972). As Césaire (1972) observed, the work of these 'colonial watchdogs' had nothing to do with objectivity or truth; their main mission was to justify the cruelty of European colonial rule.

Césaire writes from lived experiences and offers insight through the characters in his books. On returning to his home island of Martinique after studying in France, Césaire (2013) writes in *Notebook of a return to the native land* of his realisation that all this time he and his people have been mimicking the French system: like parrots, they mimic but do not generate knowledge. The social structure of Martinique, its urban landscape, education system and knowledge production are all repetitions of the systems of their colonial 'mother', France. All this time, they have been taught to behave like the French – but in France, Césaire and other black students experienced alterity (the state of otherness). Despite coming from a French colony, being a brilliant student and mastering the rules of 'being French', Césaire (2013) realises that he will never be French. His skin colour – his otherness – will always follow him like a shadow. As the book comes to an end, he fights to liberate himself and to bond with his so-called native land. Césaire highlights the horrors of enslaved Africans shipped off to the Americas, who suffered not only physical harm in the plantations but also epistemic and cultural erasure. Despite this, they were expected to behave like their colonial masters, although this would not help them be accepted by their colonisers – their otherness would remain and they would be France's commodity, growing rum and sugar from which they would never benefit.

In *A Tempest*, a postcolonial version of William Shakespeare's *The Tempest*, Césaire (1985) essentialises what happens when two cultures clash and one culture imposes dominance over the other. The two native characters, Caliban and Ariel, are treated differently by the coloniser, Prospero. The play depicts the relationship between the oppressor and coloniser and the oppressed and colonised. Both parties are traumatised and corrupted by the binary nature of colonialism. Prospero depends on the oppressed to exercise power, to fulfil his purpose and for a sense of authority, while Caliban feels trapped by the system and resists colonialism. He is unable to use

his native name, speak his native language or practice his religious beliefs, and he is physically exploited by Prospero. Ariel is loyal to Prospero and is treated better than Caliban, though they are both natives of the island. Ariel follows the western way of doing things and becomes part of the system. Césaire presents two types of the oppressed here, one who resists the system and wants to retain his culture and the other who 'sells his soul' and becomes part of the system of the oppressor.

The play may be considered prophetic as to how the aftermath of apartheid played out in South Africa. The black ruling bourgeoisie have followed the oppressor's example and ignored their own cultural practices, protecting the status quo of their white masters. This is evident in rural development initiatives such as the MFPP, which strongly resembles the old Betterment schemes of apartheid. Prospero has not left the island. Césaire shows that even when the coloniser leaves physically, its presence and influence remain. The modern Ariels now running most African countries sympathise with their former oppressor and have aligned their thinking, ruling and politics with those of the oppressors. The emergence of the black middle class in the 1800s was the beginning of the 'Ariels' we see today in South Africa (Mbeki, 2009), where groups switched to western religion, clothing, medicine, electoral politics and the like – and some, like amaMfengu, assisted Britain to conquer the Xhosa. In return, Britain provided them with land and cattle. When asked if British imperialists should leave South Africa in 1903, Macah Kunene, a black businessman and an ally of Britain responded (in Mbeki, 2009: 59):

> If the white people and the King [of England] were to desert us now and leave us here, there is a great section of us who have approximated to a great extent to the white man's way of living, and to the white man's way of doing things; and there is a large number of us who have not advanced at all, who have remained as they were practically in the former days. I am afraid that those who have remained in their former state would kill us all, particularly civilised natives, because we have bought lands, they do not approve of ownership of land. They know too that whenever there has been a war against natives like ourselves, we have always been with the colonial government and gone out to assist them in those wars … Therefore, we feel that we are far better under our colonial government and are far better than if we were deserted and left to the mercies of our people.

The rest of the masses, oppressed by the colonial or apartheid governments, remain poor and oppressed. The role of multinational companies in the economy in countries such as South Africa supports Césaire's notion. Multinational corporations hold economic power and control the structure of society. For example, a proposed law amendment in 2017 would have, if enacted, prevented small-scale farmers from exchanging and recycling their seeds (Van der Merwe, 2017) but would have benefited seed companies (discussed in Chapter one).

In an interview with Mariam Mayet, director of the African Centre for Biodiversity, an organisation that works with rural small-scale farmers in Africa, she made the case that indigenous knowledge systems are snubbed because the South African government has imposed an extractivist agrarian agenda on farmers.

> It's extractive, because it doesn't give anything back. It depletes knowledge systems. It has taken away, it's not giving. That's why we say it's neocolonial extractivism. It's part of an agenda that is linked with the global development agenda. In respect of which Africa has come short.

In rural areas such as the Eastern Cape, indigenous knowledge systems have sustained farmers for decades, if not centuries. My own grandmother, who was born in Matatiele, Eastern Cape, was considered illiterate by western standards, but she knew the natural environment like the back of her hand. She could predict the weather, she could tell when one of her cows was due to give birth, and she would disappear into the forest to seek medicinal herbs when one of us, her grandchildren, was sick. Only in recent years have I come to understand and appreciate how 'educated' she was despite never setting foot in a classroom. And my grandmother was not the only one with this kind of knowledge – the farmers I interviewed were retired, and given the injustices of apartheid most of them had never studied beyond primary school. Like my grandmother, they have preserved important knowledge rooted in culture and tradition. Such understanding has guided their interactions and relations with fellow humans, animals and other non-humans in the natural environment, a humanist approach to life that benefits the farmers, the soil communities and the environment at large.

After 1994 and years of colonial and apartheid brutality in South Africa, Eurocentric knowledge and thinking still dominate. Post-apartheid South Africa has overlooked pre-existing community-based knowledge systems and endorsed agrarian practices rooted in colonialism and apartheid (Tropp, 2006; Hebinck et al., 2011). The control of knowledge production in South Africa lies with those who hold power and whose knowledge matters. As our policies are similar to those of colonialism and apartheid, we must accordingly still live in a Eurocentric society. Those whose knowledge systems do not meet the requirements of this society are snubbed and must adapt. Using Foucault's subjugated knowledges as the premise of her research, Hartman (2000) explains how vulnerable groups should be treated during research or any other form of knowledge production. To avoid disqualifying African knowledge, it is vital not to position oneself as an expert in research and practice and to rid ourselves of the notion that we are objective observers and those we are researching are passive subjects to be understood. The research approach should preserve the knowledge of less privileged groups such as rural farmers. For example, the method of collecting data from vulnerable groups should comprise a collaborative search for answers with research subjects, their stories/voices, perspectives and constructions of reality (Hartman, 2000).

Conclusion

In South Africa there has always been a contestation between farmers and the state about how and for what purpose farming should occur, and even more so among indigenous farmers who have never been subjected to a commercial system. Despite failing agrarian initiatives based primarily on commercialising agriculture among rural black farmers, the government continues to initiate such projects.

In this chapter, I discussed the significance of agrarian policies that have contributed to the evolution of agriculture in the country. I highlighted the form of governance, the partnership between the ruling party and economic oligarchy and how this partnership influences post-apartheid South Africa and agrarian reforms. I explained how the switch from Afrikaner nationalism to African nationalism means little to rural small-scale farmers who remain destitute and oppressed. I drew on arguments by Césaire and Foucault to explain why reforms in post-apartheid South Africa have been dominated by apartheid-era policy and Eurocentric solutions that exclude local knowledge systems. I have argued that instead of dismantling old structures, the

ruling elite has assimilated them. The leadership might have changed, but the masses remain destitute. The ‘Ariels’of the political vanguard have been psychologically shaped by their oppressor so much that they too rule with oppressive tendencies.

CHAPTER 4

The use of ethnographic data and remote sensing in the rural agricultural landscape

Chapter one considered the consequences of introducing GM technology to rural agricultural landscapes and recommended that technology not replace or interfere with existing local knowledge systems and practices. In response to the need for viable solutions that can support small-scale rural farmers without infringing on their rights, this chapter explores the possibility of using the normalised difference vegetation index (NDVI) and ethnographic data to assess agricultural fields. Apart from breaking epistemic borders, the use of triangulation method in this manner helps to verify the information provided by the farmers through NDVI or the other way around. Methodological triangulation also helps this study to avoid bias in research (Oppermann, 2000).

The chapter draws on the intersection of humanities and technology and uses NDVI to corroborate the history of the fields with farmers' accounts. Using human narratives and technology to corroborate those narratives is crucial to addressing societal issues. As I conducted research on knowledge diversity, I was at pains to follow anthropologist Lesley Green's (2013) advice to exhibit "a determination to resist the dualism of 'science' v 'the indigenous', and a commitment to a style of translation – and intellectual diplomacy – that can facilitate debate on matters epistemic and ontological." A study of this nature requires the researcher to avoid polemic while addressing the matter at hand.

Interdisciplinary scholarship: Ethnographic data and remote sensing

There are benefits to combining scientific rigour and the everyday practices or realities of locals or indigenous communities (Briggs, 2013). The mixed data-collection method in this study is complementary in that the remote sensing data track changes in the fields, while farmers offer insight into the history of field management and soil practices that may have precipitated changes. Kolawole (2013) argues that a collaboration between science and farming practices is crucial to boost agriculture and soil fertility. Using mixed methods or knowledge systems to address problems has proven successful (Li et. al., 2012). The importance of integrating ethnography and satellite imagery or remote sensing has been highlighted by Jiang (2003), who carried out a mixed

method study in Mongolia and argues that remote sensing techniques complement human perceptions relating to the landscape. Guyer and Lambin (1993) conducted similar research in Nigeria and suggest that combining methods helped provided comprehensive insights that would not have been possible using either method alone.

How the NDVI is assessed

The NDVI assesses vegetation health on the basis of how plants or crops reflect energy and light (West et. al, 2017; Kraetzig, 2020), and Pettorelli (2013) proposes that the NDVI has the potential to assess the soil properties of large agricultural fields. The parameters used to monitor agricultural crops include leaf index, plant density and plant biomass (Voronina and Mamash, 2014).
The NDVI is calculated using the mathematical formula NDVI = (NIR – Red)/

(NIR + Red)

where NIR and Red are the normalised reflectance values of the near-infrared and red bands, respectively.

The calculations convert satellite data into vegetation indices (Kraetzig, 2020). Healthy plants have a considerable amount of chlorophyll, and cell structure will absorb red light and reflect near-infrared light (NIR); unhealthy plants do the opposite (Kraetzig, 2020). NDVI indices range from -1 to 1, with the common range for green, healthy vegetation being 0.4 to 1 (Muavhi, 2021) (see Image 13). The amount of chlorophyll present in a plant is affected by sunlight and rainfall, so temperature and rainfall variability can affect vegetation productivity and NDVI values.

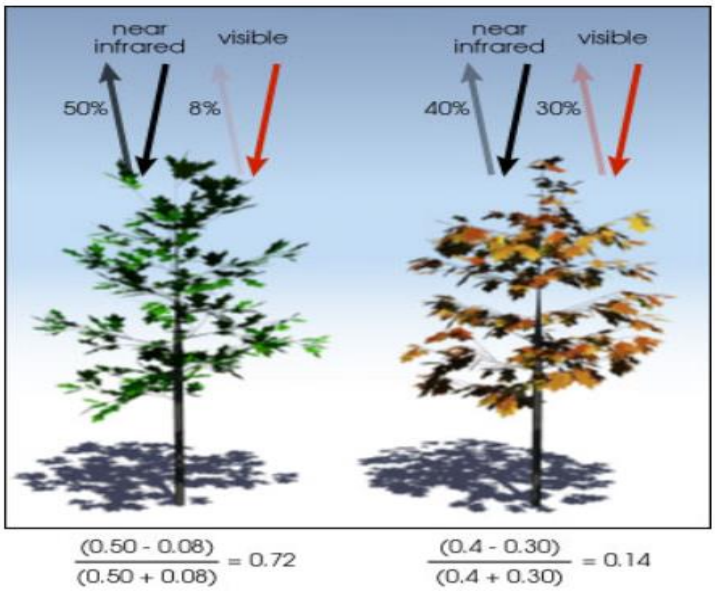


Image 13: The difference between healthy and unhealthy vegetation (Earth Observatory, 2000).

In this chapter, the NDVI was used to determine and map vegetation for the years 2000, 2004, 2008, 2012, 2016 and 2020. Local farmers started using GM technology (pesticides, fertilisers and GM seeds) in the early 2000s, around the same time that changes in weather patterns, especially drought in the Eastern Cape, began to affect agricultural production.

The NDVI can help determine the health of vegetation, which is impacted by various factors, including water stress, nutrition deficiency and disease (Mahajan, 2016). Canada, Spain, Kenya and Swaziland use the NDVI to monitor crops (Sultana et al., 2014). The NDVI can be incorporated into rural farmers' existing agricultural practices to continually monitor crop performance. Sultana et al. (2014) reported positive results when monitoring how NDVI responded to the yield behaviour of wheat cultivars and nitrogen fertilisation.

Soil and vegetation have a symbiotic relationship. Dr Maria Gobo (not real name), a senior lecturer in the Department of Architecture, Planning and Geomatics at the University of Cape Town, says that "Soil health affects the health of the vegetation, so soil is a very strong factor in this regard." Fertile soil provides plants with nutrients necessary to grow and serves as a water holder to anchor plants' roots (Food and Agriculture Organisation of the United Nations, 2015). Climatic conditions and soil properties thus play a major role in the soil conditions necessary for vegetation health and productivity.

Image 14 shows dead, unhealthy, moderately healthy and very healthy plants, where -1 to 0 indicates a dead plant (or rocks or even a house). The NDVI value of living plants ranges from 0 to 1 (Kraetzig, 2020).

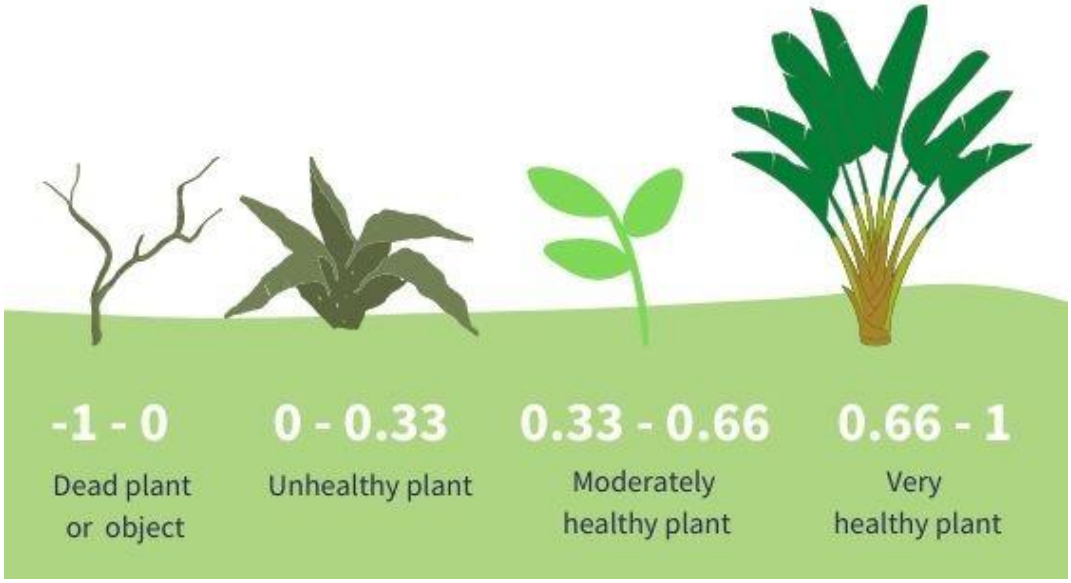


Image 14: Different vegetation states (Kraetzig, 2020).

As noted in multiple studies, however, the NDVI on its own has limitations. Pettorelli (2013) cautions that the NDVI is not always the best method for analysing plant characteristics such as pigmentation concentration, nitrogen content and water content, though some success has been reported. In a study in Senegal, Herrmann and Tappan (2013) observed that greening an area did not necessarily translate to improvement. In fact, it led to a reduction in trees, woody species richness and a switch to arid-tolerant species. Despite its shortcomings, the NDVI remains one of the most popular remote-sensing tools for monitoring vegetation (Nowak, 2020), and many

researchers still find the NDVI a useful proxy for monitoring crop health (Purkis and Klemas, 2011).

Description of method and analysis of the NDVI from 2000 to 2020

The calculation of the NDVI for the assigned study areas was carried out based on Landsat 7 enhanced thematic mapper and Landsat 8 operational land imager satellite images, with a January time frame. These satellite data have a spatial resolution of 30 m, 8 spectral channels: three in the visible and the invisible spectrum. Primary pre-processing was carried out on cloudless satellite scenes of the study areas for January for the years 2000, 2004, 2008, 2012, 2016 and 2020. The calibration was performed channel by channel using the calibration coefficients presented in the corresponding sets of image metadata. All calculations were performed using the ArcGIS NDVI calculator:

$$NDVI=(Band\ 4-Band\ 3)(Band\ 4+Band\ 3)NDVI=Band\ 4-Band\ 3Band\ 4+Band\ 3$$

The NDVI was calculated using data on two bands – 3 and 4 for Landsat 7, and 4 and 5 for Landsat 8 – where the measurements of the band are within the visible and infrared sections of the spectrum (Pisman et al., 2020). The values generated from the calculation vary depending on the density (closeness) of the plant canopy and the plants' chlorophyll saturation, but the standard values range from 1 (healthy vegetation) to -1 (dead vegetation). The more chlorophyll is accumulated in the plant and the denser the biomass, the more saturated green reflects the vegetation cover, which is fixed using remote sensing data. When there is no vegetation cover, the NDVI index values are minimal. The index increases at the beginning of the growing season and is at its highest in summer. In addition, the vegetation index has a special periodicity (Kataev et al., 2011). The years 2000, 2004, 2008, 2012, 2016 and 2020 were chosen to compare vegetation performance before and after farmers adopted GM technology, to track changes over time and to assess the vegetation growth of farmers who did not adopt GM technology. This information will be shared with participating farmers and the local Department of Agriculture to encourage discussion about how farmers can improve crop production with sustainable technology.

Selection of study areas

The nine areas chosen for this study are all in the former Ciskei homeland, which is now part of the Eastern Cape. The closest cities and towns to these villages are East London, King William's Town, Berlin and Middledrift. Situated in the transition zone between winter and summer rainfall and typified by strong topographic, soil moisture and vegetation gradients, the Eastern Cape is an interesting province in which to calculate the NDVI (Mahlalela et al., 2020). Soil moisture and drought are important factors in determining NDVI values. Multi-year droughts were reported in the province in the late 1970s to 2017, and in 2019 the province was declared a drought disaster area (Mahlalela et al., 2020). Small-scale farmers plan their crops from October to March, between rainfall seasons (Roffe and Fitchett, 2020).

Roffe and Fitchett (2020) analysed rainfall statistics in the Eastern Cape and observed seasonality change, with the wet season starting late on some occasions. They recommend that different stakeholders – including farmers, climatologists and water managers – should closely monitor rainfall in the coming years, as these changes will result in farmers having to decide early when to plant crops. Without proper planning, rural farmers face a bleak future, and these changes make clear the importance of including farmers in policymaking discussions to find solutions. This is another example of how technology such as remote sensing can help farmers monitor their crops and avoid losses. Muavhi (2021) conducted a study in Venda and found that the NDVI approach can be used in any region, because it is simple, quick and effective.

Beyond their willingness to participate in this project, the farmers and their fields in these villages were: small-scale farmers in the rural Eastern Cape (former homelands) who were part of the state-funded and GM technology-driven initiatives at the time of this project; small-scale farmers still practicing indigenous farming methods; or small-scale farmers who had previously joined state-funded programmes that used GM technology or any other modern agricultural technology. The NDVI results of these different groups will lead to further engagements and discussions on how to address the changing climate, increase crop production and improve soil management practices in the former homelands.

Table 5: Location of participating villages

Municipality	Village name	Centre coordinates of research farmlands
Berlin, Buffalo City Metropolitan Municipality	KwaNtuku	Latitude -32,907222 Longitude 27,622306
Great Kei Local Municipality	Mooiplaas	Latitude -32,72175 Longitude 28,056611
King William's Town, Buffalo City Metropolitan Municipality	Peelton	Latitude -32,808667 Longitude 27,467194
Great Kei Local Municipality	Kwelerha	Latitude -32,780083 Longitude 27,937556
Buffalo City Metropolitan Municipality	Ncera	Latitude -33,053694 Longitude 27,578111
Newlands, Buffalo City Metropolitan Municipality	Kwetyana	Latitude -32,847444 Longitude 27,808389
Newlands, Buffalo City Metropolitan Municipality	KwaMpundu (also known as Xarhuni)	Latitude -32,888387 Longitude 27,746061
Newlands, Buffalo City Metropolitan Municipality	Nqonqweni	Latitude -32,879194 Longitude 27,722667
Amathole District Municipality	Mxumbu	Latitude -32,863333 Longitude 27,062583

The rationale behind choosing the rural Eastern Cape

The selection of the participating areas and the use of the NDVI were driven by the changes in the agricultural landscape brought about by policy changes in post-apartheid South Africa. What happens when soils in these landscapes are exposed to chemical pesticides and synthetic fertilisers? Which technology can best track changes over time? What can be done to advance agriculture in a manner that involves farmers and other important stakeholders?

In the previous chapters, farmers emphasised that they chase pests away instead of killing them. This is a multispecies approach in which humans and nonhumans live in harmony, where every being under the sun is important and humans are not masters who decide what should live or die. TMany studies warn of the danger of pesticides such as Roundup, Lambda and Polytrin – all of which are currently used by farmers in the Eastern Cape. Lambda stays in the environment longer, and its residue has been found in groundwater (Premalatha and Rose Miranda, 2019), while Roundup residues are often found in humans, soil, water and even air (Novotny, 2022).

Image 15: Some of the chemical pesticides used by farmers in the Eastern Cape.

Image 16: Left: A farmer in Xarhuni standing next to a half-used Roundup container. Right: Farmers apply synthetic fertiliser in Kwamzongeshe.

Bai and Ogbourne (2016) discovered that earthworms, critical bioindicators of soil health, are reduced when glyphosate, a main ingredient in Roundup, is applied to soils. Glyphosate has also been linked to a reduction in the growth and activity of free living nitrogen-fixing bacteria in soil (Santos and Flores, 1995). Azmi et al (2006) found that those exposed to polytrin suffered from liver and kidney dysfunctions and found traces of polytrin residue in blood samples of farmers who used the pesticide. In a damning research paper entitled *Glyphosate, Roundup and the failures of regulatory assessment*, Eva Novotny (2022) declared an urgent need for regulation reform of glyphosate-based herbicides such as Roundup in the EU and US. While Roundup remains the most-used agricultural pesticide, regulators often focus on its main ingredient, glyphosate, and ignore more dangerous and toxic other formulants. In fact, Austria has banned Roundup, and Germany and France have announced plans to phase it out (The Guardian, 2019). In August 2018,

a court found that Monsanto (now Bayer) was responsible for the cancer of Dewayne Johnson, a 46-year-old former groundskeeper, and that the corporation had failed to provide adequate warning of the health hazards associated with exposure to glyphosate (Levin and Greenfield, 2018).

In South Africa, organisations such as the African Centre for Biodiversity (ACB) are fighting to have Roundup and other dangerous pesticides banned. When I interviewed ACB director Mariam Mayet, she said big corporations have turned African countries into a dumping zone for dangerous chemicals.

> "There is a campaign that started in the Eastern Cape… an anti-pesticides campaign with citrus farmers. Maybe it's a good thing to ban glyphosate, but we can't run after one chemical – but we can highlight the issue that… there is a campaign to ban 57 or so chemicals that are used in South Africa but banned in the EU. They've probably got stockpiles of chemicals they can't dispose of anywhere. So we ask the question whether dumping all these GM seeds onto farmers in the Eastern Cape or in Africa is their way of getting rid of their stockpiles. Because they are contaminating our land, our bodies. We don't want this… We call it neocolonialism extractivism, because we become the sacrifice zone, and the North is a sacred zone."

ACB is not the only organisation standing up for small-scale farmers' rights in rural areas. Zingisa, based in Berlin, Eastern Cape, also believes that rural farmers are exposed to danger when switching to GM technology. Nelson, an extension officer who works for the NGO and promotes agro-ecological agriculture in rural South Africa, thinks the government is taking advantage of farmers because they do not know about the downside of modern agricultural technologies such as GMOs:

> "Conventional methods destroy soil until it is useless. We look at the adverse effects of global warming and climate change that are perpetuated by conventional agriculture, use of chemical inputs, including agro-fertilisers, pesticides, herbicides – some of which remain in the soil for a long time and can also be taken up into a person's bloodstream."

Under the guidance of local Department of Agriculture extension officers, farmers specialise in GM maize and use Roundup-ready seeds, synthetic fertilisers and other chemicals. I asked

Nompilo, an extension officer, if she had alerted farmers to the dangers of pesticides and the controversy around Roundup. She admitted that Roundup is dangerous and controversial but defended its use among rural farmers:

"I believe that if a person uses a chemical correctly, it works well. You cannot be operating 100 hectares and expect to manually control weeds. You will be bound to use a herbicide like Roundup. We do inform them about the dangers of chemicals, and therefore they know."

Farmers in Peelton and Ncera were the only farmers to tell me they knew about the dangers of pesticides, but they did not know how they were dangerous. This could have a lasting impact on farmer health, vegetation (and crop production), soil and the overall environment.

Ethnographic data and NDVI results

Kwampundu

In Kwampundu, located in Newlands (also known as Xarhuni), Nontobeko is among many farmers who adopted GM technology in the early 2000s. She has been a farmer all her life and, despite being in her 70s, is still active and passionate about agriculture. Her sitting room walls are decorated with trophies she has won at agricultural shows and competitions. She joined most of the state-funded initiatives introduced in her village.

"It's been way over 20 years since I became a farmer. Our group's name is Lingelethu. But our initial name was Ilisolomama, back when we were part of Massive. The government no longer gives us money. It's been a long time since we got money from the government. Before Massive, I was farming on my own." – Nontobeko

"Mna 20 years idlulileyo ukusukela oko ndaba ngumlimi. Igama le-group yethu lalingu Lingelethu. Saqala sizibiza Ilisolomama si-join eMassive. Urhulumente akasasiniki imali. Wagqibela kudala ukusinika imali. Ngaphambi ko Massive bendilima ndedwa." – Nontobeko

In recent years, Nontobeko has noticed changes in her soil. She thinks Roundup is to blame but cannot confirm it, because there is no money to hire a soil expert or to take the soil to the testing lab in East London, the nearest town. She explained with pain and uncertainty in her voice:

"My soil became depleted that time when we were planting paprika. Paprika came with chemical fertilisers and Roundup. We suspect the chemicals ruined the fields. Nothing grows any more."	*"Umhlaba wam wonakala ngelo xesha sasilima ipaprika. Ipaprika yeza nezichumisi zemichiza kunye neRoundup. Siyayikrokrela ukuba imichiza yonakalise amasimi. Akukho nto iphumayo."*

Nontobeko first took me to her fields at the far end of the village in 2019. She had divided the fields with a black hosepipe. A satellite image from 2008 shows patches of bare soil on one half of the fields, as per her account.

Image 17: Nontobeko's agricultural fields are in the marked area. The satellite image shows bare patches of soil on the upper part of the fields.

I visited the fields again in January 2021, and the situation had not changed. Nobody had taken responsibility, not even the officials who had given her the paprika and Roundup. Nontobeko told me that farmers used to have autonomy over their farming practices and could account for what went into their soils. Modern technology strips them of that power, and now they have no idea what chemicals are in their soils. The farmers are old and have limited modern education, so they do not understand what is happening. The biggest challenge around the risks of GM technology to biodiversity may be that there is no consensus on the criteria that define environmental harm (Waltz, 2009, cited in Sanvido et al., 2012).

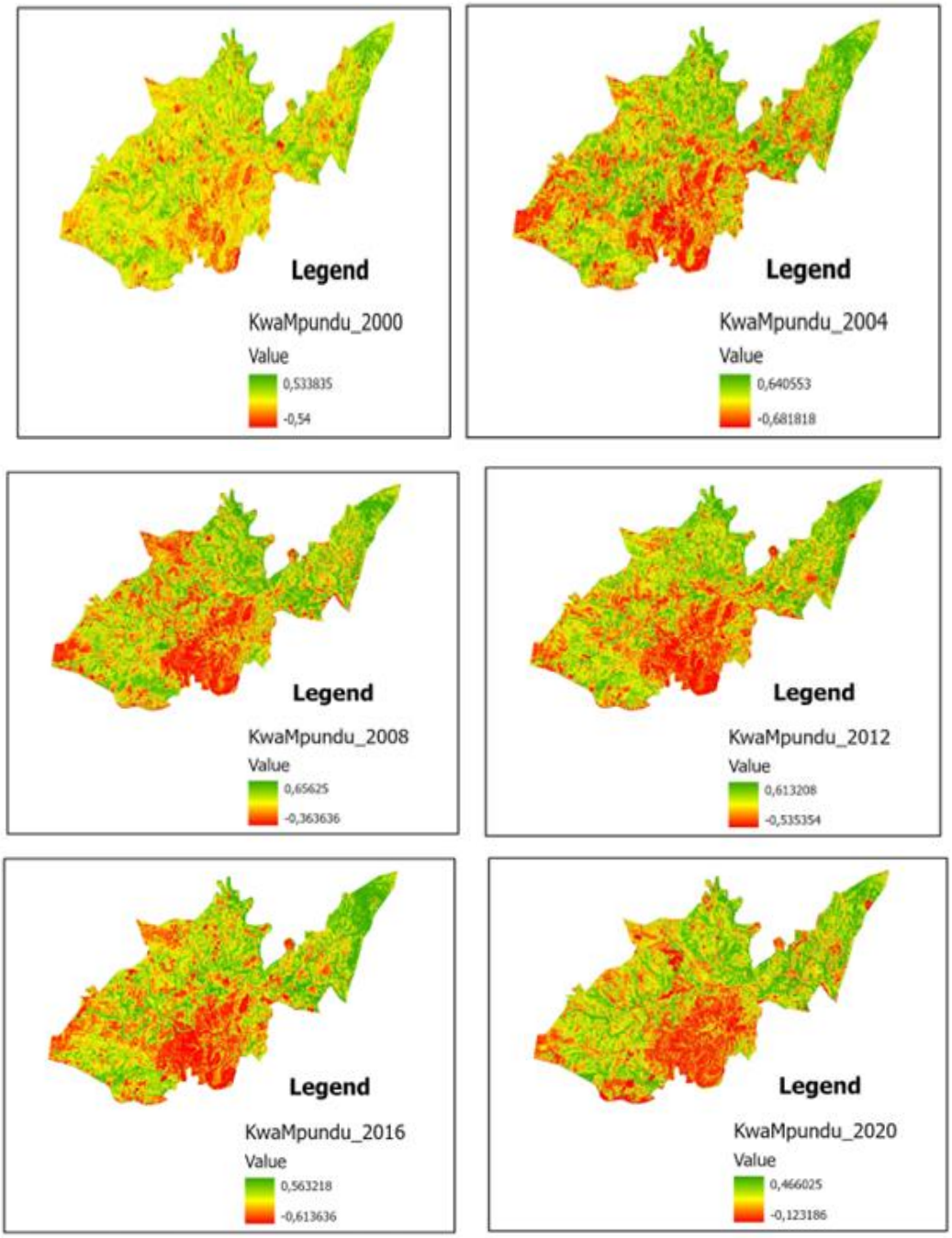
NDVI results

NDVI values range from -1 to +1, with values below 0.1 indicating bare ground and bodies of water, and values above 0.1 indicating photosynthetic activities linked to agriculture, forests and scrubland (Meneses-Tovar, 2011). The data for all the farmlands were taken in January for the years 2000, 2004, 2008, 2012, 2016 and 2020, when crops were starting to flower in the participating farmlands.

One of the maps below shows vegetation health in 2000, three years before Nontobeko started using synthetic fertilisers and Roundup. Each map shows two values (maximum and minimum) to reflect vegetation health. In 2000, the minimum value was -0.53. It went down to -0.68 in 2004, indicating declining vegetation health, perhaps, as Nontobeko explained, the result of poor soils. The value increased in 2008, as it did across all the other farmlands, but in 2012 the minimum value fell again. It fell further in 2016 but recovered in 2020, suggesting an increase in vegetation health.

In the maximum values, 2008 presented the highest value, as was true for other farmlands, while the lowest maximum value was returned in 2020.

Map 3: Kwampundu



The NDVI values and Chart 1 below complement the maps and their values. While the values in the maps are the maximum and minimum NDVI results for the given year, in the chart I calculated average values (using the maximum and minimum values) to avoid false optimism or excessive pessimism. In 2000, the average NDVI value was negative at -0.0030825, but in 2020 the value had increased to 0.1569505. In 2000, yellow was dominant, with some green and red showing. There is more green in 2020, which parallels the increase in the NDVI value for that year.

Chart 1: Kwampundu

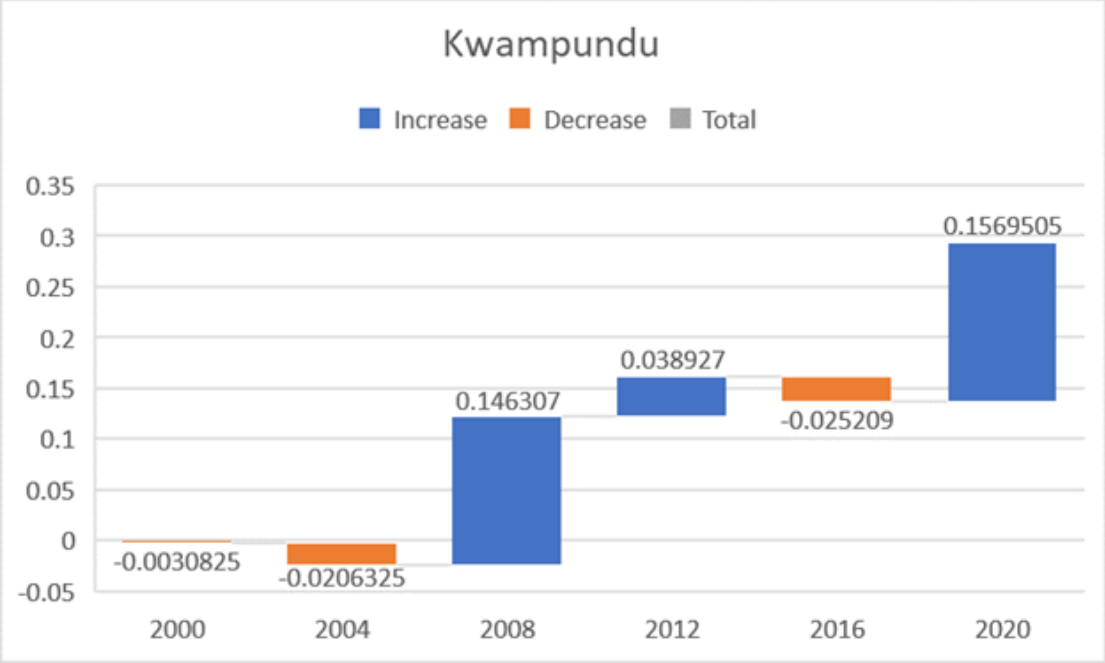


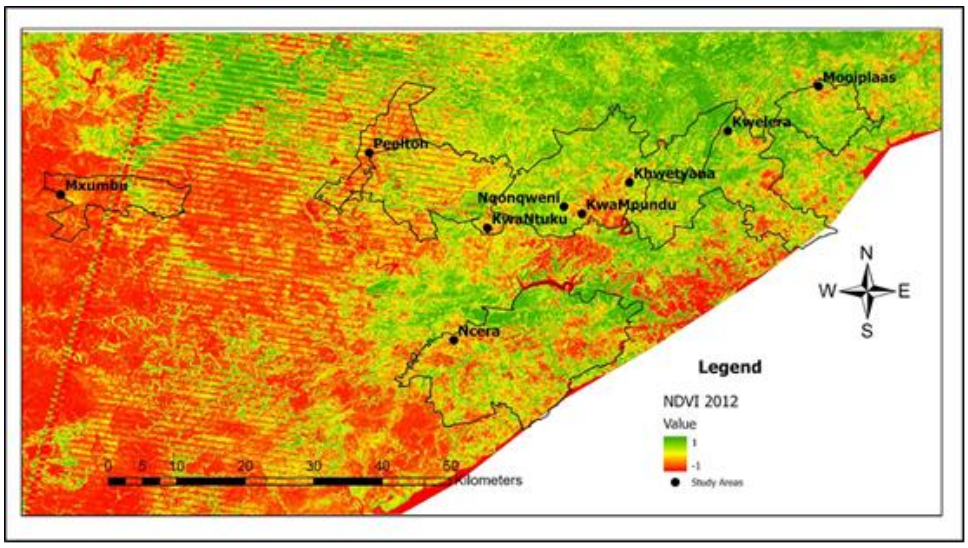
Chart 1: Inconsistent results in 2000, 2004, 2008, 2012, 2016 and 2020.

To compare the NDVI results for 2004, 2008, 2012, 2016 and 2020, I have presented maps for all the farmlands that were part of the study. Nontobeko's fields show inconsistent results: other factors must have negatively affected vegetation health in 2000, because she only started using chemicals in 2003. In 2004, the average NDVI value was still negative and low at -0.0206325. It

increased in 2008 and was still positive in 2012, but it dropped in 2016. It was at its highest in 2020. Nontobeko's fields have the lowest 2012 NDVI values relative to the values of her neighbours in Nqonqweni and Kwetyane (see Map 4 below). This rules out the possibility of a natural hazard such as droughts in the area at the time (which are frequent in the Eastern Cape). Kwampundu's NDVI results are not good, and the inconsistencies over the years support Nontobeko's observation of problems over this period.

Image 18: A photograph taken in March 2022 that shows weeds growing.

It is difficult to conclude whether Roundup or other chemicals (that came with GM technology) influenced the inconsistent trends of the NDVI values in Nontobeko's fields. I visited the fields in January 2019, when there should have been vegetative coverage, but I only saw bare soil. In January 2021 and March 2022, the fields seemed to be 'recovering' and were covered with weeds (Image 18), as suggested by the increase in the NDVI value in 2020.



Map 4: The participating fields. Kwampundu is dominated by yellow and red, compared to its neighbours, Kwetyana and Nqonqweni

Mooiplaas and Kwelerha: The rainbelt region

Located in the Great Kei Municipality, Mooiplas and Kwelerha were among the first villages earmarked for agricultural development after apartheid. An extension officer assigned to Mooiplaas explained to me that the area is part of the rainbelt region, where there are many productive farmlands. There was consistent summer rainfall and the picturesque farmlands were green when I first arrived in the village in 2019 (see Image 19), despite many areas in the Eastern Cape experiencing a prolonged and devastating drought at the time. An area with regular rainfall will have higher NDVI results than an area without.

Image 19: Agricultural fields covered in green, Mooiplaas.

Farmers in these two areas were part of the state-funded Massive Food Production Programme (MFPP). The MFPP has since ended and been replaced by the cropping project. Themba, a farmer, explains:

"I was the chairperson of Massive in this community. We specialised in maize only. Maybe the government ran out of funds. Massive started in 2006 here. For you to join, you needed 60 hectares of land. We were chosen because this area is part of the rain belt. We had a leader who allocated seeds to us. All we had to do was work in the fields, but we were given everything."

"Ndandingu-chairperson wayo. Besilima umbona kuphela. Inoba kwaphela imali kwi-site sikarhulumente. I-Massive yaqala ngo 2006. Kwi-massive babefuna 60 hectors ukuba ukhethwe. Sakhethwe ngenxa yokuba kuserain belt apha. Sasinenkokeli eyasinika imbewu ii-seeds. Besisenza yonke into ngokwethu emasimini kodwa sifumana yonke into ku rhulumente."

Image 20: Satellite image showing dark rich soils in Kwelerha.

In Kwelerha, where the soils are as rich as at Mooiplaas, the cropping project is popular among farmers. Some have formed a cooperative called Kwabasakhula. The farmers do not remember the exact year they joined the MFPP, but they think they were among the first participants in the Eastern Cape (the MFPP was introduced in 2003). They found the MFPP convenient, because they did not have to pay for it.

"With Massive, we didn't pay any money. They did everything for us. They had told us that after five years we should be able to stand on our own." – Dini	*"Ku-Massive besingakhuphi mali. Babesenzela yonke into. Babethi ukuthi after 5 years kufuneka sizimele ngokwethu."* – Dini

They took advantage of the state initiative that came to their village, but they did not know how it worked or its implications for the environment. Their first choice of fertiliser had always been *umgquba* (kraal manure), but they now use Roundup and urea (fertiliser). Urea fertiliser is a source of nitrogen but, like other industrial fertilisers, has been blamed for air pollution and poisoning groundwater (Yan et al., 2014).

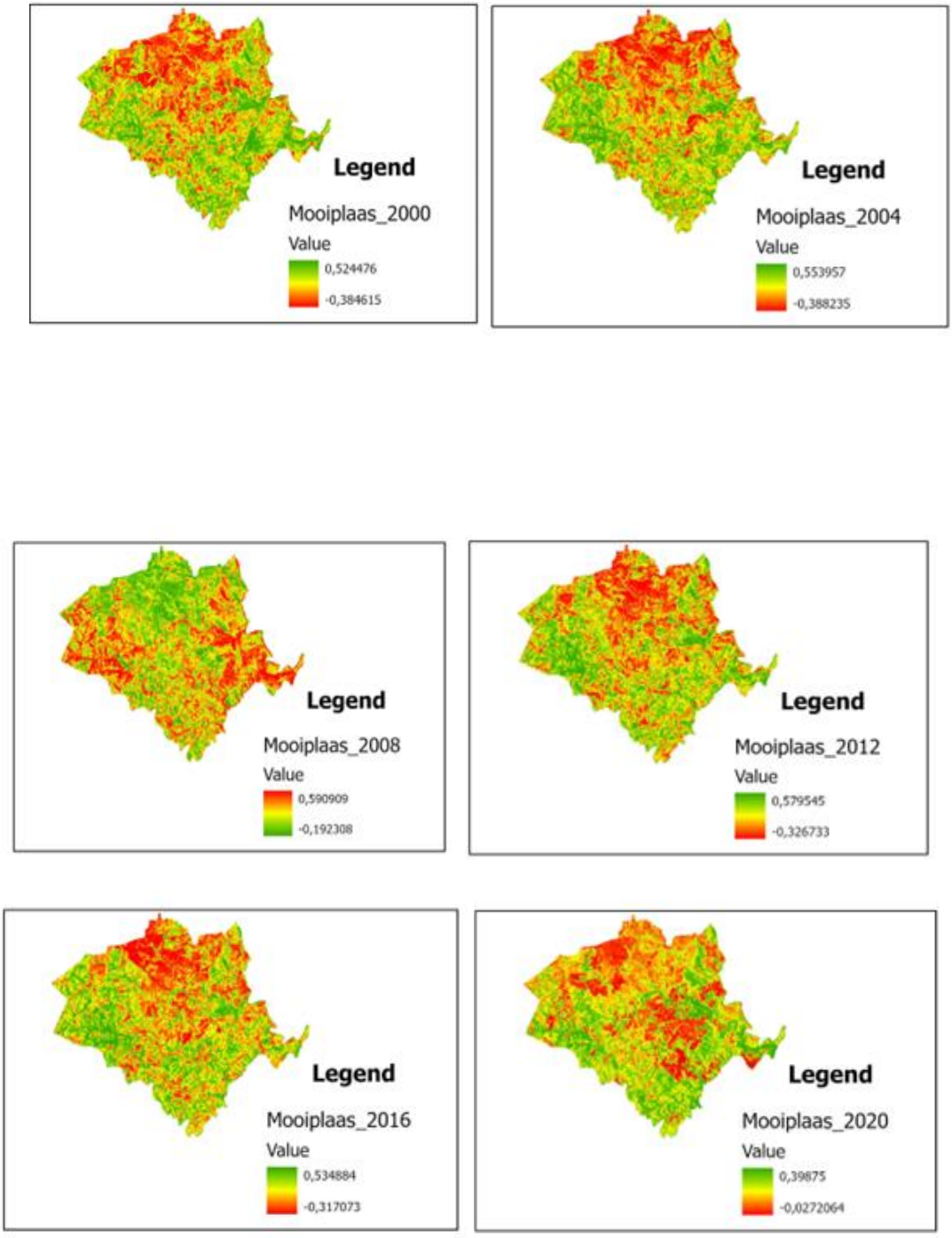
Farmers also said that their extension officers never explained to them what was going into their soils, and they did not ask questions because they were vulnerable and stranded. Important farming decisions and product choices were made by extension officers in both Kwelerha and Mooiplaas. Mthombeni, a Kwelerha-based farmer, explained that he did not join MFPP, because the government treats the farmers like children:

"I wasn't part of the Massive Food Production Programme because we were never addressed about it. Money was lost through Massive. People died complaining about the money that was lost through Massive."	*"Mna azange ndingenele i-Massive ngoba abakhange basi-address ukuba ihamba njani. Imali yalahleka kwi-Massive. Abantu basweleka bekhala ngemali ye-Massive*."

Farmers in these villages have started to question whether joining state-funded projects is worthwhile. They worry that in the long run, chemicals will deplete their soils and reduce crop production. Farmers in Kwelerha recently noticed many earthworms, which they regard as important bioindicators of good soils, migrating after they sprayed Roundup. The use of pesticides in agriculture affects soil biodiversity and exposes non-target soil organisms such as earthworms to toxic chemicals (Miglani & Bisht, 2019; Pelosi et al., 2014).

NDVI results

Map 5: Mooiplaas

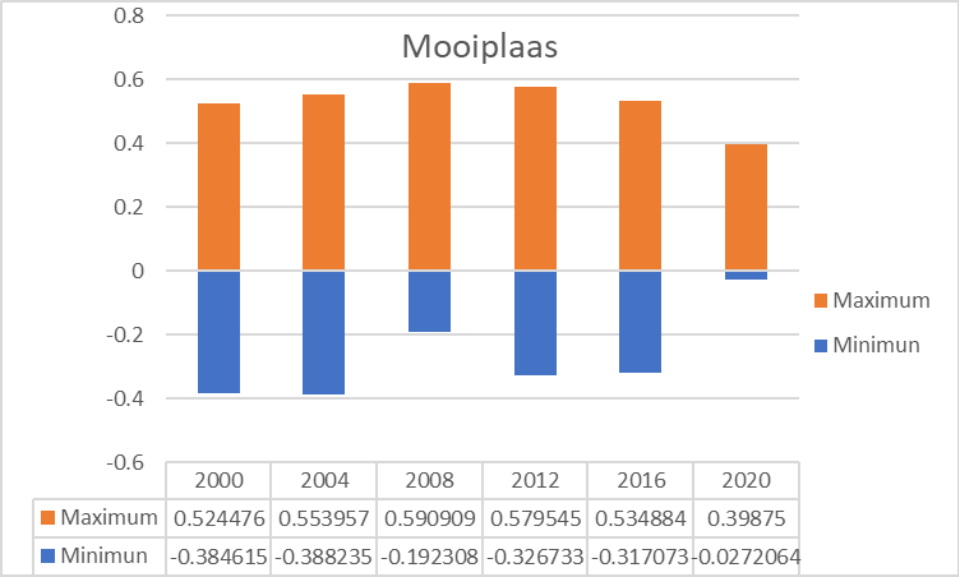


Mooiplaas in 2000 and 2020.

The minimum values of 2000 and 2004 are closest, reflected in the low vegetation health. Farmers said they joined MFPP in 2006, so fertiliser use may explain the high NDVI value in 2008, but all the areas except Mxumbu experienced a surge in 2008. The highest maximum value was in 2008, at 0.59, and the lowest was in 2000, at 0.52.

The NDVI value in Mooiplaas dropped in 2020, but was the highest relative to other areas. In 2012 and 2016 (see Chart 2 below for mean values), the values were low.

Chart 2: Mooiplaas



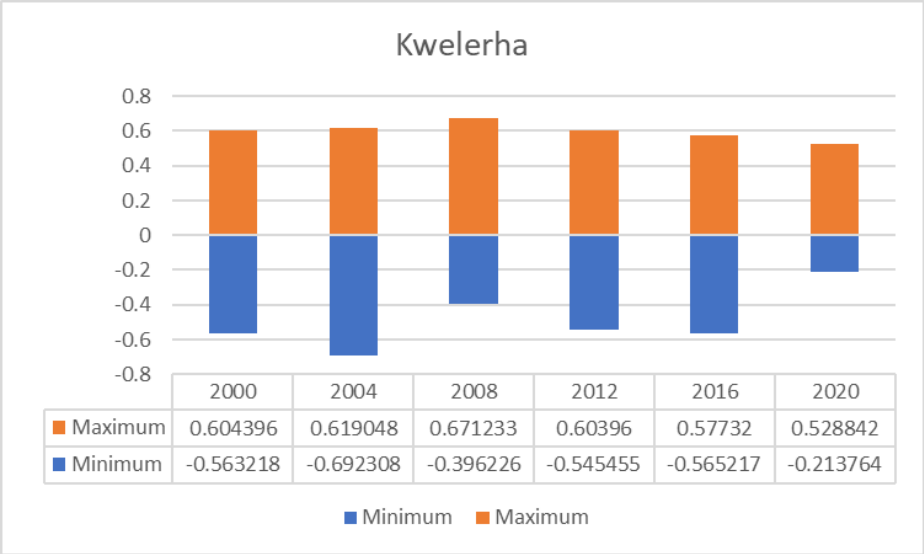
	2000	2004	2008	2012	2016	2020
Maximum	0.524476	0.553957	0.590909	0.579545	0.534884	0.39875
Minimun	-0.384615	-0.388235	-0.192308	-0.326733	-0.317073	-0.0272064

Mooiplaas NDVI values.

Map 6: Kwelehra

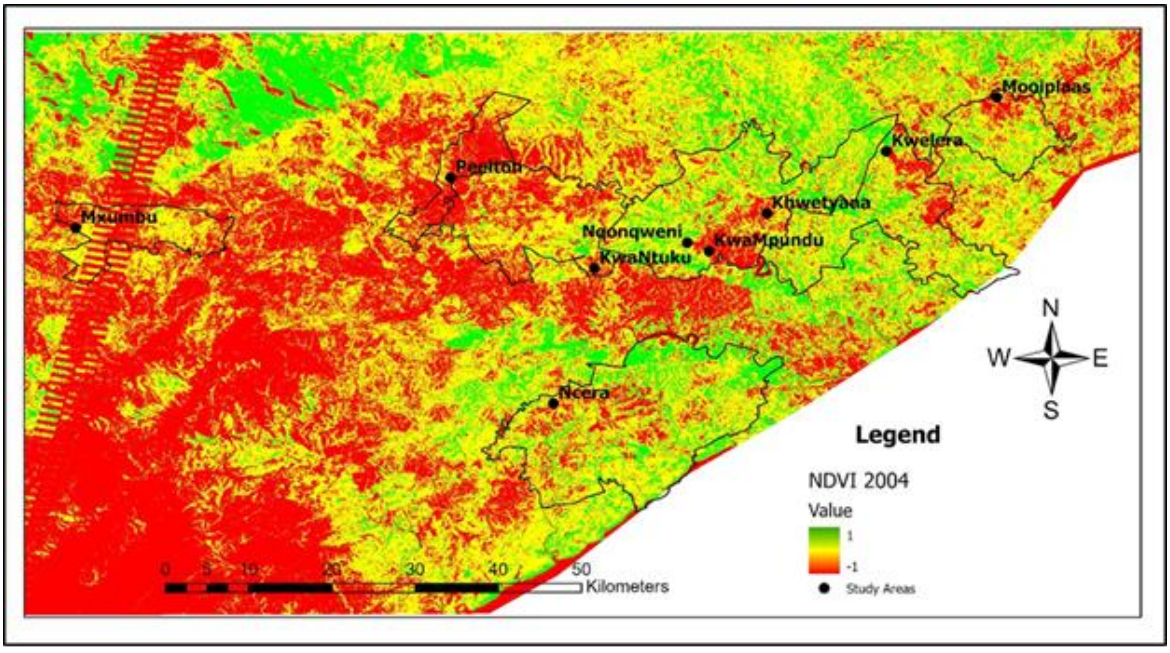
Kwelerha had lower minimum values than its neighbour, Mooiplaas. In 2004, the minimum value was quite low at -0.69, while it was 0.38 in Mooiplaas in the same year. However, Kwelerha's maximum results are higher than its neighbour (see Map 6). The lowest mean average NDVI values (see Chart 3) in 2004 in Kwelerha, Mxumbu and Kwampundu were -0.03663, -0.029921 and -0.020633, respectively.

Chart 3: Kwelerha



	2000	2004	2008	2012	2016	2020
Maximum	0.604396	0.619048	0.671233	0.60396	0.57732	0.528842
Minimum	-0.563218	-0.692308	-0.396226	-0.545455	-0.565217	-0.213764

In Map 7 below, there is red in the west, south-west, north-east and scattered around the centre of the map. The yellow regions on the map, representing bare soil with little or no vegetation cover, are scattered in the centre, south, north and east of the map. The green sections of the map are in some sections of the north, east, south-west and south of the map. In 2004, healthy vegetation was mostly scattered around the northern, eastern and southern parts of the map, while the rest was either bare soil or dead vegetation.



Map 7: All the other fields.

Given their rich soils and constant rains, the NDVI performance of Mooiplaas and Kwelerha is low. In comparison to Mooiplaas, Kwelerha's values are low.

Kwetyane and Nqonqweni: Non-conformers

In Nqonqweni and Kwetyane, both located in Newlands, farmers retained their indigenous farming practices.

"We are still using the old methods, we protect the land using manure, but not excessively though, because our land is rich." – Mkhonza	"*Sisasebenzisa indebe endala, umhlaba siwugcina ngomgquba, kodwa nawo not kakhulu kuba umhlaba wethu utyebile.* " – Mkhonza

In Nqonweni, the elders, in their 60s and 70s, teach the younger generation how to preserve old farming traditions, while the youngsters contribute energy and dedication. Their soil is rich and their only complaints were about bad weather and the lack of state support. Overall, they are successful farmers.

"We don't want GMOs. We have never used them before. We have always been organic farmers." – Mzi	*"Thina asiwafuni ama-GMOs, azange sawasebenzisa ukuqala kwethu uku-farmer saqala nge organic so asisawafuni ama GMOs.*" – Mzi

Mzi, one of the younger farmers (in his late 20s), told me they are not funded by the government, but they hope this will change. They believe the lack of support is because the state only throws its weight behind modern agricultural practices, not indigenous ones.

Drought is a problem in these areas. The weather was harshly dry between January and April 2019, and farming activities were on hold in the village. Farmers in Kwetyana went to the mountains to pray for rainfall (an old rainmaking ritual).

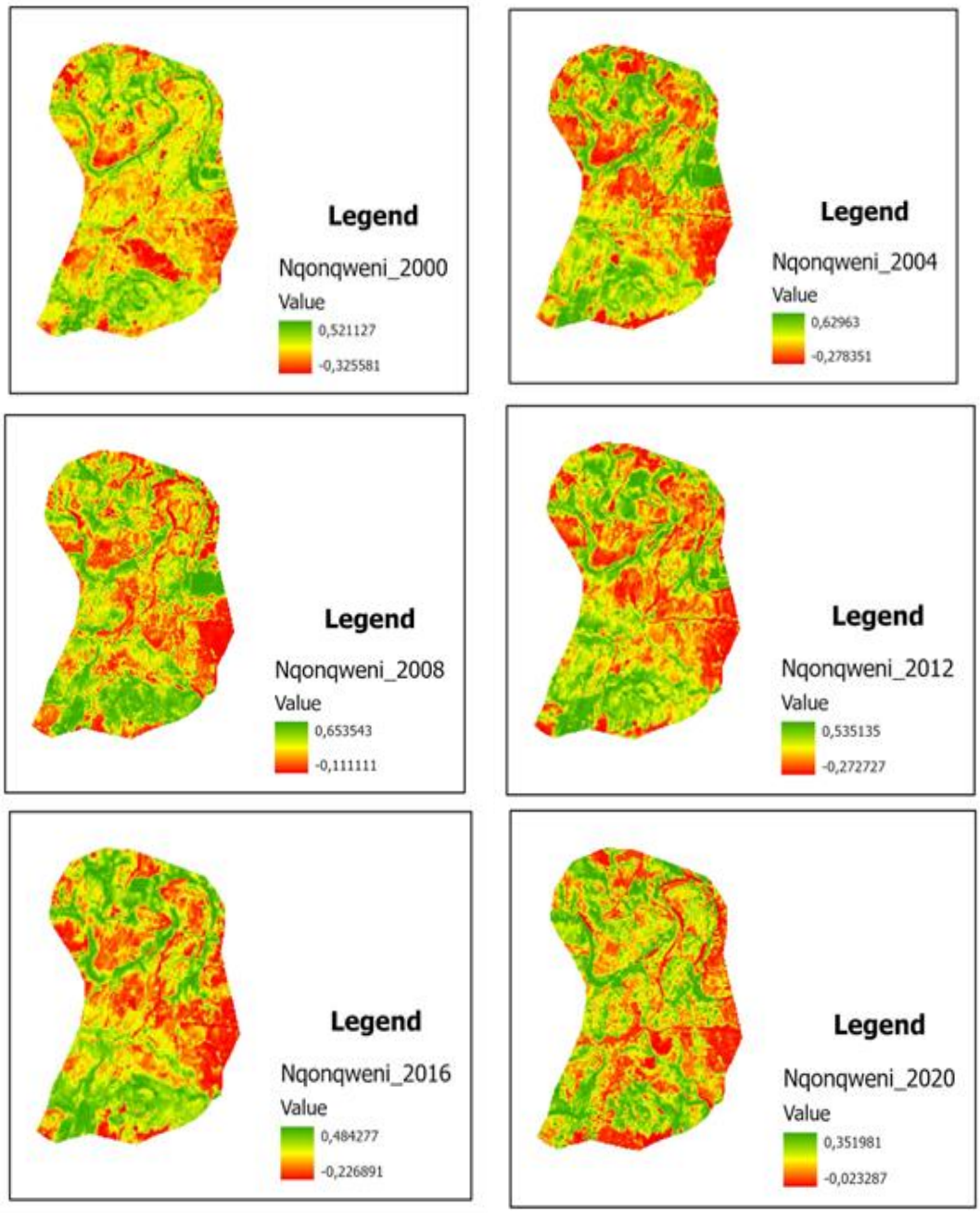
"We don't use chemical fertilisers. I use compost instead – whether it's made from chicken waste or cow dung. I know how to make my own mixture of compost by making sure that, for example, the cow dung is preserved until very dry and then mixed with tree leaves and grass. I use old traditional methods of farming." – Nomsa	*"Asisebenzise fertiliser siyazilimela sisebenzisa umgquba kangukuba nalo wenkuku siyawusebenzise nalowenkomo. Siyakwazi nokuzenzela umgquba sifumbe langca yome, siyixube, amaqabi siyawalahla pha kulangca yonke into esicocayo apha egadini siyifumbe iyahlala lanto ibole ibe ngumgquba. Sisasebenza indlela yokulima yakudala asisebenzisi fertiliser."* – Nomsa

These farmers were proud that despite peer pressure, they had never joined the MFPP or cropping project. They recycle seeds, use manure and make their own pesticides from wild plants. They said that this method is more cost effective than the GM technology.

Farmers in these two villages were eager to improve crop production but not at the expense of their indigenous practices. They were aware that climate change affects agriculture and were open to solutions to improve crop production. It is important to educate rural farmers about different technologies that can help them to boost production, such as the NDVI.

NDVI results

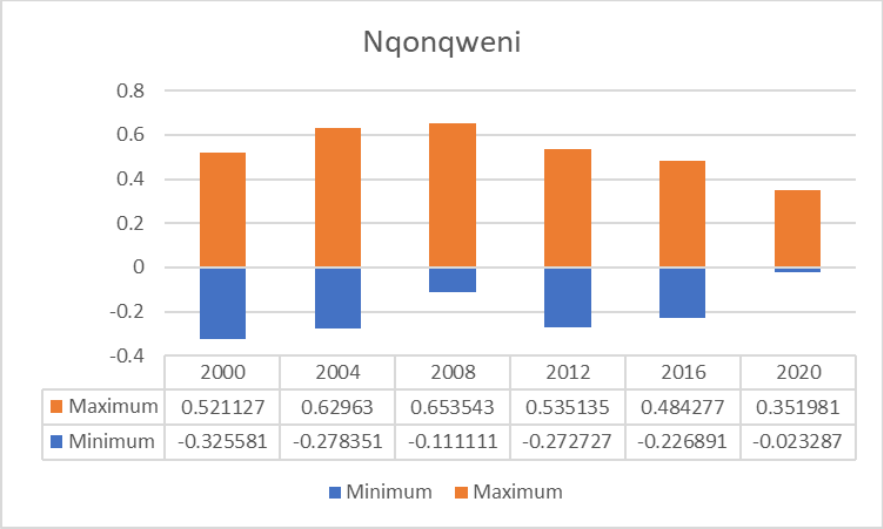
Map 8: Nqonqweni



Despite not using chemical fertilisers or pesticides, Nqonqweni outperformed all the other participating villages. Minimum values do not exceed 0.3 in Nqonqweni, reflected in their healthier vegetation. The maximum values ranged from average to high, at 0.63.

Kwetyana was not far behind (see Chart 4 below). The average NDVI value was lowest in 2000, at 0.097773, corroborated by Map 8 above, which is dominated by yellow and red. Some green is also visible, showing a bit of crop health. In 2000, 2004, 2008, 2012 and 2016, Nqonqweni outperformed all the other participating areas. Only in 2020 did Mooiplaas have the highest NDVI value.

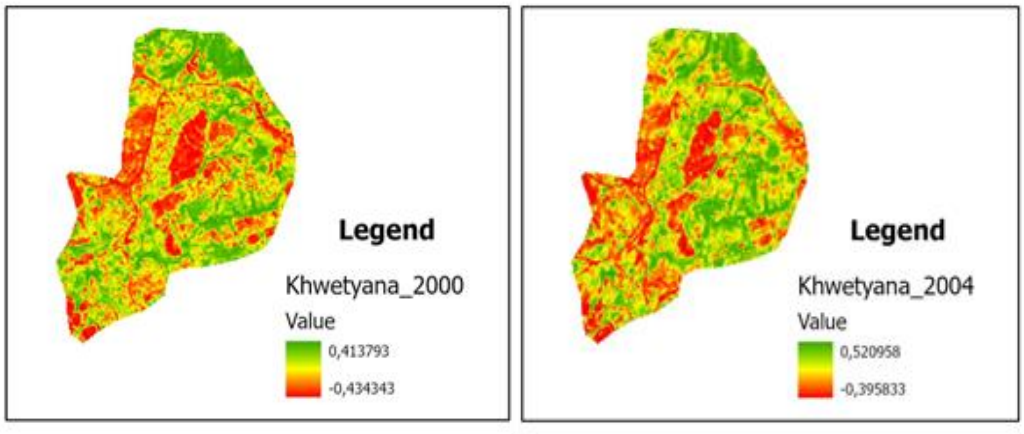
Chart 4: Nqonqweni

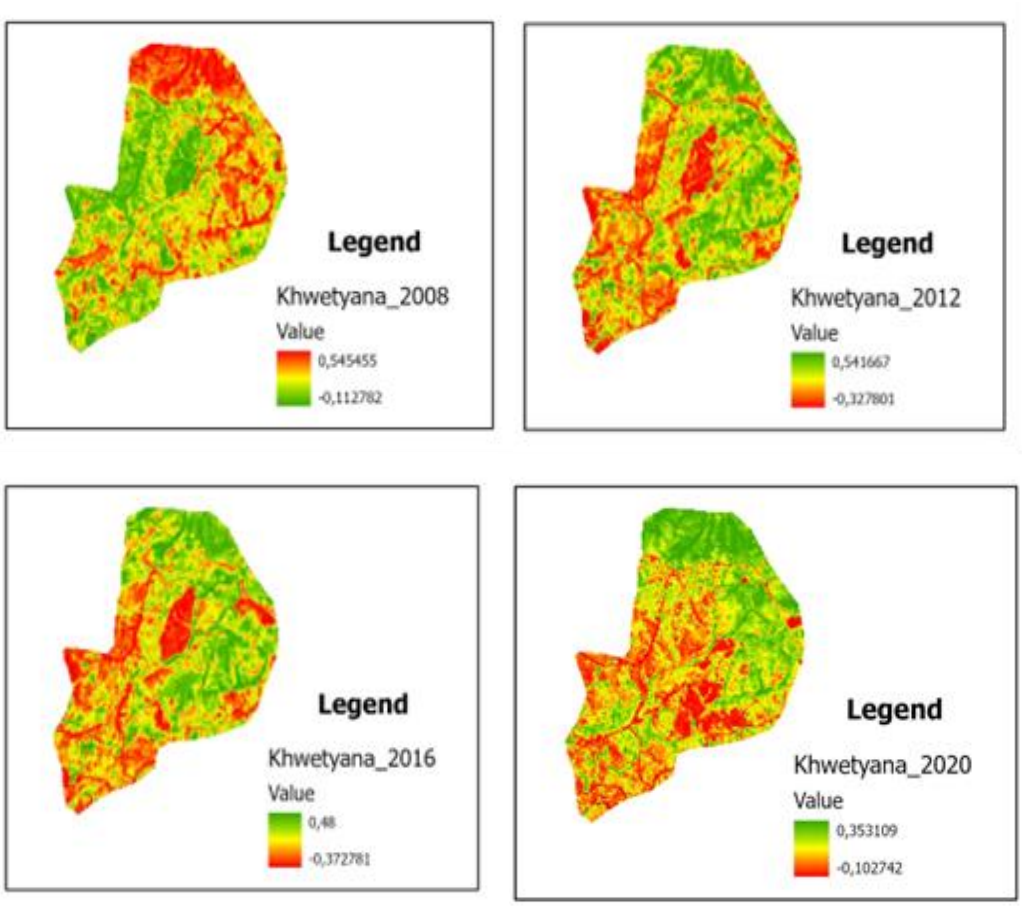


	2000	2004	2008	2012	2016	2020
Maximum	0.521127	0.62963	0.653543	0.535135	0.484277	0.351981
Minimum	-0.325581	-0.278351	-0.111111	-0.272727	-0.226891	-0.023287

Chart 4 above shows Nqonqweni's NDVI values from 2000 to 2020, which are fairly consistent except for a peak in 2008. Nqonqweni had no negative NDVI values.

Map 9: Kwetyana

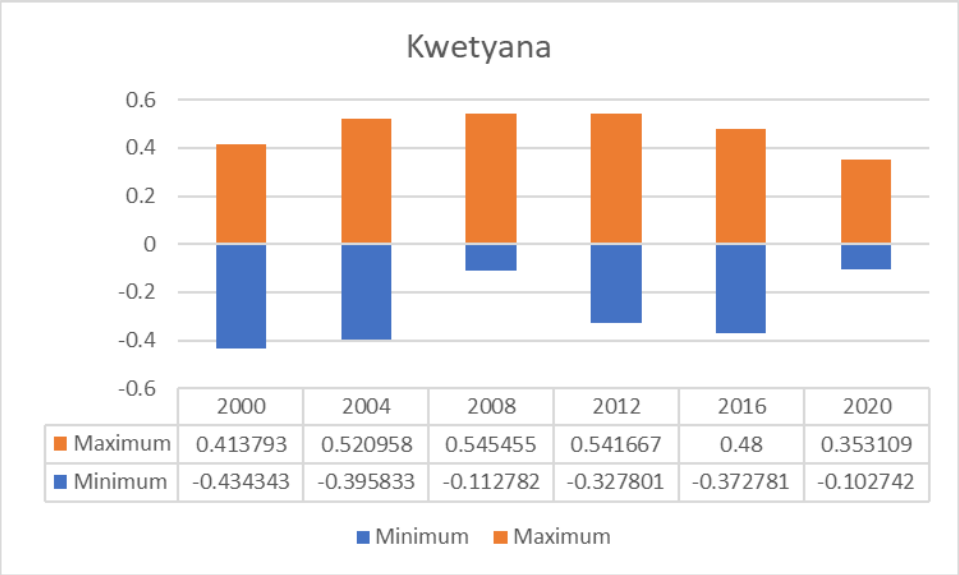




Kwetyane's minimum results differ slightly from Nqonqweni's, although they neither used chemicals. The minimum values do not exceed 0.43, which is still better than other farmlands, and Kwetyana ranks high for farmland that does not use synthetic fertilisers. The lowest maximum value was in 2020 at 0.35. Kwetyana has only one negative average NDVI value, in 2000 (see Chart 5), which is consistent with the dominant red and yellow on the map. Like Nqonweni, the highest NDVI value was in 2008. The 2020 NDVI value of 0.125184 is consistent with Map 9, with the red and yellow reflecting the low NDVI value that year. Kwetyana was the second worst performer in 2020 (Mxumbu was the worst at 0.124889). Overall, Kwetyana ranks high relative to Kwelerha, Mxumbu, Kwampundu and Ncera.

Chart 5: Kwetyana

KwaNtuku: The forgotten village



"They took our soil to the lab and told us it was depleted beyond repair." - Aphiwe, KwaNtuku

"Bathatha umhlaba wethu bawusa e lab bathi awusoze ulunge" – Aphiwe, KwaNtuku, Berlin

Berlin is a small town between East London and King William's Town. It was founded in the mid-1800s by members of the British German Legion, who named the land they were allocated after German cities (e.g. Berlin) or officers (e.g. Stutterheim) (Tyler, 1976). KwaNtuku is one of the villages near this sleepy town. There is a long farming history here:

"I started farming in 1974. We used to plough the fields with oxen. Cattle... you see, with cattle there were a heifer and ox. We would tie the ox – the ox is tied and then a yoke is placed around the neck of all the six cattle or twelve in the fields. We would also load the plough with weeds." – Ayanda

"Pha emasini mna ndiqale pha go 1974, besilima ke apha emasimi ngenkabi. Iinkabi zinkomo, uyabona inkomo kukhona ithokazi kukhona inkabi. Sibopha inkabi, inkabi ibotshwa nje ubeke idyoko apha entanyeni zonk eke zibeyi-six okanye sibeyi-twelve emasimini xa nilima apha emasimini nilayisha ikhuba." – Ayanda

Image 21: Left: An old wooden plough next to a cattle kraal in a farmer's yard. Right: Satellite image of the fields in KwaNtuku.

Agriculture has always been an important source of livelihood in the village, but poverty, prolonged droughts and lack of state support after apartheid have forced many villagers to seek employment in nearby towns and cities. The farmlands, in the heart of the village, seem neglected. Aphiwe, one of the farmers, told me they no longer received seeds from the Department of Agriculture, because an extension officer assigned to their village had recently died (this was in 2019). Farmers were told that their soils were poor and eroded, and KwaNtuku was left out of the villages earmarked for agricultural development by the Department of Agriculture. As a result, they have not bothered to farm here for over 20 years.

"They [Eastern Cape Rural Development] told us that our soil was bad and would never be fertile. They took the soil samples to their labs in 2017 to test it. They said the top soil is hard like chalk and easily gets eroded." – Aphiwe

"Kuthiwa umhlaba walapha awunakulunga. Bathatha umhlaba wethu bawusa e lab bathi awusoze ulunge. Babeze ngo-2017, kufumaniseke ukuthi lomhlaba unelihlalutye ingathi yi-chalk, bathi the reason why kuku sloper komhlabo lo ungaphatsi uya mover, soil erosion." – Aphiwe

Farmers also said that government officials never told them what caused the erosion in the first place. It could have been caused by overgrazing, as many people have livestock in the area, but it might also have been caused by heavy rains or winds. When soil is eroded, the diversity of organisms that helps to keep it healthy and fertile are washed or blown away (World Wildlife Fund, 2021).

"The Eastern Cape Rural Development officials never came back to tell us what we should do in order for the soil to be fertile again. This information is strange to us, because we have worked in these fields and used compost. We avoided chemicals." – Ndiviwe	"*Abantu babesixelela ukuba basuka kwa Eastern Cape Rural Development azange babuye basixelele ukuba sense njani after that. Its new lento abasixelela yona because thina besigalela umgquba emhlabeni wethu silime. Besingasebenzisi amayeza thina.*" – Ndiviwe

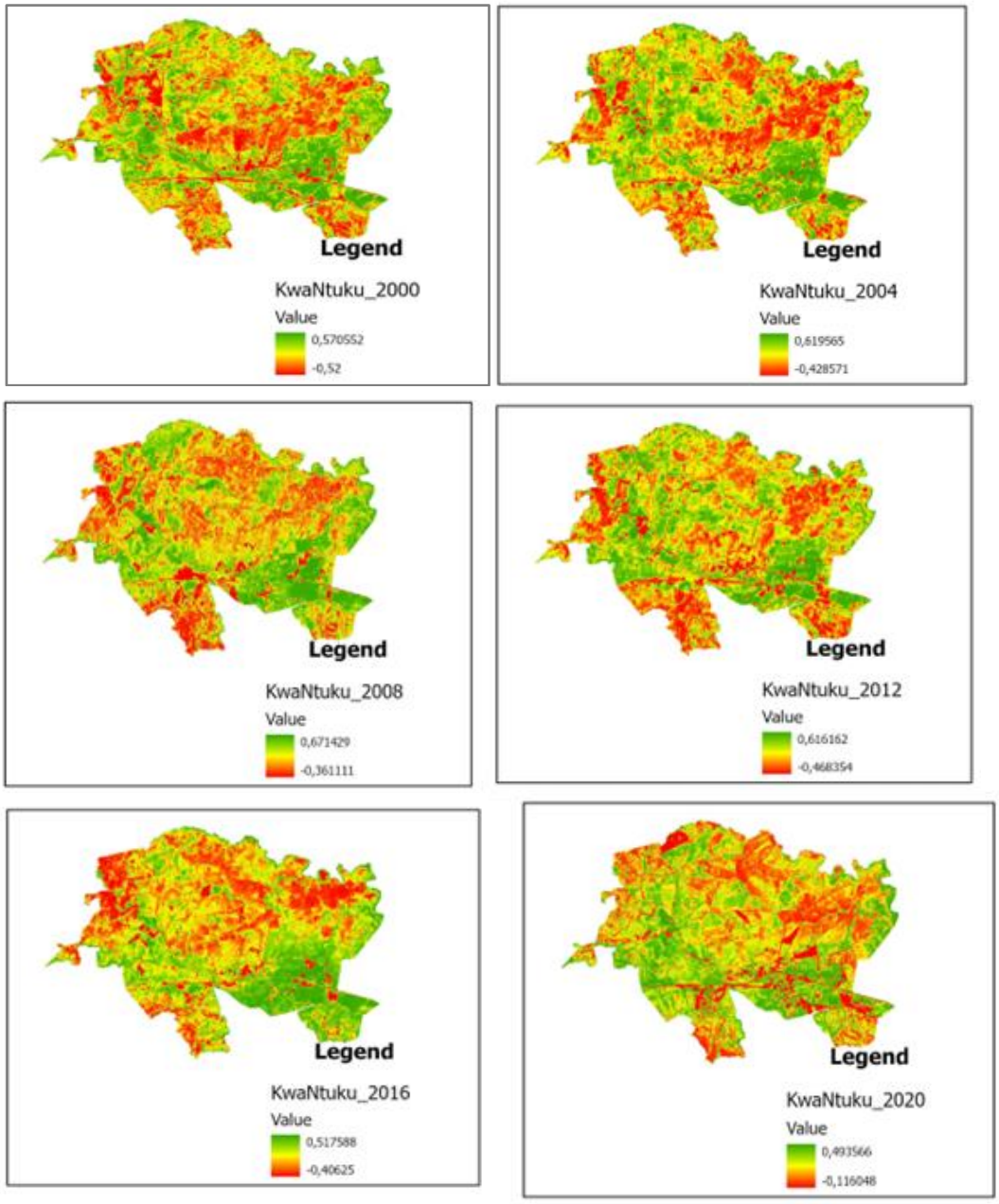
When I visited the area in early 2021 for the final phase of my data collection, there were plenty of rains. I conducted a focus group meeting with farmers to discuss indigenous soil management practices, and farmers decided to use their indigenous practices to test the soil. Among many indicators of healthy soils that the farmers mentioned were colour, texture, abundant soil biota, vegetation variety and even smell. After the assessment, farmers concluded that there was nothing wrong with their soil.

Image 22: Left: A farmer holding a weed species in the supposedly barren fields. Right: Eearthworm castings in the fields.

Topsoil contains organic matter and intensifies water infiltration and aeration, among other important functions. When it is eroded, plants lose necessary nutrients (Iowa State University, 2021). A degradation of soil will affect the ecosystem vegetation, showing on the NDVI map as red or yellow, and the NDVI values will be negative.

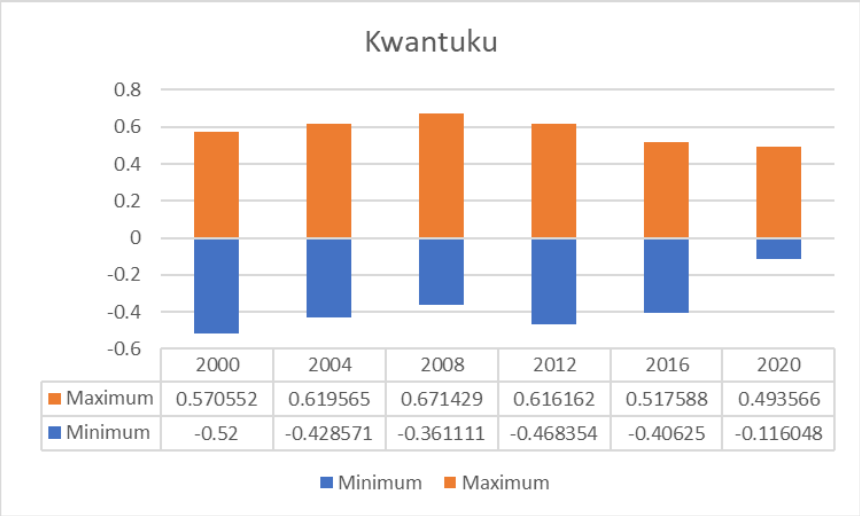
NDVI results

Map 10: Kwantuku

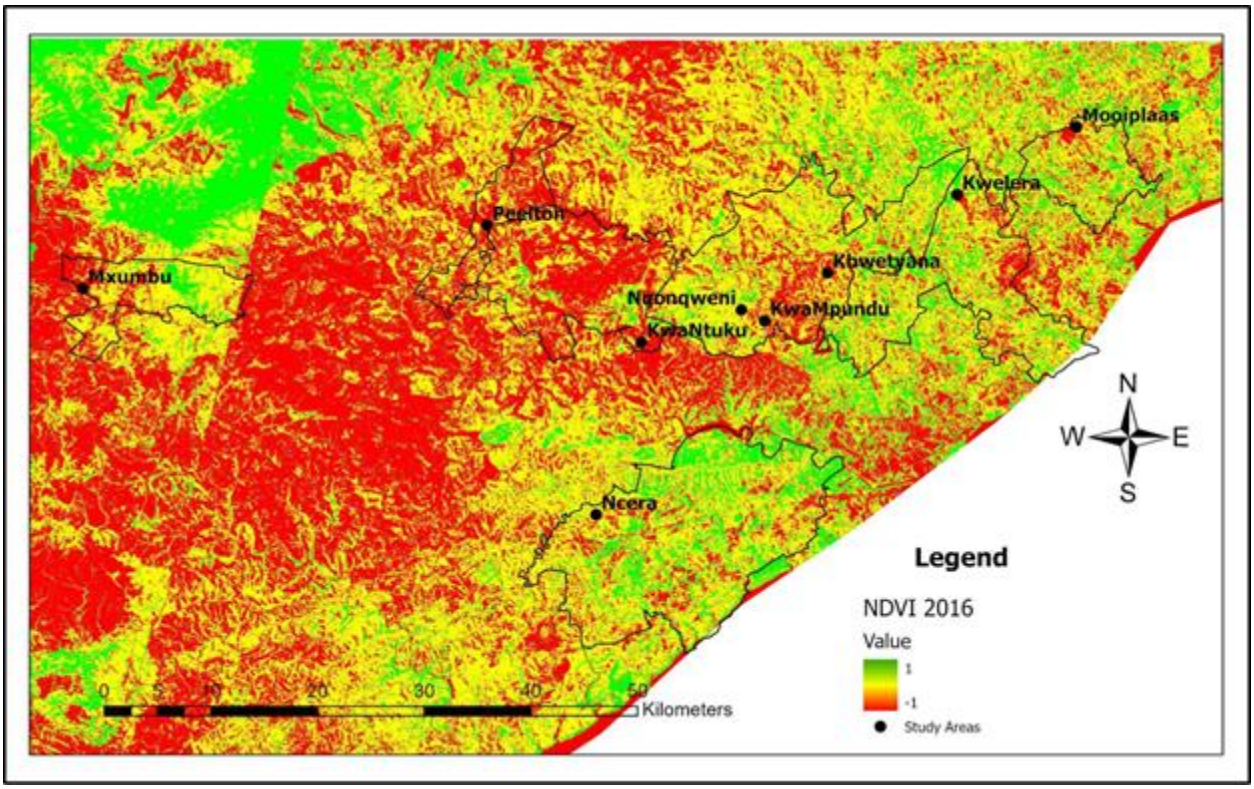


Despite the low minimum value in 2000, KwaNtuku's maximum and minimum values show an area where vegetation is healthy. The maximum values are consistent across the years, with the lowest value in 2020. KwaNtuku has no negative mean NDVI values (see Chart 6) and experienced a surge in 2008 and 2020. Like the other areas, 2000 returned a low NDVI value, but the green in the 2000 map shows the presence of vegetation. KwaNtuku experienced another low in 2016, but not the worst NDVI value relative to other areas (see Map 11 below, showing all the areas). The soil assessment by the Department of Eastern Cape Rural Development that the soil is depleted must be revisited. Like other villages, 2008 and 2020 returned high NDVI values. The 2000 and 2020 maps both have the green that represents vegetation.

Chart 6: Kwantuku's NDVI values between 2000 and 2020



	2000	2004	2008	2012	2016	2020
Maximum	0.570552	0.619565	0.671429	0.616162	0.517588	0.493566
Minimum	-0.52	-0.428571	-0.361111	-0.468354	-0.40625	-0.116048



Map 11: In 2016, Ncera and Kwelerha had the lowest NDVI values.

In Map 11 above, the red colour reflects dead vegetation and is dominant to the west, close to where Mxumbu is located. It can also be found in the south-west close to Ncera and scattered around the centre of the map. The yellow regions represent bare soil with little or no vegetation cover and are scattered in the centre, south, north and east of the map – close to Ncera, Mooiplaas and Kwelerha. The green sections represent healthy vegetation and are in parts of the north, east, south-west and south of the map. In 2016, healthy vegetation was mostly scattered around the north, east and south of the map. Relative to the 2012 analysis, vegetation health in the east and north-east of the map decreased, while the rest was bare soil or dead vegetation.

Ncera

The village of Ncera is about 30 km from East London. Like Mooiplaas, the area has rich soils and was earmarked for state-funded agricultural programmes. Times have changed, but farming remains a major source of income.

"We used to grow food and we didn't know that there were fertilisers. Now that there are white man's products such as fertilisers, we use them." – Vuyi	*"Besifumana ukutya ngoku kunanjalo singayazi ukuba kukho -ifertiliser ezingontoni-ntoni, unantsike sendisithso sasizenza ngolohlobo ke. Ngoku ngokubana kukho izinto zasebelungwini sisebenzisa ezo fertiliser.*" – Vuyi

There is even a macadamia farm nearby. Although farmers complained about the prolonged droughts that had occurred, they were happy about joining conventional agriculture. In our first interview in early 2019, they told me that they paid R1800 per farmer to get a subsidy from the state. Like farmers in Mooiplaas, they formed cooperatives to take advantage of state-funded initiatives.

"We all grew up as farmers. We joined the cropping project, calling ourselves "The Farmers of Ncera". We get a subsidy from the government, but we also contribute. For example, we pay for resources and the government comes with a tractor." – Nosipho	*"Sonke sakhula singabalimi, ubomi bethu bonke. Sangenela i-Cropping project sizibiza AmaFarmer aseNcera. Sifumana e-subsidy. Urhulumente uyasipha nathi sekhuphe. Mandenze umzekelo, thina sithenga izinto, yena (urhulumenete) uza netrektara."* Nosipho

The villagers used to plough with cows, but modern farming practices have made agriculture much better and more convenient. According to Zolani, one of the farmers:

"Maybe I will say it's because of school, because our children are studying – boys attend school. But before then, when we were young and when it was cattle-dip date, you were expected to miss school. When it was time to plough the fields you could not go to school, you would work with the ox. Do you see that this caused a lot of people to drop out of school? Parents can go to the fields. I will not allow my child to go through it as well, because they would have to drop out of school. Their interest in school would also be affected. So because of the existence of school, every parent wishes their children to have education. No parent wishes their children to work in the fields with an ox, because at the end of the day the child won't have a future."

"*Mhlawumbi ndizakuthi sisikolo, kuba bayafunda ii-boys zibheka esikolweni kuqala pha phambili ngoku sisebancinci xakubhekwa ediphini ubungayi esikolweni, xakubhekwa emasimini ubungayisikolweni ubuyokhokhela inkabi, uyayibona lanto yenze abantu abaninzi ba drop-out esikolweni, kwahambeka abazali baqonda owam umntana andizomkhupha for ukubheka emasimini ngoba uzayeka isikolo, yaye iphela kengoku umdla wokufundiswa kwabantwana ukusebenza ngenxa yesikolo, yaphela ngoba wonke umzali umnqweno wakhe umntana wakhe makafunde, akekho umzali onqwenala umntana wakhe akhokhele inkabi because kaloku ekugqibeleni uzangabi na-future.*"

The state started supporting agricultural activities in the area as far back as the 1990s, but the farmers have not been as successful as they hoped. Now that they have 'white people's equipment' such as tractors, fertilisers and pesticides, they expect their farming to be successful, but they have noticed inconsistencies in their fields.

"Now that there is white people equipment that we are using such as fertilisers, you find that the maize doesn't grow the same way in the fields. If the maize grows well here, it may be stunted in a different area but in the same fields. I don't know what causes the soil to be good in this area and bad in a different area of the same fields. After we used fertilisers, the white people products, I observed that our maize does well. But there are areas that confused us. In some plots

"*Ngoku ngokubana kukho izinto zasebelungwini sisebenzisa ezo-fertiliser zasebelungwini uwufumane umbhona kodwa ufumanise ukuba enye indawo ayikwazi ukufana nenye mhlawumbi ubemhle owalendawo umbhona ungayazi ukuba yintoni ibangela lomhlaba ukulendawo eyi-one zingafani izithombe zawo mhlawumbi umbi lona, ubemhle lona sendisitsho after sifaka ezizinto kuba kufakwa ii-fertiliser zabelungu yiyo into endiyibonayo otherwise ubamhle umbhona kodwa zibekhona*

the maize is beautiful and tall, and when you move a bit forward you find it stunted."– Fikile	*indawo ungayazi kuba ngumhlaba uyi-one ewe. Kule plot ubemhle ukubheka ngapha mhlawumbi indawana encinci ibenombona omfutshane ongafaniyo nalona.*" – Fikile

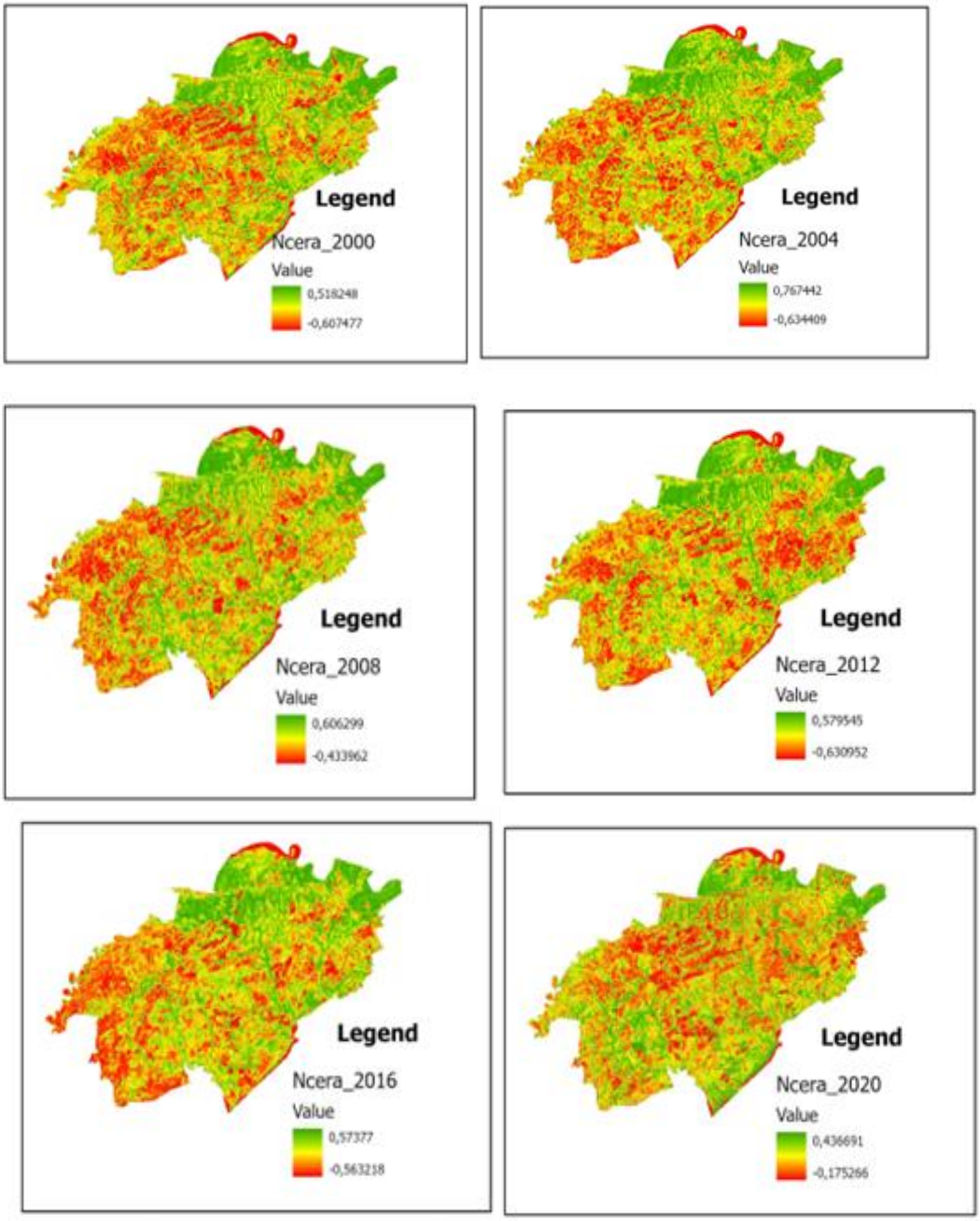
Farmers are also worried that the long-term effects of pesticides and synthetic fertilisers will affect the health of their soil.

"We use Roundup in the fields. When the government gives us Roundup, we use it to eliminate weeds in the fields." – Nosipho	*"Sisebenzisa iRoundup emasimini. Xa urhulumente esinika siyagalela pha emasimini. IRoundup siyifumana kurhulumente yokuphelisa ukhula.*" – Nosipho

All the farming decisions in Ncera and Peelton are made by the extension officer, because the farmers do not understand how the GM technology works. The farmers told me that they never question anything about GM technology, because they believe their extension officer has their best interests at heart. When I asked in 2019 if they had noticed any changes in their soils since using the GM technology, they said they had not. We visited the fields where they planted GM maize during a focus group meeting in 2021. Some areas in these fields retain moisture, while others do not. It is difficult to track these changes, because the farmers no longer work in the fields – tractors and pesticides do the work for them. They were eager to learn how they could use technology to monitor their large fields.

NDVI results

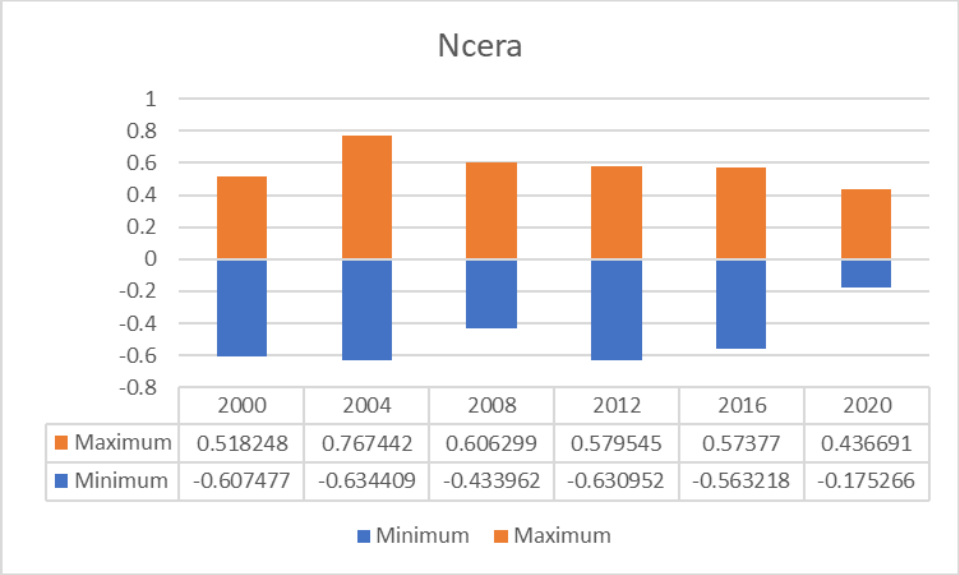
Map 12: Ncera



Despite the rich soils, Ncera's minimum results are extremely low. The lowest NDVI value was 0.63, in both 2004 and 2012, reflecting problems with vegetation health. But Ncera also has the highest maximum value of 0.74, indicating rich vegetation health.

Ncera has some of the lowest mean NDVI values. The maps are also dominated by red and yellow, corroborating the low values. In 2000, Ncera had the lowest NDVI value relative to the other areas (-0.0446145). Vegetation is only indicated by a bit of green in 2020. The NDVI value also increased, but the NDVI values are still extremely low. There are negative NDVI values in 2012 and in 2016, although the value is positive, it is still low. The results below are very inconsistent and could be the result of many factors. Further investigation is required.

Chart 7: Ncera



	2000	2004	2008	2012	2016	2020
Maximum	0.518248	0.767442	0.606299	0.579545	0.57377	0.436691
Minimum	-0.607477	-0.634409	-0.433962	-0.630952	-0.563218	-0.175266

Peelton

Peelton is 15 to 16 km north-east of King William's Town. In 2019, I interviewed a group of older farmers (in their late 50s to 70s) in the Majali section of Peelton, who call themselves Siqothindlala. The group was formed in 2003, around the time state-funded agricultural projects were gaining popularity in the rural Eastern Cape. Like most rural communities in Africa, they learned farming from an early age. By the time modern farming techniques had been introduced in rural areas, they were already farmers.

> "We have been doing this for a long time. We were born under these circumstances. Those are fields over there, even that area with trees used to be farmlands – the community used to plow in those areas, plowing was a way of sustaining our livelihoods." – Xola

These farmers had resources that included a tractor, storage facilities and water storage tanks. Their fields are bigger than the other farmers' and are fenced. They spend most of their days in the fields overseeing the farming, and their group comprises men and women. They were by far the most organised group I interviewed.

> "We are currently specialising in GM maize, but we do grow vegetables in our gardens. Our field is 50 hectares. Yes, we use GMOs and the Department of Agriculture helps us. Sometimes the government provides us with some implements, but whatever they cannot provide us with, we are forced to buy with our money." – Zola

Their main concern is prolonged droughts, such as the one they experienced in 2019 when I first visited. They welcomed drought-tolerant GM seeds with open arms.

> "The Department of Agriculture first came to tell us that the government has decided to assist communities like ours. They told us that the government is willing to offer some help to revamp agriculture to those who were interested in order for communities to survive on agriculture. " – Xola

Fezekile, one of the extension officers I interviewed, told me that although they do not explicitly tell farmers to choose GM technology, they do highlight its advantages, which include drought- and pest-resilient crops. She said it is often difficult for farmers to access the organic market, so the state offers the option of GM technology. She also said that organic farming has many disadvantages:

> "For me as an individual, my wish is for farmers to make profit. The people who suffer the most are villagers, and we want them to make money. With organic, it takes a bit longer. A big shop like Woolworths is going to need a certificate that says this product is organic. I cannot say they should use organic, especially when I know that something like kraal manure is responsible for causing a lot of weeds."

Another extension officer, Nompilo, confirmed that farmers choose the GM technology because extension officers introduce them to suppliers such as Pannar, who sell GM seeds:

"We don't tell the maize farmers, for example, to buy GM seeds. What we do is organise farmer's days or workshops and then invite suppliers. In that way, farmers can make informed decisions."

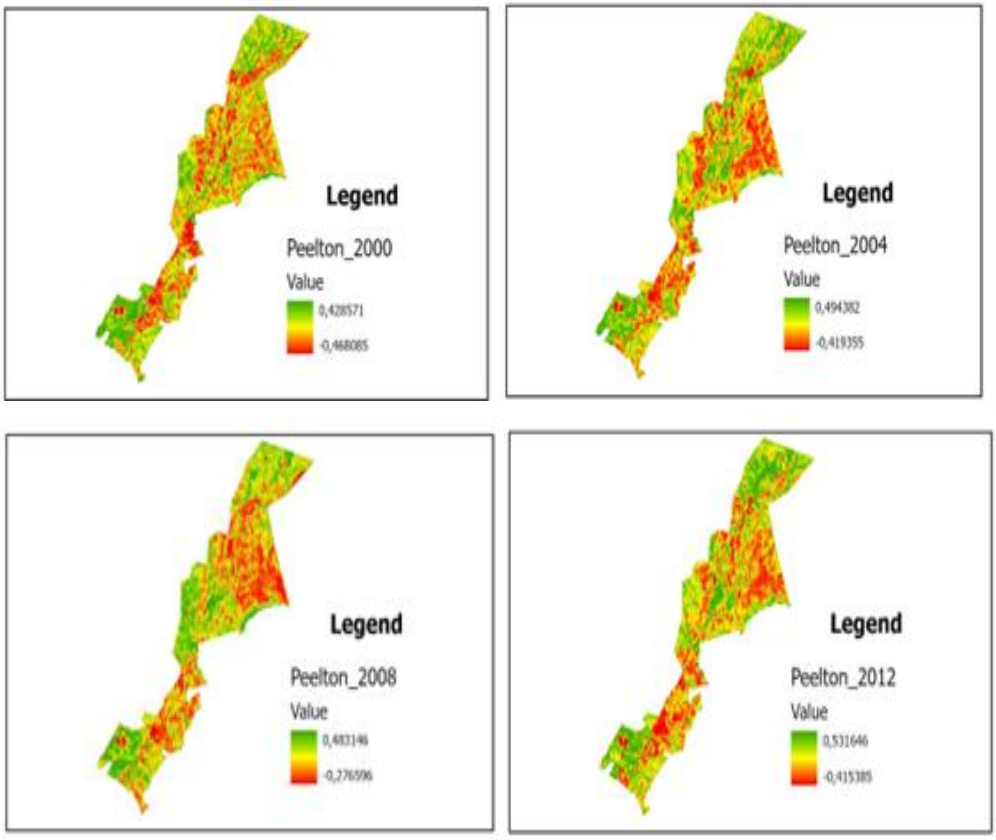
The farmers use Roundup and other pesticides they couldn't remember the names of. Like the farmers in Ncera, they loved GM technology, because they did not have to spend long hours in the fields. However, they were concerned about the long-term effects of using chemicals in their fields.

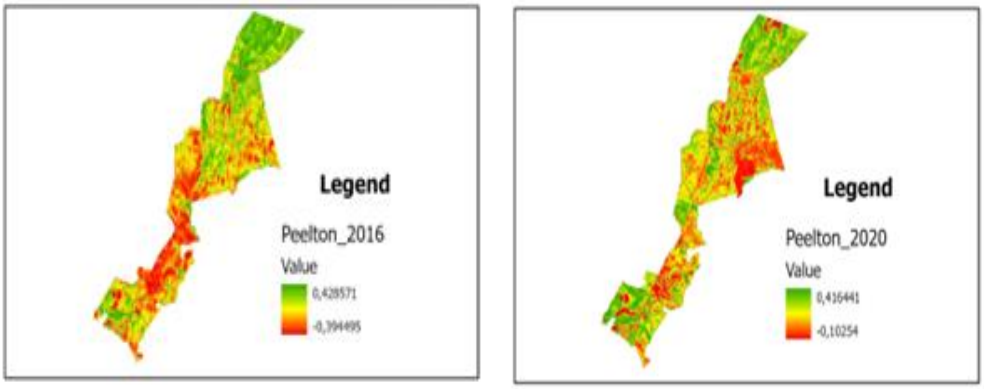
"We are told that these chemicals are dangerous and that we should be safe when we use them." – Xola	"Sixelelwa ukuba ezi khemikhali ziyingozi kwaye kufuneka sikhuseleke xa sizisebenzisa." –Xola

They were interested in exploring other technologies to improve their farming practices.

NDVI results

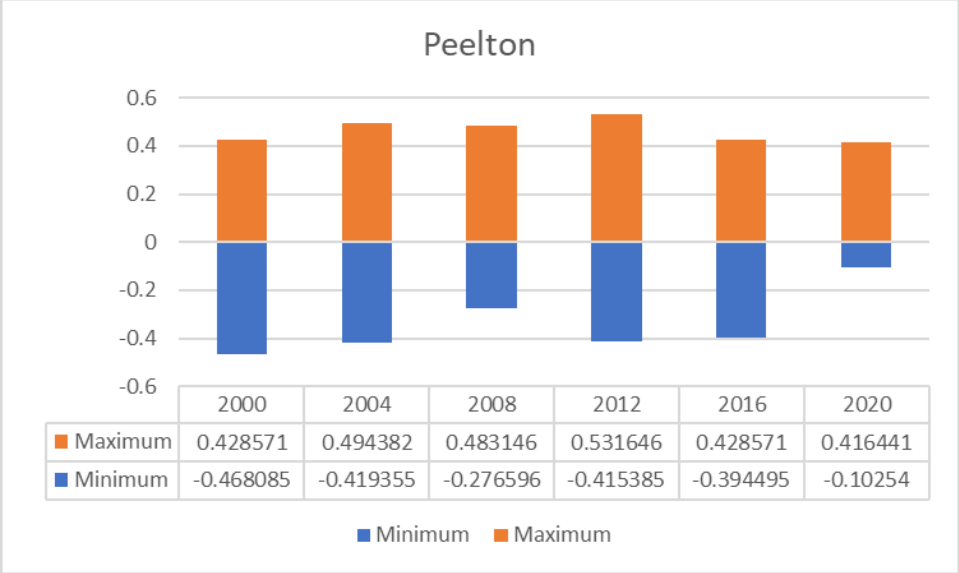
Map 13: Peelton





Minimum values in Peelton range from -0.10 (2020) to -0.46 (2000) – not surprising given that Peelton is prone to prolonged droughts and, unlike Mooiplaas and Kwelerha, is generally dry. Peelton's maximum results are not very high, with its highest value being 0.55 in 2004. The maximum values ranged between 0.42 (2020) and 0.53 (2012). Peelton had only one negative mean NDVI value, in 2000, a trend across all the areas. Although there was an upward trend from 2004 to 2008, the NDVI value dropped in 2012 and again in 2016. In 2020, there was a positive change again. The maps above are consistent with the NDVI values shown in the chart 8.

Chart 8: Peelton



	2000	2004	2008	2012	2016	2020
Maximum	0.428571	0.494382	0.483146	0.531646	0.428571	0.416441
Minimum	-0.468085	-0.419355	-0.276596	-0.415385	-0.394495	-0.10254

The values above are inconsistent, perhaps because of the frequent droughts in the area.

Mxumbu

Mxumbu is close to Middledrift, but the villagers prefer to pay R40 to go to King William's Town by taxi to shop and do other errands. Here I met a group of farmers led by the youth. It was rare to come across youth-led farming groups in my interviews. In Mxumbu, the younger generation was taking advantage of the farmlands left by their grandparents. They emphasised the importance of land to black South Africans:

"My sister, soil is life. Without land, as young people, especially in the 21st century, whereby	*"Sisi wam, umhlaba is life. Without land, as young people, especially in the 21st century*

there is a lack of food. My sister, without soil, chances are that we won't have food, we won't have livestock. Without soil, our most basic needs will not be met. Give back the land to the people, so that people can say they have access to soil." – Sipho

whereby there is a lack of inantsika… food. Sisi wam, without umhlaba chances are that asinakutya, asinayo imfuyo. Without soil, our most basic needs will not be met. Give back the land to the people, so that people can say they have access to soil."– Sipho

The group is called the Mxumbu Youth Cooperation and has received donor support in the form of farm implements, seeds, water tanks and training. Rhodes University and Fort Cox College have assisted with training, the Department of Agriculture has provided fertilisers and pesticides and Zingisa has provided implements.

"These institutions played a huge role. From time to time Rhodes and Fort Cox come to test our soil, or when there is a new trend, they teach us. They once came here to test our soil for cannabis. From time to time we get training from these institutions about trends and developments." – Sipho

"*Lezi institutions ziye zadlala indIma enkulu. From time to time e Rhodes neFort Cox bayeza apha-bazo test umhlaba or xakunento e fikayo bazo kusifundisa. Bake bafika bazo-test lomhlaba ukuba unjanina for intsangu. From time to time we get training from these institutions about trends and developments" –* Sipho

Image 23: Left: A seedling cabin provided by one of the donors for the Mxumbu youth farmers. There is even a tap in the premises for irrigation. Right: Despite donor support, their maize seems stunted.

These farmers have enough land to farm and create jobs for their fellow villagers, but they have not become as successful as one might expect.

"We have fields and eight gardens. There are others [who are not here] in this group. Others got jobs, so we are busy restructuring the group. The name of this group is Mxumbu Youth Cooperation. We plant crops, maize, tomatoes, spinach, carrots, potatoes, pumpkins, cauliflower, beetroot, cabbage, lettuce. Basically we are busy with vegetables and poultry. We ask for donations from different organisations. We don't have consistent donors." – Zipho

"We have amasimi, we do have izi-plot eziyi8. Bakhona abanye kule group. Abanye bafumana imisebenzi so we are busy restructuring. Igama legroup iMxumbu Youth Cooperation. Silima icrops, umbona, tomatoes, spinach, carrots, potatoes, pumpkins, cauliflower, beetroot, cabbage, lettuce. Basically we are busy with vegetables and poultry. Sicela i-donations from different organisations. We don't have consistent donors." – Zipho

They told me that they had felt caught between indigenous practices and GM technology and decided to use both.

"In the gardens we use organic. But there is also a cooperative where the Department of Agriculture gave us chemical fertilisers and pesticides. They are still there. We use them sometimes. Sometimes we don't. But we don't use them everywhere. To tell the truth, my sister, if you want a competitive advantage in farming, you have to use modern technology. Because you will plant 1 000 cabbages and then the pests will arrive. You will do your natural pesticides, whereby you mix natural things, but it won't be as effective as the pesticide that actually kills

"*Egadini sisebenzisa i-organic. Kodwa kukwakho i-cooperative apho i-Department of Agriculture wayesinike ifertilisers kunye ne pesticides. Zisekhona nangoku. Sizisebenzisa ngamanye amaxesha. Ngamanye amaxesha asenzisebenzise. But asizisebenzisi kuyo yonke endawo. Ukuthetha inyani sisi xa kufikwa ekulimeni for competitive advantage you have to use the modern technology. Because you will plant ama-cabbage ayi-1 000 kube sekufika izinambuzani. You will do your natural pesticides apho you mix natural things. But it won't be as effective as le*

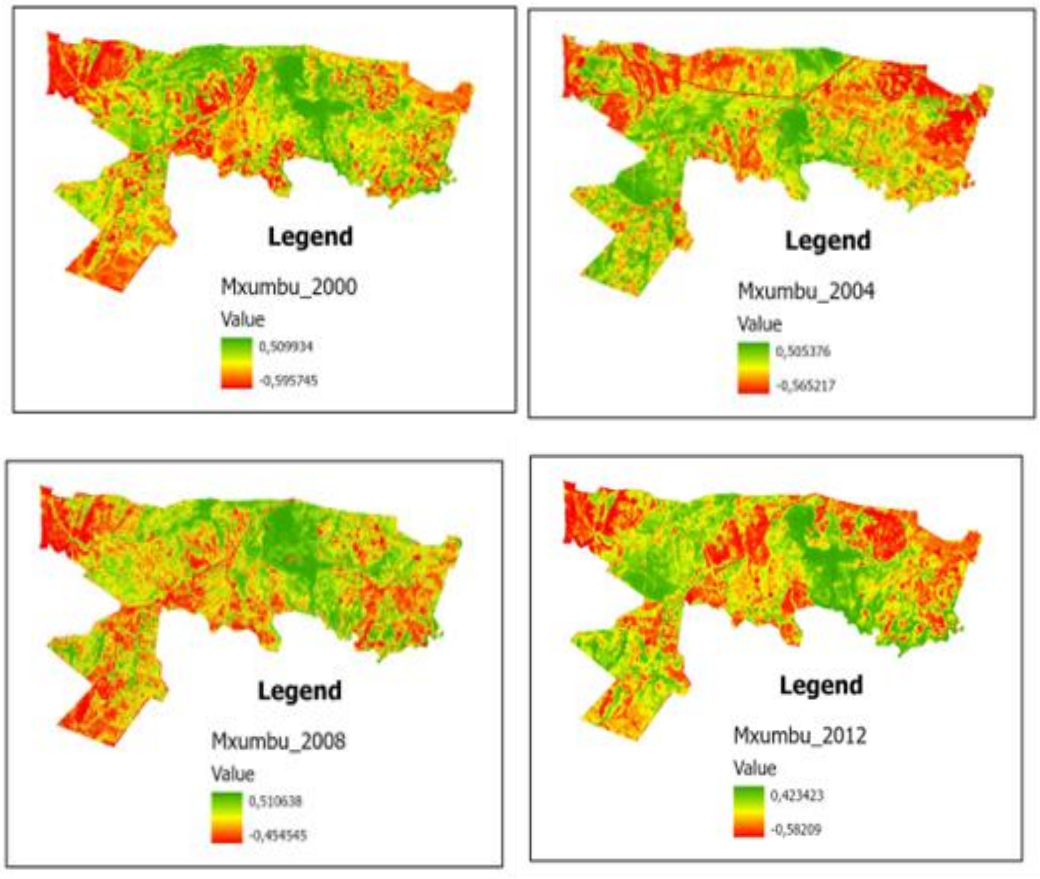
them. The one that kills them is very effective. Yes, the natural pesticides where you take aloe, *nokanoka*, gum tree, mix them and spray is not that effective. It works for smaller gardens. When you talk about large farming, it is very difficult to do organic." – Xoli

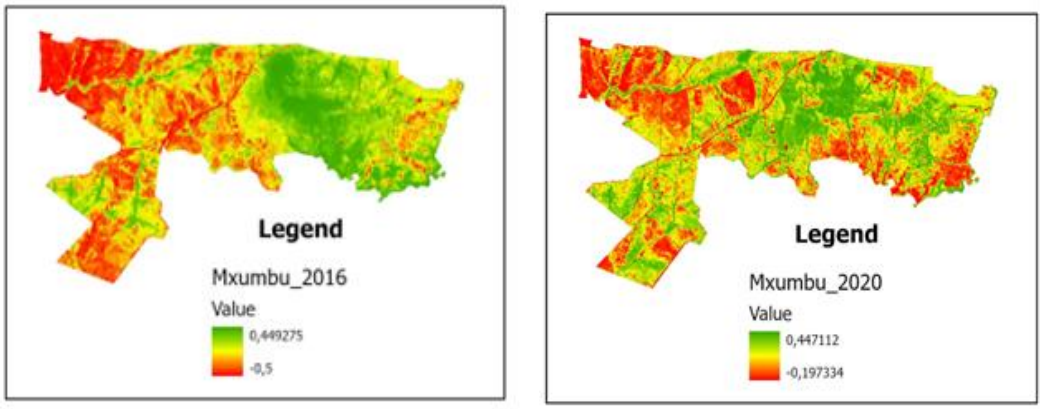
ezibulalayo nje nge pesticides. Le izibulalayo is very effective. Ewe, eza-natural pesticides ntoni ntoni – uthathi unukanuka, uthathi ikhala, uthathi i-gum tree xa u-mix, when you spray it is not as effective. Isebenza for igadini ecinci. Xa uthetha nge large farming kunzima kakhulu ukwenza lento ye-organic." – Xoli

Unlike most rural small-scale farmers I interviewed, theses farmers had a modern education *and* knowledge of indigenous practices. They had all completed matric and attended agricultural courses and had plenty of land at their fingertips. It is now necessary to strategise how to make their project a success. One of their major complaints was drought.

NDVI results

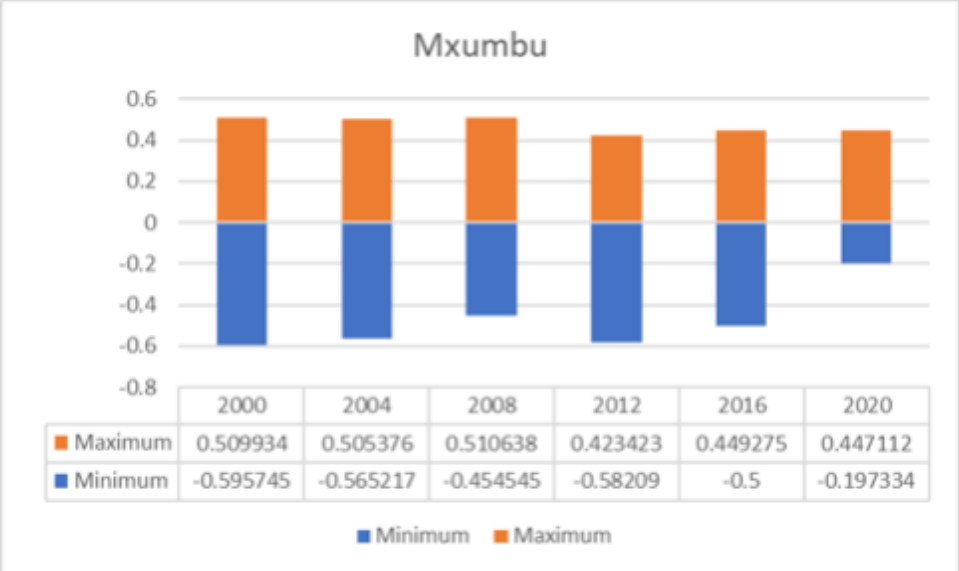
Map 14: Mxumbu





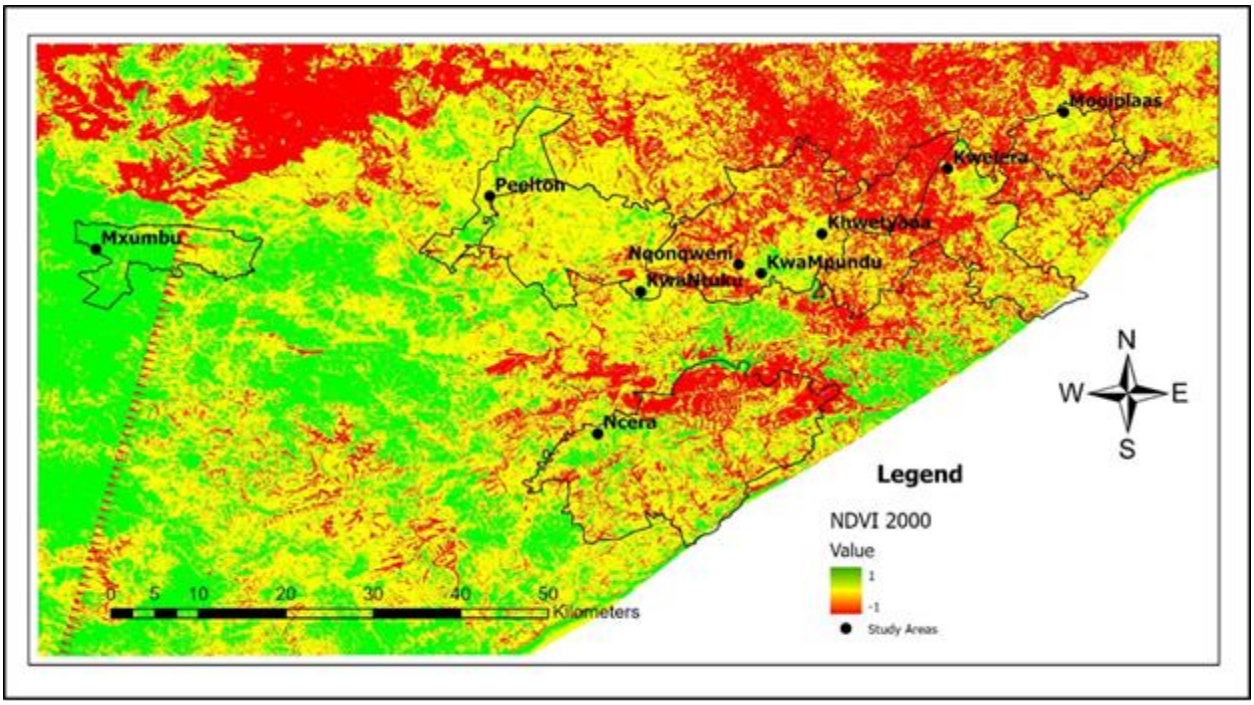
Mxumbu's minimum values were generally low, suggesting unhealthy vegetation, with a highest NDVI value of -0.19 in 2020. Mxumbu had some of the lowest maximum values, with a high of 0.51 in 2008. Mxumbu was the worst performer in terms of maximum and minimum values relative to other areas. On Map 15 below, the green sections of healthy vegetation are in the west (where Mxumbu is), the south-west and some sections of the south and south-east. The north-west is engulfed by red. The overall NDVI analysis of the map shows that healthy vegetation in 2000 was predominantly in the west, south-west and south sections of the study area.

Chart 9: Mxumbu



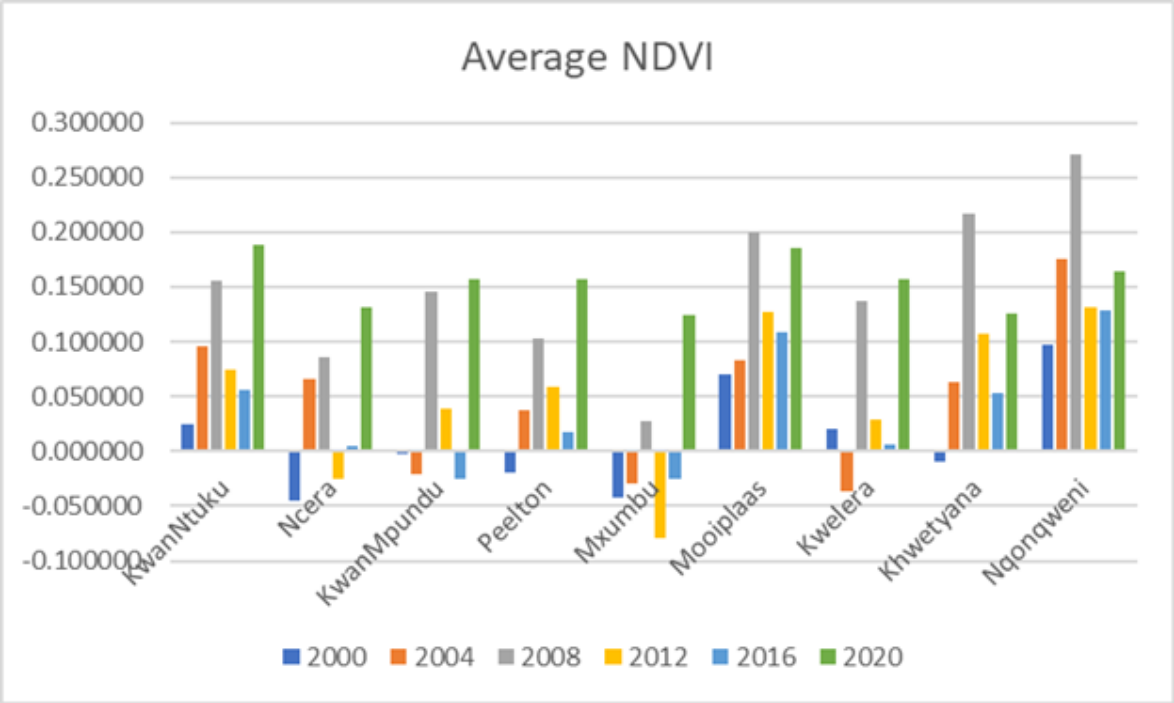
For mean values, the chart above shows four negative NDVI values out of six. Mxumbu's vegetation health only showed improvement in 2020. It had a positive but low value in 2008.

Map 15: NDVI map for all villages in 2000



Overall NDVI results

Chart 10: Overall results



The overall NDVI results for the selected villages differed, inviting further investigation. While some villages battled with drought, others contended with issues such as pest control. In a diverse farming community such as this, one solution cannot address all the problems. I selected these nine villages to show the different challenges that small-scale farmers face. The chart above shows Nqonqweni, where farmers use indigenous practices, as farmland that is performing better. What might they be doing right that other farmers are not? What can farmers learn from these results? Why is Mxumbu the worst performer, despite having an irrigation system and other resources? How did the soil specialist get it wrong in declaring KwaNtuku's soils infertile and unsuitable for farming?

Conclusion

This chapter has supported farmers' stories and linked them with remote sensing technologies. While more NDVI assessments on the participating farmlands are recommended, this chapter has demonstrated that the farmers are credible knowledge holders of their land. Current state methods fail them by not taking their voices into consideration, and regular educational workshops between small-scale farmers and the Department of Agriculture could assist them. Sharing knowledge and

information between these two parties should be the main goal of such workshops. Despite its flaws, remote sensing technology does not affect the farmers' agricultural landscape relative to GM technology (which encourages farmers to change their old farming practices), and the farmers could learn about the importance of remote sensing technology such as NDVI and other monitoring tools to keep them up to date with the health of their crops. Remote sensing could also be cost effective if the Department were to meet farmers halfway.

The high NDVI values in areas where chemicals are used are not necessarily indicative of healthy soils but may simply indicate soils that have been temporarily brought to life by the excessive use of fertilisers. The NDVI values correspond well with the rainfall trends, particularly during the rainy seasons, and the sparseness and denseness of the fields also influenced results. Fields will not be as dense in areas where farmers practice monocropping as in areas where farmers practice multicropping – the results from Mooiplaas, where farmers only planted maize, were different from Nqonqweni, where farmers planted maize and cover crops.

CHAPTER 5

Soil health indicators in local knowledge

> *As his brown coffin was lowered deep into the ground to be swallowed by the red soil, I asked mama if we would ever see ntatemoholo again. "Will he come back, Mama?"*
> *"He is not leaving us, he is just transitioning, my child. His soul is already flowing free with the winds, but his body will still be bound with us. Every time your tiny hands touch the soil, you will be gently stroking his old hands," Mama replied.*

Introduction

> "*Umhlaba asiwu-test but kuba xa ungumlimi uye uwubone ukuba hayi u-right."* ("We have never taken the soil to be tested, but as a farmer, I can tell when the soil is good.") – Nomkhosi

The connection between farmers and the natural environment was addressed in Chapter one, which highlighted that soil is more to farmers than just a commodity. Acknowledging that soil is part of themselves requires caring for it in a way that protects the species that live in it. It requires an understanding of the species – what they are, what they eat, how they survive, what threatens their existence – and an understanding of the soil food web. While understanding soil species is paramount to understanding soil's biological features, farmers also described physical and chemical properties that show soil is multi-dimensional. In this chapter, farmers discuss the multi-dimensional features of the world of soil and unpack their indicators of soil health and how to maintain it. Ideas from farmers in different villages in the Eastern Cape are combined to create a soil testing kit that all farmers can benefit from.

What I do not do in this chapter is propose solutions. I explained to the farmers that I was not there to tell them what to do or to solve their problems but that I was there to facilitate a discussion that could lead to solutions. I conducted a series of participatory focus group meetings that gave farmers the platform to discuss and propose solutions for a costless testing kit. This chapter is based on the many answers that came out of the focus meetings. I also interviewed agricultural experts and introduced soil-biology literature to support farmers' theories. More than anything, the impetus of

compiling this information was influenced by the struggles that farmers endure to keep up with the technological inventions that make it difficult for them to farm as they used to. The conventional method of soil testing encouraged by the science community is DNA testing of soil microbes, but this is expensive and rural farmers would find it difficult to adapt to this model.
The tool kit also provides autonomy to manage soils, 'autonomy' being a key principle of this research. There is a fundamental difference between scientific and indigenous soil testing methods – while scientific methods use tools and technology, indigenous soil testing methods rely more on senses such as touch and smell. Farmers use a qualitative approach to determine the fertility of the soil. This indigenous way of testing comes from rural communities' attachment to nature and stems from knowledge passed from generation to generation.

What soil means to rural farmers in the Eastern Cape

> The soil which has kept breaking away from the highlands during these ages and these disasters, forms no pile of sediment worth mentioning, as in other regions, but keeps sliding away ceaselessly and disappearing in the deep. And just as happens in small islands, what now remains compared with what then existed is like the skeleton of a sick man, all the fat and soft earth having wasted away, and only the bare framework of the land being left.

The above quote is from the famous Greek philosopher Plato's *Critias (*in Leeder, 2009: 1), in which he compares depleted soils to the skeleton of a sick man whose fat has wasted away. The farmers I interviewed explained their relationship with and understanding of soil in a similar way, giving it human qualities. Some regard soil as a superbeing, larger than life itself and without which humans cannot survive. Soil is *ubumi* (life). Among these farmers, soil has a soul, which is why they use their senses to test the soil's health and well-being. They smell it, touch it, look at it and even taste it. As explained in Chapter two, soil also provides a sense of belonging. Like a faithful partner, soil has been with them throughout their lives – from before they were born and as they grew up, and it will continue after they are buried in it. In return, farmers know the soil and know when it is changing – for the better or the worse. Most importantly, soil sustains their livelihoods.

"What I can say about the soil is that it is life, and we cannot live without taking care of it. I encourage the general public to be educated about the value of soil. There are people going around trying to scam people into selling their land. You cannot sell land because of its value. With land you can raise your kids and send them to school, but money runs out. Land is something that you should never sell." – Nzo	"*Mna umhlaba ndingathi bubomi ngoba asinakuphila ngaphandle kokhathalela umhlaba. Okunye endinokukhuthaza kukuthi abantu bafanele ukuba bakhuthazwe bangaqhathwa, bakhona abantu abajikelezayo beqhatha abantu befuna ukuthenga umhlaba. Umhlaba ayonto ithengiswayo ngoba wona awupheli ungakhulisa abantwana bakho ufundise ngomhlaba yona imali iyaphela.*" – Nzo
"Soil is important to livestock. Without soil, there is no livestock. Firstly, livestock depends on water that comes from the soil. Food comes from the soil." – Ntombi	*"Umhlaba ubalulekile kwimfuyo. Ngaphandle komhlaba, akukho mfuyo. Okokuqala, imfuyo ixhomekeke emanzini aphuma emhlabeni. Ukutya kuvela emhlabeni."* – Ntombi

By respecting soil and caring for it, farmers also acknowledge the importance of the species in it. This is the importance of human interconnectedness with other beings – what Tsing et al. (2017) refer to as 'interdependencies' among biotic and abiotic factors. de la Bellacasa (2017) argues that organisms do not simply live in the soil – they 'are soil', and we cannot treat the two separately. The fact that farmers observe and acknowledge the presence of soil species indicates that they too are interconnected with soil species.

Image 24: Left: In Kwetyane, the farmers showed me their soil after weeding. Right: In Nqonqweni, farmers showed me different wild plants that they say help to enrich their soils.

Indigenous soil management practices and evolving technology

The importance of healthy soils cannot be overstated, especially in rural South Africa, where many communities are impoverished and dependent on subsistence agriculture. According to Scoones (2001), soil fertility depletion in smallholder farms is the fundamental biophysical factor responsible for declining per-capita food production in sub-Saharan Africa. The magnitude of nutrient mining[7] is huge, with an estimated net per-hectare loss during the last 30 years of 700 kg of nitrogen (N), 100 kg of phosphorous (P) and 450 kg of potassium (K) over approximately one-million hectares of cultivated land (Scoones, 2001). Modern agricultural practices and excessive chemical usage are a major concern to soil health (Raghavendra et al., 2020; Cardoso et al., 2013).

To ensure that evolving agricultural practices do not leave rural farmers behind, their perceptions and understanding of soil practices should be assimilated into research and agrarian reforms. Agricultural policies after 1994 were enacted to support black farmers snubbed by the apartheid regime by making modern technology, money and equipment available. Over the years, different soil indicators based on science and modern technological advancements have also been compiled

[7] Nutrient mining, also known as negative balance between nutrient input and output, happens "when the crop nutrient removal and nutrient losses to other sinks become higher than the soil-inherent nutrient supply" (Majumdar et al, 2016).

to assess the health and functioning of the soil (Raghavendra et al., 2020). Indigenous soil practices have sustained African rural communities for centuries, but traditional knowledge often falls out of favour because it is not considered 'effective' by modern standards.

Many efforts have been made to promote so-called improved soil management practices in Africa, but the results have been unsatisfactory (McDonagh et al., 2014) – perhaps because something is missing in how they are implemented. Nederlof and Dangbégnon (2007) contend that for research or development projects to be effective, they should meet the sociocultural perspectives of farmers and should be included in the planning and implementation of such projects. The authors conducted a study in Togo to determine why poor farmers did not adopt soil management practices recommended to them and found that, among other conclusions, there was a lack of communication with farmers about the projects. Scientists and planners took ownership of the project instead of allowing farmers to share their knowledge and run the project. Buthelezi-Dube et al. (2019) found that only a few studies have been conducted on the soil knowledge or perceptions of small-scale farmers in South Africa, despite proof (Šūmane et al., 2018; Maru et al., 2019) that understanding farmers' traditional soil health assessments is necessary for the protection of agro-ecosystems.

To showcase alternative soil assessment practices, I have highlighted research studies that used farmers' indigenous practices. These research studies list texture, structure, moisture, acidity, alkalinity and salinity as important elements (Mengel and Kirkby (1987) cited in Hirzel and Matus (2013)). Giri and Varma (2020) list indicators of a healthy soil as being soil organic matter (has an impact on nutrient supply for plants and soil microbes), soil structural stability (incorporates soil erosion, root penetration and water and air movement in the soil) and bioavailable nitrogen (nutrients that sustain plant growth and soil microbes). Their diagram offers a summary of healthy soil.

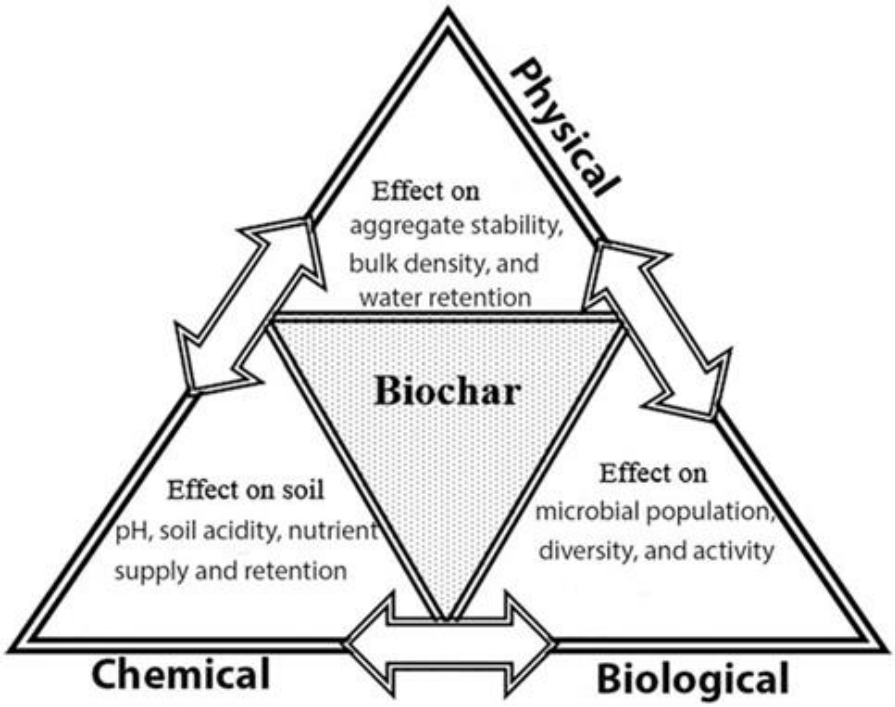


Image 25: A diagram of healthy soil (Giri & Varma, 2020).

Eze et al. (2021) conducted a study in the highlands of nine African countries (Cameroon, Ethiopia, Kenya, Rwanda, South Africa, Tanzania, Uganda, Zambia and Zimbabwe) and identified 16 soil health indicators reported by farmers. The indicators comprised texture, colour, vegetation performance, consistency, workability, drainage, water retention, organic matter, fertiliser requirement, depth, macro-fauna population and degree of erosion. Buthelezi-Dube et al. (2019) and concluded that farmers in the eastern parts of South Africa used a qualitative approach to distinguish between healthy and unhealthy soils. The farmers described soil indicators such as soil colour, depth, drainage, earthworm presence and more. The authors recommend that future research should focus on other chemical fertility problems – for example, acidity and nutrient levels.

Wawire et al. (2021) compared farmers' soil fertility knowledge in Kenya, where farmers remarked on soil colour, earthworms, topography, indicator weeds, water-holding capacity and more as indicators of soil health. The researchers concluded that there were crossovers between farmers' knowledge and scientific assessments. Eze et al (2021) suggest that knowledge sharing across geographic areas would be helpful because soil health indicators differ from area to area and the importance of local context should not be ignored. Tesfahunegn et al. (2016) carried out

similar research in Ethiopia and concluded that the indicators used by farmers, such as weed species and crop types, were vital for soil quality assessment. The researchers argue that farmers' knowledge can play a vital role in decision making and is less costly. In African rural areas, home to the poorest of the poor, it is important to consider viable solutions that are cost-sensitive.

Local soil vernacular

Table 6: Local soil vernacular

Term	Translation
Lafu lafu *Khafu khafu* *Thafu thafu* *Nduvu nduvu* *Ntofo ntofo*	Soft and easy in the hand
Udongwe	Clay soil
Tyebile	Fat/rich
Isanti	Sand
Hlalutye	Infertile soil with rocks
Umgquba	Manure
Imbalela	Drought

Soil health indicators

In modern terms, healthy soil is defined as: "the continued capacity of soil to function as a vital living system, within ecosystem and land-use boundaries, to sustain biological productivity, promote the quality of air and water environments, and maintain plant, animal and human health" (Doran and Safley, 1997, cited in Cardoso et al., 2013). In the soil food web, bacteria and fungi feed on dead organic matter, while other organisms feed on bacteria and fungi and animals or plants (Griffiths, 2018). In addition to understanding the biological properties of soil, it is vital to understand its physical and chemical properties, because soil health is not one-dimensional but embodies all three of these features (Griffiths et al., 2018).

On the other hand, farmers who were interviewed believe that the 'living soil' is a habitat for organisms like earthworms and other creatures. The 'living soil' must show life by smelling earthy and not look dull or feel hard in the hand – *umhlaba uyaphila* (soil is alive). For soil to be alive, it should teem with plant and animal biodiversity. As Mr Nzo said, "*Kumhlaba otyebileyo ibaninzi nje into evelayo*" ("In healthy soils, there is life, there is diversity"). In short, farmers' definition of a good soil is that *uyaphila* (it is teeming with life). Starting with the soil health indicators, Table 9 shows a detailed soil assessment kit with explanations, including soil restoration techniques, soil structure assessment and pest control techniques.

Table 7: Soil assessment kit

Indicator	Healthy soil	Unhealthy soil
Texture	*Lafu lafu, khafu khafu* (easy in the hand) Soils with ground structure Full of organic matter Good soils should allow for water penetration and drainage	*Uhlalutje* (stoniness), too hard and shows no life Poorly drained soils that hold on to water for too long or lose water too quickly
Structure	Not too sandy or too much clay (*lafu lafu*) Silt/loam soil	*Isanti* (sand), easily eroded *Udongwe* (clay) Holds on to water for too long and in the end depletes soil of oxygen
Colour	*Umnyama* (black or dark) The soil should be dark – if brown, it should be dark brown; if red, it should be dark red. The dark colour is an indicator of the organic carbon present in fertile soils Soil colour indicates other benefits too. E.g. red or brown soils are rich in oxidised (ferric) iron	*Umhlophe* (whitish or pale) is unhealthy soil Grey could indicate a drainage problem Depletion of nutrients in soil can cause the soil to be pale Excessive chemicals can also cause the soil to be pale
Smell	Earthy smell Petrichor (the smell when the rain hits the ground)	Smells like something is rotten Sour smell indicates acidity
Creatures found in/on soil	*Imsundululu* (earthworms) –popular indicators of good soils and show that the soil has good pH *Intuku* (moles) love healthy soils Healthy soils sometimes invite pests	Moles are also pests Snails are pests The presence of many frogs could indicate a wet area that holds water for a long time

	There is a diversity of microbes in healthy soils. Farmers mentioned: *inkunzane, usinyeke, umbungu, iphuphu, imbovani, isongololo, imibundane, umhlabangula, nambuzane*	
Effective depth	Deeper than 30 cm Enough depth for roots to grow Important for roots to absorb water and nutrients "Soil has to go down deep enough for roots to also go down. That's why container gardening is an advantage in this case. You can control the depth." – Mamorena	*Uhlalutye* is hard when you dig down – prevents roots from flourishing "You can also use the spade to check how deep the top soil goes." – Nosiviwe
Other plants found in/on healthy soils	A diversity of different wild plants shows that the soil is healthy. Some of these wild plants are natural pesticides too. Farmers mentioned a few: *umhlonyane* (wormwood), rye grass, *inkanga* (green with a yellow head) *khatha-khatha* *umva-bafana* *ukokoyi* *nuka nuka* *qwangu-qwangu* *tjutu* *imbikicane* *nentsungwana* *infino ye sxhosa* *monakaladi* variety of different weeds (rae grass, star grass) *umhlabangula* *imbicane* *imbhotyi ka Sathane* *ngamgam* *khonxina* *inkunzani* *umsokosoko*	Some plant species are heavy feeders and are not good for farmers because they outcompete crops for soil nutrients Other species, such as mopani and acacia trees, indicate dryness in the area.
Fungi	Presence of poisonous mushrooms	Lack of diversity
Crop appearance	Dark green colour Unlimited growth	Stunted growth Discolouration, including yellow colour on leaves Purple instead of green Pests often attack unhealthy crops

Indicator	Healthy soil	Unhealthy soil
Taste	Good soil has no taste	Salty taste indicates too much alkaline Sour taste indicates acidity
Others	Earthworm castings (indicate presence of earthworms even if they cannot be seen)	Bare soil – no life, no sign of organisms

Texture and structure

Doelman and Eijsackers (2004) provide the following definitions for soil structure and soil texture:

Soil structure: Three-dimensional spatial arrangement of aggregations of soil particles and of large pores (channels, cracks) in the soil matrix.

Soil texture: The size distribution of individual soil particles in a given soil sample.

Soil properties are susceptible to change over time, depending on factors that include parent material, climate, biota, topography and soil age.

By virtue of their texture, soils are generally classified into three major categories (Doelman and Eijsackers, 2004):

1. Clay soils – water and air movement are restricted and particles tend to form lumps when dry. Clay soils are characterised by poor drainage and tend to crack in the dry season. Their colloidal nature allows them to hold on to a large number of mineral ions, but these are inaccessible to plant roots due to poor drainage.
2. Sandy soils – artificially dried soils that are well aerated, light and workable. On the downside, nutrients are easily leached from these soils because of their high porosity.
3. Loam soils – a composite of sandy and clay soils containing a balance of clay, silt and sand particles. Considered suitable for most crops, their clay content permits nutrient and water retention and their sand content provides adequate drainage.

By feeling the soil in their hands, farmers can establish whether it is *lafu lafu* (soft and easy – healthy*)* or *uhlalutje* (hard and infertile). The language matters in this regard. The repetition of *lafu* (*lafu lafu*) indicates love and affection for something that is likable or good. These terms are paradigmatic of what feels good and soft in the hand. In all the villages, farmers used these terms to describe a healthy soil. *Lafu lafu* is also used to describe the softness of bread flour. As Sipho said, "*Flour e lafu lafu ngoba e soft*" ("Flour is *lafu lafu* because it is soft"). Some farmers believe

that any soil, no matter how damaged or infertile, can be fixed. Nelson, a farmer and extension officer, believes that every soil type can be used to grow something:

> "There is no soil which is bad for farming. Every soil can be improved. If you have clay soil, there is something a farmer can do to actually improve it. You add organic matter. Once you add organic matter, the soil become a bit more loose – which allows root penetration and drainage and promotes the moisture-holding capacity. The same applies to sandy soils. We say sandy soils are very poor and loose, they are very infertile, but you can improve the soil by adding the same organic matter. Organic matter works for every soil type."

Farmers had a variety of thoughts about soil texture and structure:

"Sandy soil will not be good for all plants, it will be suitable for root crops like carrot, beetroot because they do not need strong soil, because they loosen out or above the ground." – Mxo	"*Umhlaba oyisanti awuzobamhle kuzo zonke izityalo,kuzobalula ngetyalo ze-Root crops (izityalo zengcambu) e.g. carrot, beetroot ngoba aziwufuni umhlaba oqinileyo ngoba zikhula ngaphandle okanye ngaphezulu komhlaba.* – Mxo
"The environment or vegetation will tell you what kind of soil you are dealing with. The earthworms and moles are indicators that the soil is healthy. The other thing that will show you what kind of soil you are dealing with is how the soil absorbs the water. You will be able to tell, for example, whether the soil is clay or sandy." – Mzobe	"*Environment okanye vegetation iyakuxelela yonke into ngomhlaba. Imisundululululu nentuku, uyibona ukuthi loyo mhlaba muhle, mase kuba ukuzibonela ngoku faka amanzi emhlabathin ukubona ukuthi amanzi awuphatha kanjani umhlaba. Ukubonakala kwamanzi amaningi noma umhlaba oyisanti noma iloamy soil.*" – Mzobe

"Stony soil like gravel is mainly suitable for construction. That's not the type of soil suitable for crops." – Nombi	"*Umhlaba ngathi unamatye, osebenziwa xa kwakhiwa [construction]. Akuwona umhlaba wezityalo, kwari*." – Nombi
"For example, when I want to plant potatoes, I need the soil to be easy in the hand [*khafu-khafu*], as if it is sandy but not quite like sand." – Nomkhosi	*"Xa ufuna ukulima itapile kufuneka umhlaba ube lafu lafu, ubengathi yisanti, ngoku ndiyahlakula ndenzela ukuba ube khafu-khafu.*" – Nomkhosi
"We know the soil is good when it is easy in the hand." – Yolisa	"*Umhlaba siye siwubone ukuba u-right uye ube lula apha esandleni.*" – Yolisa
"When the soil is hard and has stones, then I know it is not healthy and I need to use manure to make it better." – Nomkhosi	*"Siye siwubune mhlawumbi ulafu-lafu okanye une-dongwe, xa ugqinile unamatye umhlaba uphelile umdala.*" – Nomkhosi
"When the soil is good, it has to be easy in the hand when you are holding it." – Lasizwe	*"Umhlaba ma u-right kufuneka ubambe ungaqini."* – Lasizwe
"When the soil is rich it's soft in the hand [*laphu laphu*]. When you dig it with a spade you can tell that it's soft [*khaphu khaphu*]. But when the soil is infertile, it's hard." – Babalwa	*"Xa utyebile umhlaba uba laphu laphu, kwa ukuba uwuthi nge-spade uyavakala ube khaphu khaphu. Kanti xa ungatyebanga uyaqina.*" – Babalwa

Image 26: Left: "Uyabona xa uthi ungaphlalai ungabi ludongwe ube lafu-lafu. Yinto ayiqinanga ayithambanga yinto ephakathi nje." A farmer in Kwetyane showing and explaining to me what lafu lafu soil looks like. Right: Another farmer in Mooiplaas showing me her rich soil.

Image 27: Farmers in Mgwali (Stutterheim) show me an example of uhlalutye (stony soil).

When the soil is *lafu lafu,* it is easy to remove unwanted weeds or wild plants. There is no struggle. With that soft soil, going to the fields become less labour intensive as time goes by.

"When there are weeds in the field, and if it is easy to remove such weeds, then the soil is healthy." – Mamorena	"*Ha hona le lehola masimong hape lehola le tswa habonolo, kea tseba mobu o hantle.*" – Mamorena

Image 28: Mzi, a farmer in Nqonqweni, shows me how easy it is to remove weeds in healthy soils.

Colour

Soil colour is important as both a qualitative and quantitative indicator in agriculture. It can be used to indicate important processes taking place in a soil profile, such as formation processes, and important constituents such as humus, hydroxides of iron and silicic acid (Ibáñez-Asensio et al., 2013; Mouazen et al., 2007). Colour indicates the rock type that the soil originated from as a result of soil weathering. Colour is also important as an indicator of a healthy soil; healthy soil is generally darker because of the humus – when leaves or compost rot, they become black.

Colour is a physical property that offers knowledge of important characteristics, such as mineral composition, age and soil processes, including chemical alteration, carbon accumulation and the presence of humufied organic matter. A dark colour may also indicate the presence of organic carbon in fertile soils (Buthelezi-Dube et al. 2019; Mouazen et al., 2007). All the farmers I interviewed identified a dark colour as the healthiest and their favourite.

Literature suggests that darker soils are associated with increased agricultural productivity as a result of the amount of organic matter present. Other soil properties that affect colour include drainage and aeration. The colour composition of soil constituents yields the observed colour. Based on their studied soil profiles, Doelman and Eijsackers (2004) found that the A zone (uppermost layer) is usually dark and rich in humus as a result of a higher supply of plant litter. This is especially true of farming soils. As noted previously, chemicals change the soil to a pale colour, but the soil may also appear pale when it has been depleted by crops (without the use of chemicals). If soil is pale but has never been used for farming, the existing vegetation may have depleted it. A soil scientist from the University of Stellenbosch also indicated that a greyish colour could mean that the soil lacks oxygen – this could be caused by excessive water, which depletes oxygen and builds up carbon dioxide (Fernández and Hoeft, 2009).

Researchers use the Munsell colour notations[8] for soil classification (Frankel, 1980; Pegalajar et al., 2020). Though qualitative, the farmers' analysis is supported by the scientific literature, and the findings of the Munsell notations and indigenous knowledge are similar. Nelson, an extension officer, had this to say about soil colour:

> "The colour of the soil can also indicate the history of the land. How it was used. If, for example, you find that your soil is always having some salts, there is a whitish salt layer, it can tell you that the soil was used heavily and the previous owner was using a lot of chemicals."

Nelson said that understanding different soil colours is an advantage for other reasons too: "The red soils are richer in iron. This is good if you are keeping pigs. You won't need to inject them

[8] Colour charts are used to classify soil colours. The charts, which incorporate 238 colours, are encoded using the Munsell system (Pegalajar et al., 2020).

with iron. They will pick it from the red soils." Mouazen et al. (2007) similarly found that red or brown soils are rich in oxidised (ferric) iron.

Mxo cautioned, "*Xa umhlaba u-acidic ubonakala ngokuba dry, uzofika kukhona into ngaphezulu ngathi luthuthu ngathi ubolile. Khona i-powder ngathi umhlophe, utsho ukuthi umahlaba u-acidic.*" ("When the soil is too acidic, it becomes dry and there is a colour like ash, as if it is rotten. There is a white colour. Then you know the soil is acidic.")

"When the colour changes, then we know there is something wrong with the soil. When the soil is healthy, its colour is black" – Nomkhitha	"*Siye sibone unengxaki xa uqala utshintsha i-colour. Xa umhlaba u-healthy, umbala wawo ubamnyama"* – Nomkhitha
"When the soil is unhealthy, it changes to a white colour." – Buyi	*"Mawungatyebanga umhlaba ubamhlophe.*" – Buyi
"When the soil is healthy it is also shiny." – Boni	"*Umhlaba xa utyebile uba ngathi uya-shine*." – Boni

Mxo says you can even determine which crops to plant by looking at the colour of the soil:

"Red soil means there is iron oxide. It means the soil is full of iron. Root crops are suitable for such soil."	*"Umhlaba onombala o-red kusuke kukhona iron oxides. Kusuke khukhona iron khona, Root crops zifuna umhlaba o-red.*"

Smell

López-Aguilar et al. (2020) assert that smell is more effective than the other senses, because smell is sensitive to even low concentrations of a particular compound in the air. The authors used smell to assess the fertility and toxicity of soil contaminated with crude oil and concluded that smell was a reliable criterion with which to assess the toxicity and fertility of the soils tested. According to farmers, rich soils smell earthy, such as a fresh, earthy smell after a light rain. The type of organic

matter present is indicated by the sweet aroma. Nosiviwe, a farmer, likened the smell of rich soil to freshly baked cakes. Nomkhosi said about the smell of soil: "*Ukhe ubone xa bekushushu then kunethe kukho elavumba andikwazi ukulichaza, limnandi li fresh. Yeke yinto enjalo ke*." ("You see when it is hot and then it rains? That smell, I cannot explain it, but it is breathtaking and fresh. Yes, it is something like that.")

Babalwa agreed: "*Ewe sibakhona qha andikwazi ukusibiza ngegama elipheleleyo, uyavumba andazi ukuba ndizakuthini. Ukuvutha yiphunga lemvula, makuna imvula uyabona lephunga leli imvula xa ihlangana nomhlamba*." ("Yes, there is that smell. I can't explain it but when it rains... that smell when the rain hits the soil, that smell when the rain and the soil meet.")

Mzobe also described soil smelling good: "*Umhlaba ofakwa umnqumba ne co-host, uyazwakala unuka kamnandi*" ("When you put manure on soil, the soil smells good").

Taste

Retallack and Burns (2016) note that the French compare the taste of their wine to the taste of the soil – *gout de terroir*. The soil pH and nutrients affect the taste of the wine, so wine grown in soil with a normal pH of 3.4–3.8 tastes fresh, while wine grown in very acidic soils tends to be sharp like vinegar (Goode, 2014 cited in Retallack & Burns, 2016). Retallack and Burns (2016) argue that "wine, like soil, is a living medium with a geological heritage."

In some parts of Africa, eating soil is a culturally constructed practice – for example, some women eat soil because they associate it with reproduction and life (Geissler et al., 1999). This should not be confused with geophagy or dirt-eating, however – tasting soil in this context is an assessment tool with which to diagnose its health or fertility and demonstrates a relationship of trust between farmers and their soil.

Farmer Nosiphiwe says that the taste of the soil can indicate whether the soil is acidic: "At times when it comes to soil pH, when you are dealing with acidic soil, it turns to be sour in taste. So you can even taste soil to check acidity."

Effective depth

Hirzel and Matus (2013) conducted a study in Chile and concluded that relative to shallow soil, deep soil had a positive impact on grain yield. Hao et al. (2020) explain that our understanding of soil composition and diversity are often restricted to topsoils, but deep soils are equally important for crop production. For example, topsoils tend to become dry in summer and roots find it difficult to absorb water and nutrients, while deep soils contain more than 50% of total soil's organic carbon on average (Hao et al. 2020). Similarly, farmers offered different reasons for why effective soil depth is important, with Bongiwe saying:

"When you are covering your holes with the soil, make sure you use enough soil so that it will not be easily blown away when there is wind, and the soil should be soft."	"*Qha xa ugqumelela akufuneki ugqumelele kakhulu, worse into ezinje nge carrots nezi-spinach akufuneki xa ugalela lamhlaba uwugalele kakhulu wenzela ukuba ungaphumi. Kufuneka ube soft lamhlaba ube khaphu-khaphu.*"

Farmers use a spade to determine the suitable depth of the soil, with Nosiviwe explaining that "You can also use the spade to check how deep the top soil goes." For root crops such as nuts and potatoes, there should be enough depth for roots to spread out. A farmer in Ncera told me that nuts are especially vulnerable to depth and to rocks underneath – if the root hits a rocky area, that is the end of the nut crop. Tillage should also be effortless to indicate the softness of the soil.

Mzobe explained that some seeds do not need to go too deep into the soil though:

"I once planted butternut in my loam soil, but it didn't grow. I later found out the reason why – it was depth. I had planted the butternut very deep."	"*Bekengatyala kumhlaba wami oyi loam soil, ndatyala imbewu ye-butternut yangaphuma, ndathola emva kwexesha ukuba ndizifake phantsi kakhulu imebewu, ndaziqiba nge-spade.*"
"With other crops, the seed doesn't need a spade, because they are too small. You can	"*Ewe kwezinye izityalo noma imbewu awuzodinga ispade, ungadinga nje i-rake*

simply use a rake to let the seeds into the soil." – Kwebulana

lokuvula umhlaba ngoba i-seeds zincane" – Kwebulana

Mamorena, a farmer in Stutterheim, does not take chances with her vulnerable crops. In addition to her maize fields, she also does container gardening to control soil depth.

"Soil has to go down deep enough for roots to also go down. That's why container gardening is an advantage in this case. You can control the depth." – Mamorena

"*Mobu o tlameha hoya fatshe hore methapo e tsebe hoya fatshe le yona. Ke ka hoo ke sebedisang container gardens hobane ke kgona ho laola botebo ba mobu."* – Mamorena

Image 29: Mamorena, a farmer in Stutterheim, has made a success out of container gardening.

Presence of other plant species

Holzner (1982) points out that so-called primitive cultures used the fact that certain plants prefer certain habitats as an agricultural indicator long before it was known in the science community. Plants are as important to the soil as the soil is to the plants. Cover crops improve soil quality and prevent soil erosion (Wall, 2013). Farmers can also identify plants that thrive in rich soil. According to Tesfahunegn et al. (2016), Ethiopian farmers mentioned the following weed species

as indicators of high quality soils: *Datura stramonium* L., *Hyparrehnia* spps, *Carthamus lanatus* L. and *Galinsoga parviflora* L. In Kenya, farmers used different weed species to assess their soil fertility (Mairura et al., 2008, cited in Tesfahunegn et al., 2016). Nosiviwe also observed that "You can see when the soil is changing. Even the weeds that are growing in that soil, you can see they are stunted."

Both agree that good soils are rich in plant diversity, be they different weed species, aloes or other wild plants.

Nosiphiwe said: "There are various wild plants found in healthy soils. There are certain weed species that will tell you that the soil is rich – *qwanqwang* will grow where the soil is rich, as a result you can add *qwanqwang* when you are making liquid manure. There is *infino ye sixhosa* called *tyutu* (leafy amaranth), it trenches nutrients from deep down in the soil, as a result you can plant it with potatoes, it loosens the soil."

Some farmers worry that the state programmes introduced in the rural Eastern Cape will affect some of the indicators described here. Farmers who have joined these programmes use the most controversial pesticide, Roundup. Ntombi, a farmer in Kwelerha, thinks the chemicals will affect what she calls good weeds:

"The truth of the matter is that we are using Roundup because people don't do manual weeding anymore. These chemicals that they use to kill pests end up destroying weeds that can also be used as fertilisers."	"*Inyaniso nje ukuba kusebenziswe i-Roundup kukhawulelwana nemeko, ukuba akusekho bantu bokuhlakula. Ezi-chemicals bazifaka ukuba kubulalwe i-pest kodwa bezimosha nokhula ngoba ukhula luphinde lusebenze njengo manyolo (fertiliser).*"

Wild vegetation also feed on nutrients in the soil, and exotic species like gum trees and pine trees are heavy feeders. In Peelton, farmers complained that *umnga* (acacia) trees were taking up too many nutrients and disadvantaged pastures and other areas in their fields. They also drew a lot of water from the ground. Xola said, "*Ziyamosha ngoba zithatha amanutrients amanintsi*" ("They

destroy, because they outcompete crops and take up excessive soil nutrients"). Van der Waal (2009) conducted a study in Kouga, Eastern Cape, about the invasion of acacia trees and its negative affect on the ecosystem, specifically noting a reduction in species richness, nutrients and N cycling rates and an increase in water use.

"As you can see here under this tree, there is nothing growing. It is taking up all the nutrients in the soil. This is not an isolated case. Our pastures are bare because of these trees. From afar you may see a very dense forest, but when you come near, there is bare soil, nothing but these trees growing. They also take up too much water, which is already a problem here, because we tend to experience prolonged droughts. Our cattle are suffering." – Xola

"*Njengoko ubona apha phantsi kwalo mthi, akukho nto ikhulayo. Uthatha zonke i-nutrients ezisemhlabeni. Le asiyomeko yodwa. Amadlelo ethu abharhileyo ngenxa yale mithi. Ukude ulibone ihlathi elishinyene kakhulu, kodwa xa usondela kukho umhlaba obharhileyo, akukho nto ngaphandle kwale mithi ikhulayo. Bakwathatha amanzi amaninzi nasele iyingxaki apha kuba siqhele ukudibana nembalela ixesha elide. Iinkomo zethu ziyasokola.*" – Xola

Image 30: Left: During a focus group meeting, farmers in Peelton showed me a pine tree they said is a heavy feeder that should be removed from their fields. As can be seen, there is a bare patch in the soil where nothing is growing. Right: Pine trees and a forest at the far end of the fields.

The farmers pointed far across the fields to a forest that they say is useless, because all the trees there are pine and have finished the pastures and the little stream that used to be there. They call the problematic tree *umga* in their native Xhosa.

"Even near the dam these trees start growing, and they have long roots that take up too much water. Do you see over there – those fields? Even that area with pine trees used to be our fields. The community used to plough in those areas, ploughing has always been a way of sustaining our livelihoods." – Xola	"*Nakufuphi nedama le mithi iqalisa ukukhula, kwaye ineengcambu ezinde ezithatha amanzi amaninzi. Uyabona phaya – ngamasimi lawo? Nalaa ndawo inemithi yompayina yayikade ingamasimi ethu. Abahlali bebelima kwezo ndawo, ukulima ibisoloko iyindlela yokuziphilisa.*" – Xola

Sage grass is also a heavy feeder. Like the pine trees, it outcompete crops for nutrients in the soil. Nelson, an extension officer, said that this grass species is an indicator of a healthy soil but that you remove it from the fields. Any grass species can be an indicator of healthy soils, and rye grass and star grass cannot grow just anywhere, with rye grass being very selective. Nelson explained:

> "Even *imfino ye sexhosa (*leafy amaranth). There are other species that show the grass is poor, or some can indicate the climatic conditions of the area, for example the area is semi-dry or dry – doesn't receive lots of rain. For example, we have the acacia and the mopani trees – wherever you see them, then you know it is an arid or dry area. In these types of areas you can farm provided you have irrigation – not rain-fed crops. It has to be irrigated crops. The soils in these areas can be very rich but dry. You need something to augment the moisture of the soil, but wherever they are, it shows that the area does not receive rain regularly."

Fungi and bacteria

Microfauna such as bacteria and fungi are also soil inhabitants. Because they generally cannot be seen, the importance of microfauna is often underrated, but they play a role in decomposing organic soil matter, protecting plants against pathogens, forming soil from rocks, fixing nitrogen and degrading waste (Giri & Varma, 2020; Frac et al., 2018). Plants depend on fungi and bacteria to digest nutrients, as they cannot digest nutrients as humans do (Dunham, 2011). Although mushrooms can be seen by the naked eye, they belong to this group of organisms. Farmers mentioned mushrooms as indicators of healthy soils.

Frac et al. (2018) write that organic manure influences soil health and directly affects soil fungal communities. Farmers using manure mentioned seeing mushrooms in their fields, and Dunham (2011) states that mushrooms are an indicator that soils are healthy. Mushrooms form a structure known as hyphae in the soil that increases plant roots' area. The collaboration between the hyphae and the plant roots is known as mycorrhizae (Dunham, 2011). Mycorrhizae support plants with nutrients, are responsible for nutrient recycling and contribute to soil structure (Dunham, 2011; van der Heijden, 2009).

Bacteria and mycorrhizal fungi both exude glue-like substances that are responsible for the production of particle aggregates and contribute to good soil structure, which reduces compaction and increases porosity and the soil's capacity to hold air and water. Additionally, some microbes are responsible for the production of natural surfactants that promote water infiltration through the soil.

The rhizosphere is the area in the soil close to the roots and is considered biologically active, as it is where plants and microbiome interact (Giri & Varma, 2020).

Image 31: Left: Mushrooms growing where kraal manure was spread in Mxumbu. Right: "We know when the soil is this dark and when we see poisonous mushrooms that it is healthy" – Mzi in Nqonqweni.

Creatures found in rich soils

The important role that soil biota play in the ecosystem is often underrated, with the focus often on aboveground organisms. But these soil organisms are responsible for the maintenance of stable soil structure, something that not even fertilisers can do (Veresoglou, 2015; Wall, 2013). In a multispecies model such as a food web, species feed on one another, and one species' waste becomes another's food (de la Bellacasa, 2017). The soil ecosystem is vital for plant growth. Microorganisms, which dominate the underground, drive agro-ecosystem functions such as maintaining soil structure, recycling nutrients, degrading agro-chemicals and pollutants and biologically controlling plant and animal pests (Lupwayi et al, 2010; "Soil organism", 2016). Soil organisms are also responsible for drainage and aeration, among other important functions ("Soil organism", 2016).

Invertebrates such as earthworms are considered highly important for the health of the soil, because they stimulate plant growth by releasing nitrogen into the soil (Van Groenigen, 2014). Soil is teeming with life and reacts to environmental changes that arise (Wall, 2013).

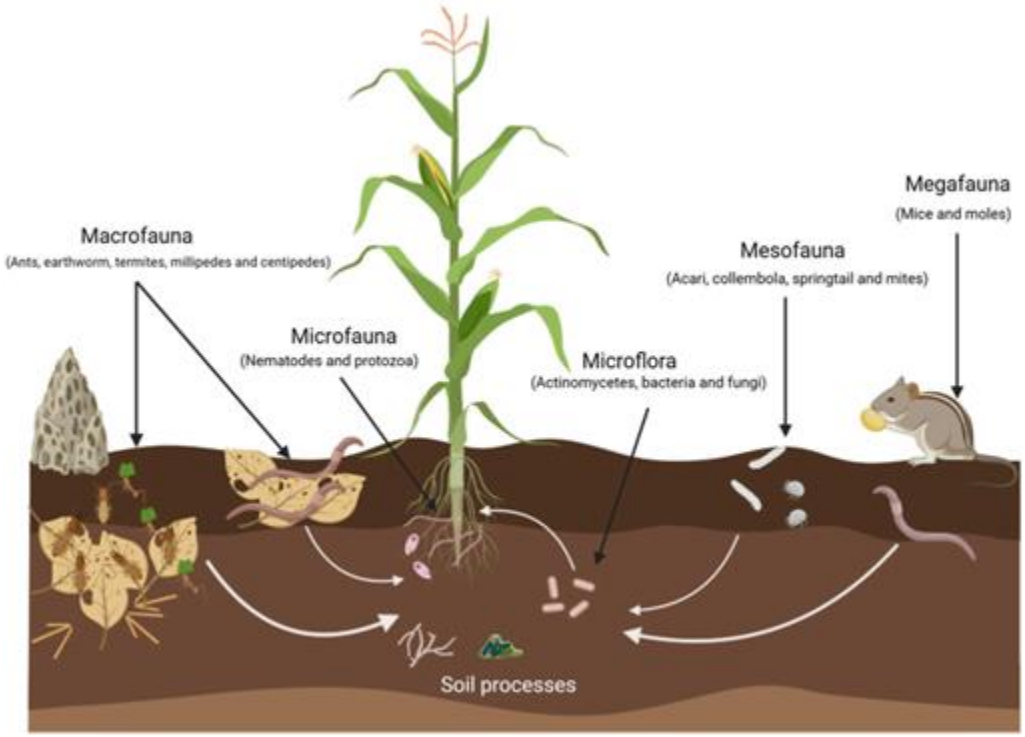


Image 32: The role of soil organisms (Giri & Varma, 2020).

Although megafauna such as moles are often blamed for disrupting plants roots, they play an important role in improving soil aeration and drainage (Giri & Varma, 2020). Other, smaller soil animals and macrofauna such as earthworms aerate the soil and break organic material litter ("Soil organism", 2016). Earthworms were mentioned by all the farmers as indicators of good soils. Among other important functions, macrofauna improve water infiltration, mineralise organic matter and release nutrients into the soil (Giri & Varma, 2020). Earthworms produce binding agents that form water-stable macro-aggregates, and they burrow and mix soil, improving soil porosity (Doran & Parkin, 1996). During feeding, earthworms are said to contribute to the decomposition of plant residue, nutrient recycling and the redistribution of nutrients in the soil profile (Doran & Parkin, 1996).

Farmers regard moles as pests because they eat root crops such as potatoes, but they only appear in rich soils. Nelson observed that "They will destroy your crops, because they are looking for earthworms. They are herbivores and are not interested in your crops. But they will ruin your crops while searching for earthworms in the soil."

The organic farmers in Berlin did not mind moles. They told me that because their potatoes are of good quality, moles often do not cause problems for them.

"Our potatoes are hard and of really good quality, so the moles don't make huge bites. They make a little dent and go." – Aphiwe	"*Itapile zethu ziqinile kwaye zisemgangathweni olungileyo ngokwenene, ngoko ke intuku azenzi izilonda ezinkulu. Zenza isibonda kwaye zihambe.*" – Aphiwe

In Kwamzongeshe, Xarhuni, farmers have noticed many frogs in the fields where they have been planting cabbage over the past few years. Nelson suggested that "Frogs could be an indication that the water stays on top of the soil longer."

This could happen in soil with drainage problems, but frogs are not always a sign of trouble. A study carried out in paddy fields in China discovered that introducing frogs reduced rice pests and improved the nutrient status of the soil (Teng et al, 2016). Due to the overuse of pesticides and being hunted by human, frogs have disappeared from the paddy fields in recent years, and pests

have become rampant. The two-year study concluded that frogs hunted as many as 12 different orders of insects, and soil aeration and nutrients increased as a result of burrowing and frog excrement in the fields. Frogs improved enzyme activity and microbial biomass, the two most vital factors of soil fertility. This demonstrates that biological control methods can answer current global environmental challenges.

"Frogs are not bad for crops. But a frog is also an indication that there is too much water in the fields. The grasshoppers are a nuisance, because they eat the crops, there is a black bird that eats corn while it is still in early stages. And if you beat it all of them will come for your crop, and then you will have to brew a traditional beer and ask for their forgiveness so that they can leave your crop." – Sizwe	"*Masele awazimoshi izityalo tu, kodwa alikho right xa lisemasimini ngoba lichaza uba intsimi yakho imanzi kakhulu, intethe ziyamosha ke zona ngoba ziyazitya izinto eziluhlaza, kukho intaka emnyama iwutya umbona uselapha phantsi xa ujike wangumthoba iyawugrumba xa uyibethile kubuya zibeninzi zizokutya apha kwesisityalo sakho siphele, ngoku funeka uzozicenga ezintanka wenze noba ngumqombothi uthethe nazo zihambe zishiye itsimi yakho.*" – Sizwe

Nonto, a farmer, observed the following indicators:

"Songololo [millipede], *msundululu* [earthworm] and *intuku* [mole]. There are many that prefer fertile soils. There is even a snake that we call soil snake. It doesn't bite, just eats soil. It is short and brown in colour. There is also *mbundana* [a type of worm], it likes fertile soil."	*"Songololo, umsundululu kunye nentuku. Ibe yilanto ingxola gqithi ikritsi, nayo iyawuthanda umhlaba otyebileyo. Zininzi kukho nobhomoli ithanda lamhlaba utyebileyo, kukhona nenyoka ithanda ukuvela pha kulamhlaba utyebileyo siyibiza inyoka yomhlaba ayimoshi, ayilumi itya nje umhlaba imfutshane ngokokumila ifana nosundululu ibrown.*"

As their presence stimulates the decomposition of organic matter, soil without earthworms or with an extremely low earthworm count indicates unsustainable crop production. An insufficiency of

earthworms results in a reduction in nutrient cycling, uptake availability, natural drainage and aggregate stability, all of which protect the soil from erosion (Doran et al, 1996).

Crop appearance

Just as soil health should be monitored continuously, so should crop health. As described above, healthy crops also indicate healthy soils. Crop appearance assessment should be done when crops are visible. Farmers can look at different factors, as described in Table 10.

"We can also tell by our produce when the soil is rich. If our spinach is big, our soil is healthy, but if the spinach is stunted, then we know the soil is not rich. The other indicator is the presence of earthworms. We know the soil is healthy when we see them." – Mthombeni

"*Siphinda sibone nge-produce, umhlaba otyebileyo siwubona nange spinach ukuba sikhulu kwaso ukuba utyebile umhlaba, ukuba asikhulanga siyayazi ke awutyebanga umhlaba. Enye into xa sibona imisundululu siyayazi utyebile umhlaba, nenyiki umbungu sibona ngawa ukuba utyebile umhlaba ayizityi nezilimo zethu.*" – Mthombeni

Table 8: Crop appearance assessments

Indicator	Healthy crop	Unhealthy crop
Colour	Darkish green	Changes in colouration may indicate nutrient deficiency Appearance of yellowish colour in green leaves indicates nitrogen deficiency (See pictures below) "If the soil has very little phosphorous, the leaves turn purple." – Nelson
Crop growth	Tall or large crops	Reduced or stunted growth "If there is stunted growth, that's potassium. You can use the crops themselves to assess the conditions of the soil." – Nelson (See pictures below)
Presence of pests and disease	Healthy crops are able to resist pests or disease "When plants don't grow in healthy soils, they become weak." – Nelson	Unhealthy crops are likely to attract disease and pests "The healthier the plant is, the better it is resistant to pests and diseases. It's called comorbidities in humans." – Nelson

Indicator	Healthy crop	Unhealthy crop
Resistance to stress caused by natural factors	Stress tolerant	Not able to withstand stress

These indicators are co-dependent on each other. For example, Nelson explained that you cannot depend on colour alone to check the overall health of the soil. Other indicators, such as crop appearance, matter.

“You know the NPK [nitrogen, potassium and phosphorus] – those are the major nutrients. If the soil has very little nitrogen, you will see the leaves turning yellow. And then phosphorous, the leaves turn purple. Then if there is stunted growth, that’s potassium. You can use the crops themselves to assess the conditions of the soil.”

Image 33: Left and right: A proud farmer in Stutterheim standing in her fields. Behind her is a tall field of maize. The height indicates the health of the maize. Stunted growth is an indicator that a nutrient is lacking in the soil. She is holding a healthy-looking green pepper (dark green, no discolouration).

Farmers say that crop appearance is an indicator of how healthy soil is. Soil lacking in nutrients will affect growth and the health of the soil. Farmers in Peelton believe that one stick of maize

should be able to carry at least three corns at harvest. In areas such as Mxumbu, the crops looked stunted and yellow. The farmers in that area blamed drought.

Image 34: Left: In Mxumbu, the maize was yellowish and stunted and was surrounded by weeds, which could be outcompeting crops for soil nutrients and contributing to the stuntedness. Right: Some butternut leaves were turning yellowish in Mzongeshe, a sign of nutrient deficiency.

Other indicators mentioned by farmers

Earthworm castings

Earthworms leave castings where they live, which farmers can look for to determine the presence of earthworms in their fields. Earthworm casts are good sources of nutrients to the soil, as are their dead and decaying bodies (Doran & Parkin, 1996). In addition to providing nutrients to soils, earthworms create burrows that roots can follow to uptake nutrients associated with casts.

"Another thing, I do not know if you know it, is intsudwana. There are many of them here, they are produced by worms and utyani. All these things makes the soil to be rich." – Bongiwe

Image 35: Left and right: Earthworm castings in Kwantuku and Peelton.

Soil assessment scorecard

Farmers can use this scorecard to assess their soils.

Table 9: Soil assessment scorecard

Indicator	Bad	Moderate	Good
Texture (*lafu lafu*)			
Colour (dark in any colour)			
Smell			
Taste			
Depth			
Creatures present in soil			
Plants present other than crops			
Crop appearance			

Soil restoration techniques

Farmers believe any soil can be fixed, no matter how bad a state it is in. Section 5.6 presents indicators that are helpful when assessing soil, and it is vital that farmers come up with their own soil restoration techniques. Farmers have different remedies for problems associated with soil health and agriculture more generally. Farmers love organic remedies such as *umgquba* (manure) and compost, because they boost soil quality by increasing plant residue (Wall, 2013). Organic remedies also help reduce soil-borne pathogens and increase soil biomass (Wall, 2013). The information in this section is from the farmers themselves, a few agricultural specialists and from literature.

Soil structure assessment: Understanding soil structure/knowing your soil

Mamorena, a farmer based in Stutterheim, said that the first step to soil restoration is understanding what soil structure/texture you are dealing with. Soil structure is also an important determinant of which crops to farm. Nelson, an extension officer, advised that knowing your soil structure will also help you decide how to treat it and farm it. Some farmers believe there is no such thing as bad soil, and Mzobe said, "*Soze kubekhona umhlaba omubi, qha kusuke kube umuntu utyala into engafanele kuloyo mhlaba."* ("There is no bad soil, it depends on which seeds you are planting in that soil").

One of the easiest and most cost-effective ways to assess soil structure is by using the jar test (Bradley, 2021). Any jar can be used: half fill it with soil; add a drop of dishwashing liquid; fill the rest of the jar with water; close the jar and shake it for at least three minutes; wait for the soil particles to settle. The sand's large particles will be at the bottom, silt will be in the middle and clay will be on top (Image 36). Organic matter floats to the top. Use a ruler to measure the three soils. In Image 36, sand dominates at about 50% and is followed by silt and a small amount of clay. The ratio determines the soil structure – this could be classified as sandy loam.

Image 36: Jar test.

Farmers also described their own easy assessment tests:

Mzobe is a farmer and an extension officer. He has worked with rural farmers in the former Ciskei and Transkei homelands and was raised by farmers. He knows another technique:

> "I also take the soil and mix it with water. I then do a sausage-like shape in my hand and then I make a round shape. If the soil is able to make a round shape without breaking, then I know it's clay. If the soil breaks in half, then I know it's loam, but if the soil doesn't even agree to make a round shape, then I know it's sand." – Mzobe

Mxo uses a similar technique:

"You can assess good soil or bad soil by merely using your hands. You can take a handful of soil and mix it with water, then create a ball shape. If the ball breaks easily, you know you are working with sandy soil.	"*Umhlaba omuhle uphinde ubonakale ngoku thatha umhlaba esandleni uwufake amanzi mase wenza ibhola uzobe usubona uma ibhola lomhlaba liqekeka/liphihlika ukuthi lomhlaba owesanti (sandy soil) umhlaba wedongwe*

Clay soil will form a ball and won't break. Loam soil will form a ball but there will be cracks."

awuphihliki mase kuba i-loamy soil izoba nama crakes amancane."

"The environment will tell you what type of soil you are dealing with. The vegetation will tell you as well and even the organisms in that soil. Earthworms and moles are an indicator that you are dealing with rich soils. Even when you water the soil, if the water doesn't stay for long in the soil, you know your soil is sandy. If the water stays longer, then you are dealing with clay." – Nombi

"*Environment noma vegetation iyakuxelele yonke into ngomhlaba. Imisundululula nentuko uyibona ukuthi loyo mhlaba muhle, mase kuba ukuzibonela ngoku faka amanzi emhlabathin ukubona ukuthi amanzi awuphatha kanjani umhlaba. Ukubonakala kwamanzi amaningi noma umhlaba oyisanti noma iloamy soil.*" – Nombi

"Areas that are closer to the sea often have sandy soils. Crops such as *amadumbe* are suited for such areas, areas such as a little town called Lusikisiki, not very far from the sea. It is also hot." – Nombi

"*Izindawo eziseduze kolwandle zinomhlaba oyisanti njalo ke amadumbe alungele yona lo ndawo, e.g. indawo ekuthiwa iseLusikisiki iseduze base lwandle futhi kushushu.*" – Nombi

Farmers prefer *lafu lafu* soils, which have ground structure and are full of organic matter. Healthy soils produce healthy plants, and the healthier the plant is, the better it resists pests and diseases. Nelson, who spent decades working with farmers in Zimbabwe and now in the Eastern Cape, says diseases mostly attack crops that are poor in terms of health. When plants do not grow in healthy soils they become weak, like comorbidities in humans. While farmers should strive for *lafu lafu* soils, they should also be aware that some crops thrive in so-called bad soils such as clay, which is considered to be a poorly drained soil.

> "There are plants that do well in poorly drained soils, like bananas, yams, *amadumbe*, et cetera. While the soils become poorly drained, the drainage doesn't happen fast. These soils hold on to water. Rice, for example, loves these types of soils. Rice can actually grow submerged in water," said Nelson.

Mamorena, a farmer, works with sandy soil and decided to try container gardening to prevent soil erosion:

"My soil, first of all we have got bad soil here. Our soil is sandy and gets eroded by water. That's why I also do container gardening. When you pour fertiliser inside a container, it remains there [doesn't get eroded]. Even the soil inside the container improves, because I also mix it up with grass. When the grass decays, it helps the soil. For hard soil, you can also use chicken manure to loosen it."	"*Mobu wa mona o mobe. Mobu wa rona ke lehlabathi hape o ya le metsi ha bonolo. Ke ka hona ke sebedisang container gardening. Mobu kahara mabidi ana o ba hantle hobane ke o tswaka le jwang. Ha jwang bo bola, mobu o wa thusahala. Ha mobu wa hao o le thata, o ka sebedisa moitedi wa khoho ho o nolofatsa*."

Farmers such as Mxo know that sandy soils are suitable for root crops such as carrots:

"Sandy soil won't be suitable for all the crops. It is best suited for root crops such as beetroot, carrots and so on, because such plants don't want heavy soil, since they are inside the soil most of the time."	"*Umhlaba oyisanti awuzobamuhle kuzo zonke izityalo, kuzobalula ngetyalo zeRoot crops (izityalo zengcambu), e.g. carrot, beetroot ngoba aziwufuni umhlaba oqinile ngoba zikhululula ngaphandle noma ngaphezulu komhlaba."*

Nelson agreed: "Carrots do well in sandy soils. The only disadvantage is that it needs constant irrigation because it doesn't hold moisture, lots of drainage because leaching [leaching is washing down of minerals] is very high. Most of the root crops like carrots don't need very heavy soils – there are carrots, radish, beetroot and groundnuts too. These are root plants. They don't need heavy soils, otherwise they won't form. These crops need sandy loams. It doesn't have to be sand, but sandy loams. The soil has to be loose."

"Seeds and soil have to go together. You can't plant a seed in a soil that is not good or suitable for that seed. You have to consider the depth,	"*Imbewu nomhlaba kuyahambiselana, ngeke ulime imbewu bekungewona umhlaba omuhle ukuthi utyaleleyo leyo mbewu kuphinde*

the timing [season]. If you plant it too late or in the wrong season, it won't come out. The other thing that we are working against is climate change. The seasons have changed and the farming landscape has changed. It is no longer like in the olden days when you knew for sure how the seasons would turn out." – Mxo	*kubekwe ne depth oyityale ngayo imbewu futhi nexesha, ngoku lelixesha (season) belima ngayo beseku-late, ixesha elingafanelekileyo. Njengoba sengene kwi climate change, amaxesha (seasons) aseshintshile nawo, awasafani nakudala lapho obuwazi khona ukuthi ngesikhathisoulima kubanjeni.*" – Mxo

Farmers who have sand or clay can improve their soil structure to suit their farming needs. Nelson explained:

> "If you have clay soil, there is something a farmer can do to actually improve it. You add organic matter. Once you add organic matter, the soil become a bit more loose – which allows root penetration and drainage and promotes the moisture-holding capacity. The same applies to sandy soils. We say sandy soils are very poor and loose, they are very infertile, but you can improve the soil by adding the same organic matter. Organic matter works for every soil type.
>
> "But for closely packed soils like clay, you need to be careful when working with them. You don't need to work on them when they are too wet – or when they are too dry, because the structure of the soil can be destroyed. When you work it when it's wet and then it becomes dry, it becomes very hard like cement. It will then affect the health of the crops."

Image 37: Left: Mamorena's container farming in Fort Marie showing one of the herbs she planted. The soil in her area is sandy and easily eroded. She controls the soil through container farming. Right: In Mzongeshe, a farmer shows me that their soil is sandy, but since using umgquba it is getting better. The picture shows sandy soil without umgquba and the darker soil with umgquba.

Choosing a cropping system

Crop rotation/intercropping/companion cropping/monocropping

Small-scale or peasant farmers have grown multiple crops dating back to ancient civilisations (Takim, 2012). Intercropping has many advantages over monocropping, including weed control, disease and pest control, increasing yields and soil conservation (Takim, 2012; Song et al., 2021). For farmers who prefer organic farming, crop rotation can offer a herbicide-free alternative. Dominschek et al. (2021) carried out a study in Brazil and concluded that rotating tropical grassland with cash crops is an effective herbicide-free management strategy that also reduces weeds. Farmers suggest that choosing a cropping system can also be a soil restoration technique. Nompilo cautions farmers to be wary of sticking to one crop, which can exhaust the soil in the long run: "Be wary of crops that exhaust the soil, like pineapples. It is also advisable to do crop rotation."

Farmers prefer intercropping or multicropping for different reasons, with Nosiphiwe saying:

“There should be an understanding of a friendship that occurs between the plants – symbiotic relationships. For example, if you plant potatoes, beans, maize, that’s a good example. The maize will shelter butternut and beans from extreme weather conditions. Beans will bring back nitrogen from the soil for the other plants and then the butternut will shelter the soil. That’s a symbiotic relationship.”

Mkhosi said: “You see, my father has always done that [companion cropping]. Sometimes he would mix beans with maize or maize with pumpkins. So at home we used to eat maize, beans and pumpkins at the same time.”

Research conducted on intercropping has proven that, for example, pairing legumes and cereals results in higher grain yields than planting either crop alone (Takim, 2012). Intercropping is beneficial for the soil and is economically rewarding, as farmers can harvest different crops across the year to sell to feed their families. However, it is a problem for farmers who have joined state-funded initiatives such as cropping. The cropping projects in Mooiplaas, Peelton, Ncera, Kwelerha and some sections of Xarhuni only grow maize, planting genetically modified seeds and spraying them with Roundup herbicide.

Nonceba, a farmer, observed that “This means we are unable to pair maize with root crops like we used to in the past. In the past we would plant different crops such as maize, butternut and potatoes. But now we can’t, because Roundup will kill them.”

Soil preparation

Farmers informed me that land or soil preparation is an important step before planting crops. Nelson explained:

“You see, before I plant, I remove all the dirt in my soil and make sure that it’s clean. I don’t plant my seeds in unclean fields where there are weeds. This ensures that the crops don’t compete with weeds for nutrients in the soil.

In terms of soil preparation, even if you are working with virgin soils, which are not very loose, you need to loosen soil particles by adding organic matter. It assists the workability of the soil. If in your field you have different soil types, you still need to add organic matter, but don't plant the same crops throughout."

Nosiphiwe cautioned: "When you have already worked the soil, don't step on it, because you are interfering with soil structure. You work this side, stand on the other side – work the soil, but don't step on the soil that has been worked on."

Nomthandazo noted that even the tools they use are important:

"If you use a spade, the worm will die, because you cut it with a spade and it is needed on the ground to stay alive – but the fork spade does not kill from the sides. They are both deadly, but the rate of death with a fork spade is lower than that of a spade. The presence of earthworms in the soil mean the soil is healthy."	"*Mawusebenzisa ispade umsundululu uzofa ngoba uyawunquma ngespade kanti iyadingeka emhlaben ihlale iphila kodwa ifork spade yona ayibulali iphuma emaceleni. Zona aiyabulala zombini kodwa izinga lokozibulala ngefork spade liphansi kune zinga lespade. Ukubonakala komsundundululu kumhlaba usho ukuthi umhlaba omuhle*."

Bongiwe said that the weeds can be used as compost too:

"When you are cleaning your garden of the unwanted plants and roots, you dig a hole in the corner where you put all these to make them your fertiliser. All the time when you are cleaning your garden you put the unwanted in that hole to make a good fertiliser."

Farmers in Peelton explained that after harvest they leave corn leaves on the fields to decompose and enrich the soil. Xola explained after harvesting, he does not get rid of the field residues including stalks and leaves. The residues become fertiliser instead.

What farmers use to keep the soil healthy

The inherent complexities of soil management require diverse approaches, some of which will work for some farmers and some of which will not. This testing kit comprises different approaches to offer farmers a wide range of choices.

Table 10: Methods to improve soil

Technique to improve soil	What it does
Umgquba (manure) Livestock manure (cows, goats, sheep and pigs) Poultry manure (chicken)	"Kraal manure improves soil structure." – Thuli "I have realised that the manure of four-legged animals is best suited for root crops. I use goat manure for my turmeric." – Mamorena "In my opinion, pig manure is better than cow manure. It tends to be hotter and more effective." – Mthombeni "For my maize to be this big, I use goat manure. Even my cabbages are huge because we use goat manure." – Nomsebenzi "Chicken manure is best for the leafy plants that grow on top." – Mamorena
Compost: Vegetable waste Newspapers	Discarded organic matter, including eggshells, vegetable peels, fruit, teabags, nut shells, newspapers, paper, grass clippings, plants, leaves, sawdust, wood, cotton rags, wool rags, hay, straw, hair, fur, ashes, yard trimmings, etc. "It can also be dead chickens from poultry producers, chicken manure and other things. You can mix all of them together with decaying plants." – Nosiphiwe "Piling together vegetable waste and using it as compost later on." – Mzi
Green manure	Sown crops that can be used for mulching Legumes such as beans, peas and lentils Non-legumes such as ryegrass, buckwheat and oats
Liquid manure	Mixture of animal waste and water Must be stored for at least three months to release toxic gases
Fertigation	" Fertiliser + irrigation = fertigation" – Mxo Applying fertiliser with irrigation water increases soil fertility
Mulching	"It helps with retaining the moisture, it also helps to protect the soil structure, also helps maintain the balanced warmth in the soil so that the crops can grow even if it is very cold – they cannot feel that cold to the extreme because they are covered." – Nosiphiwe "Before I plant, I place dry grass in the tyres. When it rains, the grass keeps the moisture in the soil. I place the grass underneath and then pour the soil until the tyre is full. Underneath is your grass, there should be grass on the sides, then pour the soil in. As time goes by, the grass decays and the soil becomes fertile and nutritious." – Mamorena (this applies to container gardening)

	"One can also use dry grass and spread it on the soil. It works like a fertiliser." "We also use *qwangqwang* for mulching. It's very effective. *Qwangqwang* is also an indicator that your soil is rich." - Mzi "You can also use potato peels and *qwanqwang* for mulching." - Mzi "Mulching suppresses the growth of weeds." – Nosiphiwe
Wood ash and limestone	Wood ash works best for treating acidic soils "Wood ash is an organic lime. It replaces agricultural lime, which is a chemical." – Nelson "Limestone helps with controlling soils with too much acid."– Sizwe Chalk also treats acidity Oyster shells balance soil pH levels
Recycle stems/leaves or any crop material left behind after harvesting, weeds	"I never get rid of maize stems after harvesting. I use them as fertiliser." – Nombi "When cleaning my soil in preparation for planting, I collect all the weeds and put them in one place until they decompose. I then use the weeds as fertiliser." – Nombi
Comfrey leaves Banana peels	"I put banana peels in a container and pour water. After a few days, I use the mixture as fertiliser." – Mamorena "Banana peels work very well as a fertiliser." – Mzi

Umgquba (manure)

This is the composted manure of livestock, including pigs, goats, sheep and cattle, and some farmers use poultry manure as well (e.g. chicken). Popularly known as *umgquba*, composted manure is extremely popular among rural farmers in the Eastern Cape. They believe that *umgquba* can fix the most damaged of soils. However, farmers were quick to point out that it takes a while for manure to "age" and become effective. Using fresh manure can contaminate crops and cause disease. Manure is an effective fertiliser because it contains three important nutrients – phosphorous, potassium and nitrogen – and improves soil structure and boosts organic matter (Mahr, 2022).

"Cow manure has to be 'ripe', the colour and the smell also have to change before you can use it." – Mzobe	"*Lo wenkoma kumele ulindwa uvuthwe, utshintshe umbala kanye nokunuka kwawo.*" – Mzobe

"Kraal manure takes up to five years in the soil. You don't have to use it every season, but fertiliser ruins the soil, it even kills earthworms. Soil can also have acid. When your soil is too acidic, your crops turn red." – Sizwe	"*Umgquba lo wenkomo uthatha five years ulima kuwo not every year ufaka umgquba after five years, fertiliser iyawumosha umhlamba ibulala imisundululu, ziyafa ezizinto zikhulisa umhlaba, umhlaba uyakwazi uba ne-acid, xa ulima kumhlamba one-acid ufumaniseka uba izityalo zakho zibomvu*." – Sizwe
"By using manure – we use it a lot – and when planting sweet potatoes, it helps to break the soil. One can also use dry grass and spread it on the soil, it works as a fertiliser." – Nonto	"*Utshintshwa ngomgquba, siwusebenzisa kakhulu kanti ne bhatata iyawuzama umhlaba ongavelisiyo iwuqhekeze ukuze ibengumhlaba okwaziyo ukuvelisa okanye usebenzise ingca eyomileyo uyondlale pha kwezozityalo iye ijike ke ibe ngumgquba.*" – Nonto

Compost

Kalamdhad (2021: 2) defines composting as "an organic waste disposal method that allows biological decomposition of organic materials to conserve and recycle nutrients essential for plant growth and make an application in soils possible." The composted organic waste is generally comprised of discarded food scraps and other items, including vegetables, fruits, eggshells, tea bags, newspapers, cardboard, grass clippings and leaves (United States Environmental Protection Agency, 2022). This form of composting is environmentally friendly, because it removes these items from landfills where they would otherwise be discarded. Like composted manure, composting requires time. Nosiphiwe, a government extension officer who promotes organic farming in the Eastern Cape, explains:

"Compost making needs time. I know someone who takes dead chickens from poultry producers, chicken manure and other things. He mixes all of them up together with decayed plants. You need to give that some time and it will be ready for use. As a result, when you take compost when it's

ready, it doesn't smell. You can drive from here to King William's Town with it and you won't smell a thing. It smells okay, because it is ripe or ready to use.

"There is manure, there is compost. Compost is a mixture of everything that was alive, even dead animals – everything that is decaying, decayed substances. They are being mixed in a certain ratio. Then it stays there for some time and you need to occasionally stir it to make sure that it mixes. It enriches the soil. It even suppresses some pests. Especially the ones that are soilborne. Compost helps the plants to be strong. It's an immune booster to the plants. It's like a supplement. It protects the soil for a long time. And with this method, whether it's manure or compost, you don't need to add it every day, like they do conventionally. Because with conventional, if you put in fertilisers this year, the fertiliser just helps boost the plant. With manure and compost, they enrich the soil and the plant. I always say to the farmers: healthy soil is equal to healthy crops, healthy crops are equal to healthy animals, healthy animals are equal to healthy people. So we start this with the soil. The soil is so fundamental to this production."

In *Integrated approaches towards solid waste management*, Kalamdhad (2021) suggests composting bovine blood and rumen as an environmentally friendly and cost-effective solution for slaughterhouse waste management. This recycled waste can be used as an alternative to chemical fertilisers. This method has been used in Mexico and Brazil to grow peppers and soybeans (Kalamdhad, 2021).

Green manure (GM)

Green manure, also known as 'green undecomposed material', is mainly used to amend soils by providing necessary nutrients (Jeanroy, 2022; Cherr et al., 2006). These cover crops improve the soil and are used as a form of mulching (Jeanroy, 2022). Green manure with legumes (e.g. beans, clover) is useful for fixing nitrogen in the soil, while non-legume green manure includes ryegrass and oats (Jeanroy, 2022). In *Duckweed (Spirodela polyrhiza) as green manure for increasing yield and reducing nitrogen loss in rice production*, Yao et al. (2017) reported their findings from a three-year experiment in China using duckweed (water lentils) to improve rice production. Although the researchers also used chemical fertilisers, they concluded that duckweeed increased nitrogen and was more effective than using chemical fertilisers alone.

Sizwe, a farmer in Kwetyane, uses this method:

"When the peas are almost ready to pick, you cover them again. By doing that, you enrich the soil. That is called green manure. Even if it rains a lot, the topsoil does not erode because of green manure. When you want food, you let it grow."	"*Pees xa ziqalisa udumba ziphume uye uphinde uzigqumelele ngokwenza njalo uyawuhlaziya umhlaba kuthiwa yi green manure keleyo, iyakwazi noba imvula inetha kakhulu ungahambi umhlaba ngenxa yale green manure.*"

Liquid manure (slurry)

Only one of the farmers I interviewed used liquid manure (animal waste mixed with water), which is not surprising, as water shortages remain a huge problem in the Eastern Cape. Boni, a farmer, said:

"For liquid manure, you take water and fresh cow dung and mix it with aloe and tobacco. Spread the concoction on your plants. It will help with pests, and the cow dung will protect your crops against the sun."	"*Liquid manure uthatha amanzi, ubulongwe obu-fresh udibanise nekhala necuba lesixhosa uzidibanise engxolweni uzifake ezityalweni iyasiza kwizinambuzane, obabulongwe buyahlala apha ezityalweni iyangceda ilanga lingatshisi izityalo.*"

However, it has been argued that fresh manure cannot be used immediately and should be stored for three months or until it is odourless so that it can release gases harmful to soil and plants (Tanks, 2017; Gov.UK, 2016).

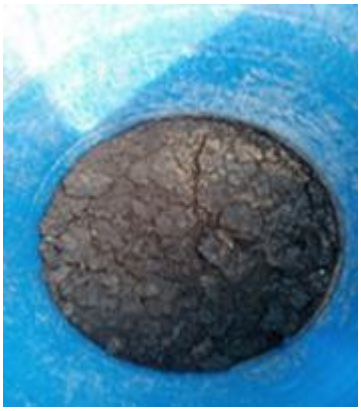


Image 38: Liquid manure container in Nqonqweni.

“Inside this tank was our liquid manure mixture. We have to pour water in. It serves as both a fertiliser and pesticide. Because of the strong smell, it chases away pests.” – Mzi

Fertigation

Fertigation is “the technique of supplying dissolved fertilisers to crops through an irrigation system” (Falivene, n.d.). Crops are supplied with water and necessary nutrients (Incrocci et al., 2017). Mxo, a farmer, explains:

“Fertiliser + irrigation = fertigation is also important for nutrition, and it does not waste much, because it works where you plant between rows. I apply the mulch after harvesting the weeds to avoid evaporation so that the nutrients will remain, and then you turn the soil and apply the mulch – but the fertiliser will not work immediately, as it will take up to three months. The presence of leafy amaranth and earthworms mean the soil is rich. The animals that kill the earthworm can still be chased away by the pig manure. You place the pig manure in your fields and that strong smell will chase away pests.”	*“(Fertiliser + irrigation = fertigation) ibalulekile nakwisondlo (nutrition) futhi ayimoshi kakhulu ngoba isebenza lapho otshala khona between rows. Ndigalela umnqunwa emva kokuvuna (harvesting) kukhula to avoid evaporation ukuze isondlo zizohlala, mase uzowuphethula umhlaba usufaka umnqunwa uwufaka ngaphansi kodwa lo manyolo awuzosebenza ngokushesha kuzothatha noma izinyanga ezintathu kusho ukuthi loluhlobo engifake ngayo ngalima into ezosuka yenzeke kuzobakhona ukhula oliningi, e.g. imfino yesixhosa kubalulekile ukubakhona kokhula. Imfino nosundululu ukubonakala komhlaba omuhle. Izilwane ezibulala umsundululu ungsazigxotha ngomnqunwa wehagu, uwufaka khona kumhlaba olime kuwe ngoba ivumba ilona eligxotha leziwane.”*

Wood ash and limestone

Farmers use wood ash as both a fertiliser and a pesticide. Bongiwe, a farmer, says this technique was passed on from her ancestors, and she is teaching it to her children:

"At home we did not use fertiliser when we wanted our vegetables to be healthy, we used manure before we planted the seeds. We used the old way to plant potato seeds. We just dug holes using ploughs and threw potato seeds all over the place. At times we used ashes from burnt wood, cut a potato in half, dunked it in the ash and put it in the hole and covered it with soil. We had many healthy potatoes. We did not have the white powder that was used then [Blue death pesticide]. We used the old method by sprinkling ash on the cabbage so that the insects wouldn't eat it."	"*Ekhaya besingawasebenzisi ama-fertiliser vele nje besisithi xa sifuna into esiyilimileyo lo veg esiyilimileyo ityebe izoba right besisebenzisa umgqhuba which is manure before sifake itapile xa sifaka itapile besigrumba besingayenzi into yokubala mhlawumbi kuthwe umngxunya wakho ofaka kuwo itapile kuba besizebenzisa indlela endala ubugrumbha nje ngegaba ufake umgquba ufake itapile ugqumelele. Okanye besisebenzisa uthuthu, uthuthu ke yi-ash, yes, i-ash le yenkuni u cutter itapile phakathi landawo umhlophe uyikhatileyo kwitapile uyinxuze aphe ethuthwini ufake apha emngxomeni lo uwombileyo ugqumelele. Itapile zethu ke bezityeba, bezityeba ke itapile zethu sivune itapile ezininzi. I-cabbage lethu ke nalapho besingenalo la-powder ifakwa ngoku uyabona kuba besisebenzisa i-method endala futhi i-ash sigalele apha i-cabbage uyabona ukwenzela i-cabbage yethu ingatyiwa zirhohro zikhona eza rhohro zitya i-cabbage besizenza lonto ke uyabona.*"

Wood ash and limestone boost soil pH levels, which indicate the alkalinity and acidity in soil (Fernández and Hoeft, 2009). In agriculture, pH is associated with soil fertility and can indicate whether soils are in good or bad condition (Merry and Sabljic, 2009). Soil fertility and crop production are thus linked to soil pH levels (Oshunsanya, 2019). Acidic soils have a low pH level and are low in phosphorus, magnesium, calcium and/or molybdenum but are high in iron, aluminium and manganese and are toxic to plants (Kaur et al., 2019). Merry and Sabljic (2009) write that alkaline soils, which contain excessive sodium, can reach a pH level of 10, when

magnesium and calcium are displaced. Soil pH should be at least 7.0, which is considered neutral (Arnold et al., 2021; Oshunsanya, 2019; Merry and Sabljic, 2009). Lower levels are problematic: in addition to crop stress, important soil organisms such as earthworms disappear when soil pH drops below 3.5 (Arnold et al., 2021; Oshunsanya, 2019). Most crops prefer slightly acidic soils, but there is variance across crops (Saunders, 2014; Oshunsanya, 2019). For example, in *Improving nutrient use efficiency of annual crops in Brazilian acid soils for sustainable crop production*, Fageria and Baligar (2001) conclude that while upland rice tolerated acidic soils, soybeans were sensitive to them. However, Oshunsanya (2019) advises that it is important to ensure that both alkaline and acidic soils are brought to a neutral pH level in order to promote plant growth. This can be achieved using wood ash and limestone: wood ash provides essential nutrients such as calcium, potassium, phosphorus and magnesium, while limestone boosts soil pH, calcium and magnesium (Saunders, 2014; Fageria & Baligar, 2001).

"For acidic soils you can use wood ash. Wood ash is an organic lime. It replaces that agricultural lime, which is a chemical. In fact, wood ash does wonders. It even treats your water. In acidic water, you can also put ash in it to treat the water. It should be from proper wood, not treated poles." – Nelson

Sizwe uses limestone when soils become acidic: "*"limestone iyayithoba acid"* (limestone neutralises acidic soils.)

Pest control techniques

Pests and disease affect crop production, competing for nutrients and reducing physiological capacity and root parameters by causing tissue death (Fernández and Hoeft, 2009). However, pesticides (insecticides, herbicides, fungicides, nematocides, rodenticides, etc.) are an environmental concern, because they are persistent organic pollutants that do not easily decompose and that remain in the environment for long periods (Arnold et al., 2021). Farmers can manage pests without using deadly chemicals. Luviwe, a wise farmer in his 80s, explained that everything in the ecosystem has a purpose, even if it seems like a pest to some. By using pesticides to kill pests, we are tampering with the eco-chain, and he said instead "*Siyagxotha asibulali*" ("The aim is to chase away pests, not kill them"). Another farmer, Mamorena, agreed: "Some natural

pesticides can be planted in between crops. In organic farming we chase away pests, we don't kill them."

Planting 'natural pesticides' among crops

Table 11: Planting for pest control

Material	Description
Wild garlic/*Itswele lomlambo*	
Marigold	"I have noticed it's good for getting rid of bad worms." – Mamorena
Stinging nettle	
Comfrey	"Stinging nettle, as you can see, is all over here. It is for pest control. Wild garlic, comfrey are helpful for controlling pests when you plant them between your crops." – Mamorena
Wormwood	
Aloe	
Cigarette filters/wild garlic and chillies/kraal manure concoction	The concoction should be given at least a week to ferment. The strong smell chases away pests. The concoction is also useful as a fertiliser. "We mix them together with water. Then we water our fields with the concoction" – Mzi
Tobacco	Sometimes you use the old traditional tobacco, which is scarce nowadays. It contains herbs. You mix it with water and wait for the fermentation to happen. Then you can water the fields with the concoction." – Mlambo

Nelson advocates for these natural remedies, because farmers do not have to spend money on them to sustain their agricultural practices. "We tell them to make their own concoctions. For example, sour milk with water controls fungal diseases. Some of these concoctions are both pesticides and fertilisers."

Pesticide concoctions

Table 12: Natural pesticide concoctions

Ingredients	Recipe
wormwood aloe chillies	Cut them into small pieces Mix them with water Wait for the mixture to ferment
stinging nettle Sunlight soap chillies	Cut the ingredients into small pieces Mix with 2 litres of water Leave for two weeks to ferment After two weeks, pour one cup of the fermented concoction into a 20-litre container. Spray as desired.
manure water	Pour dry manure into a container (preferably 20 litres) Mix with water Use the mixture to water crops The mixture acts as a fertiliser
nuka-nuka tobacco red chillies	Mix them with 20 litres of water Spray affected areas
urine	"Pour into the mole hole. It's more effective if the urine is at least two days old, then there will be a concentration of ammonia. When you put the urine there, it chokes it and it runs away." – Nelson "Another trick of keeping moles away is to keep the soil moist. Moles hate moisture." – Nelson

"There is something I know… it's just that other people do not understand it clearly, it is rare and it is called *nuka-nuka.* And there is also tobacco. You pour it in 20 litres of water and put in *nuka-nuka* and a small portion of the tobacco and red chillies." – Zanele

"When we get rid of pests, we don't use Roundup. We use chillies, herbs such as wild garlic. We mix the concoction in a container for a day or weeks. The smell of the concoction will chase away pests. The concoction has to be in a 20-litre container. You put it in your fields and it will chase away pests." – Boni

"Xa sisusa irhorho asifaki i-Roundup sifaka i-chillies, herbs, njengetswele namanzi silifaka ebhakethini ebeusuku okanye iveki elevumba layo liyabulala, silifaka ku 20 liter webhaketi emvakoko utshize plot zakho, ikhala netswele eli lasemlanjeni notefani uyakwazi ufumana ne oil pha kuyo nayo iyanuka ngoku into enukayo iyazigxhotha irhorho nenzinziniba uyakwazi ukuthatha amaqhambi wayo uwabeke

phezukwetafile iyazigxhotha izinambuzane." – Boni

Old rituals that some farmers still use

Rituals have always played a big part in African culture and tradition. For important functions such as funerals, Africans have rituals that are held in high regard. Similarly, agriculture is regarded as an integral part of life in many African communities, and agricultural rituals are still performed even today. Some of the rituals are performed when there is a crisis, and many of the rituals have to do with rain, as when there is a prolonged drought. Some are performed out of respect for culture. For example, when a funeral takes place, no one touches the soil or works in the fields. Even when the grave is being dug, nobody works the soil. Farmers described some of the important rituals:

"There are some days when one is not supposed to be working with the soil. Otherwise the soils will not produce. That's a belief. It's in Limpopo. The soil should be left alone on Thursdays. It's a sacred day, when you are not supposed to be working in the fields." – Nelson

"According to our old ways, when someone has died and farmers receive the message while they are still working in the fields, they come back and stay at home or go to the family of the deceased." – Buyi

"When there is no rain and it's dry, we go to eBhakaneni. There is a place called eBhakaneni, which is up in the high hills, it's a place that we put much value and respect on." – Zanele	*"Xa imvula ingekho komile siyahambe sibheke eBhakaneni kunendawo yethu ekuthiwa kuseBhakaneni ephezulu pha kulantaba yindawo ebuphakama yindawo esiyixabisileyo, ewe."* – Zanele
"Our parents worshiped Qamata. When there was drought, people used to go and ask for rain, dressed in Xhosa traditional attire." – Nomzamo	"*Abazali ababethandaza uQamata kuthwe xakubaleleyo mabayokucela imvula, kombhathwe ezanto zesiXhosa kuthwe xakubuywa kubuyiwe*." – Nomzamo

"Most of the time in the Xhosa tradition *isikhakhulu* is used as part of our Xhosa tradition whereby we appease our ancestors. We make traditional beer to thank them and then we go to the fields." – Zanele	"*Isikhakhulu ngesiXhosa into eyenziwayo ngesiXhosa ngaphezu kokucela Siyabulela, xasesibuya kwenziwa kuthiwa yintoni obatywala? Kuyasilwa utywala obukhulu kuthiwe kengoku kuyiwa emasimini*." – Zanele

"We used to go to the mountains and pray for rain, we would wear blankets and put on our traditional bracelets and go to the mountain, we would sing and dance the traditional songs, and the rain would fall within that day. It would rain even before we arrived at home." – Bongiwe

"Back in the days, what happened was that men and women would go to the mountain together. On arrival, the women would sit down and the men would do the praising of uQamatha. Even before they arrived back from the mountain it would start raining." – Mlambo

"There were games that were played by young girls. They would call the rain while playing. Also, a squirrel was used to call the rain. It's hard to catch a squirrel, but if you could, you would tie it to a place where there is water. In that way, you were calling the rain. It was a ritual associated with the rain." – Babalwa	"*Ibikhona imidlalo ibidlalwa amantombazane asemancinci, abekhululа adlale mase abiza imvula. Khona nentsikizi (inyoni) benikwazi ukuyibamba intsikizi noma kunzima ukuyibamba kodwa maniyibambili intsikizi bebeyithatha iyobophwa endaweni emanzi, nayo ibibiza imvula. No, bekuyinto besiyibona inxulumene (associated) nemvula*." – Babalwa

Conclusion

This testing kit suggests a way forward for policymakers and the Department of Agriculture, who should work with what farmers know about their soils and develop a strategy for farmers to generate their own evidence. Most importantly, this chapter proposes a way to integrate local knowledge with science and policy.

CHAPTER SIX

The Black Consciousness Movement, South African liberation and the epistemicide of African farming knowledge

Introduction

Marya and Patel (2021) explain that in Turtle Island, known by non-first nations people as Canada, colonisers deliberately dismantled the indigenous population's connections with nature to subjugate them. Without land, the indigenous population lost access to food and their spiritual power, both rooted in nature. In South Africa, land dispossession of the oppressed black communities resulted in their psychological and physical exile from the soil that gave them food, from the land where their ancestors were buried and from their sense of belonging. In Guinea Bissau, although there were no serious attempts to appropriate land and create white settlements as was the case in Mozambique, Angola and South Africa, Portugal forced small-scale farmers to change their farming practices in order to create a plantation economy (Chabal, 1983; Green and Chabal, 2016; Temudo and Abrantes, 2013). In situations where land was appropriated, black Africans were forced to work as farmworkers for the settlers (Chabal, 1983). The point I am trying to make is that there was always an oppression of some sort in order to exploit either African labour or natural resources. In this final chapter I introduce Nadine Gordimer's *The conservationist* (1974) into conversation with Lesego Rampolokeng's *Bird-Monk Seding* (2017) to demonstrate the interwovenness of environmental degradation, social justice and power dynamics. I also situate Black Consciousness Movement and black activism within Africa's black farming landscape and environmental justice. I contend that although we owe some of the freedoms we enjoy today to the likes of Steve Biko, Martin Luther King, Aime Césaire, Frantz Fanon, Robert Sobukwe and Amilcar Cabral, much of modern-day activism is still centered on oppression against racialised and vulnerable communities and the environment.

Wound within living memory: apartheid geographies, blackness and belonging

Scholar Byron Caminero-Santangelo posits that many African authors and activists do not separate environmentalism from social justice in their work (The University of Kansas, 2018). The work of these two important literary figures can arguably be classified under resistance literature,

highlighting the racialised social structure of apartheid and its continuities into the post-apartheid era. Within this discussion, the questions of belonging and blackness arise.

Mehring: The tale of a capitalist who likened himself to a conservationist

Gordimer's *The conservationist* (1974) describes apartheid South Africa's land and political climate. Mehring, the protagonist, is a white mining magnate and the owner of the 400-acre farm where the novel is mostly set. In apartheid South Africa, farms were symbolic of land dispossession, white power and national identity, especially in Afrikaner communities (Coundouriotis, 2006). For Mehring, who is of German descent, nature is only beautiful when it is exploitable: "A farm is not beautiful unless it is productive" (Gordimer, 1974: 23). Gordimer reveals Mehring's contradictory character – a "conservationist" who wants to "preserve nature" and a global capitalist who believes that nature is there to be exploited and to serve humanity. To him, natural resources are infinite and can be plundered and abused for his satisfaction.

Mehring wants to plant imported chestnut trees on the farm – not to conserve the environment but to remodel the native landscape, a symbolic gesture of white conquest (Coundouriotis, 2006). This gesture also represents mastery over nature. Mehring views himself as being in charge, one who can change nature to suit his needs and wants. The mining dumps that he passes on the way to his farms do not bother him, seeing them as monuments to his power as an imperialist rather than as a symbol of the depleting environment and the extractive and ruthless nature of the mining sector. The townships were structured in such a way that only their residents are exposed to these polluted spaces. This is a global struggle that mostly affects people of colour. In the US, environmental activist Robert Bullard (2020) discovered that from the 1930s to the late 1970s, five out of five of urban landfills were located in African American neighbourhoods, exposing them to dangerous chemicals on a daily basis.

Gordimer highlights the racialised social structure that renders black people pariahs in the land of their ancestors. When Mehring arrives at the farm, he finds the black children of the farm workers playing with guinea fowl eggs. The sight of these children roaming free in his farm repulses him. "You must tell them those eggs are not to play games with. If they find eggs in the veld, they are

not to touch them, you understand?" Mehring reprimands one of his farmworkers (Gordimer, 1974: 12).

The discovery of a black corpse on the farm causes havoc, at least to Mehring's mental well-being. Nobody knows who the dead man is or how he ended up on the farm. Based on the dead man's skin colour, one of Mehring's white associates thinks he must have been a criminal: "There is a lot of loafers about. It's that location [nearby township]. Honestly. And you even had some skelm lying murdered in your place. It's not safe…" (Gordimer, 1974: 56). The apartheid police bury the body in a shallow grave on the farm, promising Mehring they will return in due course to move the corpse to a different location.

The BCM was active around this time, and the corpse is symbolic of resistance against apartheid (Coundouriotis, 2006). The corpse re-emerges after floods and drives Mehring to the point of exasperation, which can be interpreted as the unconquerable spirit of the resistance movement challenging the apartheid regime. The corpse is the rightful owner of the land and stubbornly refuses to leave the farm. The corpse also raises the notion of the land as the place we dump corpses and as a place of beauty. The dead things we throw into the land give us that beauty.

Towards the end of the novel, Gordimer brings to light another important theme, that of African humanness. The farmworkers initially want nothing to do with the corpse but eventually claim it as their own, highlighting the collective nature and solidarity of black Africans. Though the dead man was unknown to them, they bury him as one of theirs. The same can be said about their relationship with land. Instead of buying and owning it individually like Mehring, they view the land as communal, that they can farm as a collective and allow cattle to graze on open land (Biko, 2017).

In the last paragraph of the book, they bury the dead man, bringing him into the fold:

> The one whom the farm received had no name. He had no family, but their women wept a little for him. There was no child of his present, but their children were there to live after him. They had put him away to rest, at last; he had come back. He took possession of this earth, theirs; one of them. (Gordimer, 1974: 267)

African humanness is an important determinant of how black people relate to humans and the natural environment in its entirety. Unlike Mehring, there is no mastery over nature. The late author Es'kia Mphahlele (in Samin, 1997) once explained:

> In African humanism there is no dichotomy between the material world and the spiritual world. There is a continuity reinforced by interrelationships and interconnectedness. That is, animal life, plant life and inanimate objects have a life of their own which is part of us. Which is why, for instance, a traditional healer will use organic matter to heal the body, it will be something plucked from nature, because there is a unity. Part of the continuity is also dramatised by the way in which women will take their afterbirth and bury it in the vicinity, because it symbolises reincarnation, the cyclical pattern of existence.

This novel is important because it explains the role of the imperialists in South Africa. The imperialists not only exploited black labour, they exploited nature as well, but the critical focus is always on the human victims. The novel also explains imperialism as dependent on place and placement. For imperialism to work, it lays claim to a place that does not belong to it, imposes a cultural paradigm on another people and extracts natural resources that do not belong to it. Gordimer describes the displacement of black people that severed the traditions that kept black people physically and spiritually connected to nature. Nature suffers the same exploitation at the hands of capitalists such as Mehring, but it has no voice to speak for itself.

Bird-Monk Seding **highlights apartheid continuities**

Rampolokeng's poetic *Bird-Monk Seding*, published 23 years after South Africa's democracy, lays bare the struggles of post-apartheid South Africa under the ruling ANC. The influence of Aimé Césaire in Rampolokeng's writing is evident, but Rampolokeng does not promise a better tomorrow or offer any hope that the oppression of poor black communities will end.

Rampolokeng parallels Césaire in addressing the connection between imperialism and the environment. Césaire's *Notebook of a return to the native land* ends on a positive note. The poet finally bonds with his native land, which in the beginning seemed foreign to him. The poet also points out that the greedy colonialists are so busy making money that they do not hear the sound of revolting slaves. In *Bird-Monk Seding*, Rampolokeng highlights the continuities of racial

injustices after apartheid – racial subjugation, poverty and "land hunger" (Madlingozi, 2018). South Africa is beautiful to those who do not live in the dark underbelly of its ghettos.

> The stars come out to play in the bushveld. They cavort, tossing light and tickling the trees. And when the wind blows you can hear the trees giggling, happy. Very close by. It lubricates and scents the senses. The breathing bush whispers its happiness. You feel like you want to touch the sky deeper than Hendrix. The firmament seems like it wants to touch your eyes and it is wondrous, especially if your whole life was tied to the Soweto-imagination-prison habitat. They smile, those stars. & the moon comes out seductive-like, wanting to wrap around you. "Ah but your land is beautiful" once said the dreamy wonder-struck liberal. He didn't know the cursed & poisoned half of it. (Rampolokeng, 2017: 68)

The narrator in the book, Bavino Sekete, grows up in Soweto "the crime-land, earth scum" during the height of apartheid (Rampolokeng, 2017: 6). Post-apartheid, Sekete moves to another township in North West – Leseding, or Seding – surrounded by farmlands, where the situation has not changed much since the end of apartheid. The ANC government has replaced the iron shacks with 'proper' houses, but no more land has been allocated to blacks. The area is plagued by poverty, alcoholism and prostitution. Environmental justice is a question of skin colour and economic class – the white-owned farms get their clean water from the Marico River, not the water contaminated with sewage that is provided by the municipality to the black and poor residents of Seding. Seding is the country's smallest municipality, but "the regularity of graves opening up beats average middle-town" (Rampolokeng, 2017: 60). It is even worse to be a black woman here. Not only is the black woman at the very bottom of the food chain, she is vulnerable to the white man's world and black man's patriarchal violence. Skin colour still matters, and the oppressed are still landless.

The mass relocation of black people to the homelands that made up only 13% of the land heavily affected their capacity to sustain themselves off the land. In Seding, Sekete writes that some individual farms belonging to white people are so big that a township would only take up a quarter of them. In *The conservationist*, the government wants to buy Mehring's farm to build another township there. Only Afrikaners feel a sense of purpose here, as they still have the land. Black people only get the land when they are dead, because their graveyard "keeps eating up new ground, itching closer to the township" (Rampolokeng, 2017: 133).

Despite the end of segragational policies, a neo-Nazi white supremacist movement, the Afrikaner Weerstandsbeweging (AWB), is active where white farmers still operate and own land close to Seding. The members of the AWB often drive into the bush dressed in their khaki outfits to train and prepare for civil war! The bodies of dead black people are sometimes found nearby. "Nobody searches the farms, so nobody knows of the corpse becoming manure there" (Rampolokeng, 2017: 61). Where the black corpse 'fights' for a proper burial in *The conservationist*, in post-apartheid North West province corpses end up as "manure", enriching the farmers' soils.

Growing up in Soweto during apartheid, Sekete realises that the old system never really ended. In fact, the beauty of the area had captured him from afar, because he was searching for a tranquil, beautiful place for a writing retreat, not "that soul-polluting and cursed" (Rampolokeng, 2017: 61) Soweto he grew up in. Post-apartheid, Seding is still like "the slave-labour camp Soweto". What happened to the long-awaited freedom the black oppressed have longed for? In Soweto, Sekete explains that the black bourgeoisie often show up in expensive cars, flexing in their fancy clothes: "They don't ask for more, they believe it's theirs to take … They don't see the misery. Or more truly, they see it and rejoice, makes them know how far off the dust and away they are" (Rampolokeng, 2017: 67). Back in Seding, racism prevails and old stereotypes about black people persist. The white farmers still own this part of the world, and Oubaas[9] still calls his black farm workers baboons. Blacks still internalise oppression. Black shop assistants run when a white man requests something, but this privilege is denied to black customers. Rampolokeng presents the sad reality of what blackness and belonging look like in post-apartheid South Africa, and *Bird-Monk Seding* offers no hope that the situation in post-apartheid South Africa will change.

The conservationist and *Bird-Monk Seding* are set decades apart, but they address similar themes that continue to haunt South Africa: racism, environmental justice, racialised social structures and land dispossession. A wound, a discontendness continues to haunt the formerly oppressed and racialised communities. Without land, they will never regain a sense of pride and belonging. While the BCM emphasised black pride and called for black people to reclaim their blackness, I posit

[9] "Oubaas" or "baas" is an Afrikaans word that black workers used to address their Afrikaner employer (Burden, 1997). It carries negative undertones and is associated with the apartheid era, when blacks were treated like slaves.

that black pride' can be defined and expanded in several ways. bell hooks (2008) associates pride with belongingness and place and writes about the beauty of her hometown in Kentucky's natural environment, a place that heals, "a place of refuge", a place where one chooses how to live and "a place to die". Here, black jockeys felt a sense of pride as part of the town's horse culture, but this changed when segregational laws were imposed in the United States. These laws changed black people's attachment to the town, their relationship with nature and animals – especially to the horses they loved so much.

> Separating black folks, especially black jockeys, from the world of Kentucky horse culture went hand in hand with the rise in white supremacist thinking. For us it meant living with a culture of fear where we learned to fear the land, the animals, where we became fearful of the moist munching mouths of horses black jockeys would rarely ride again. This separation from nature and the concomitant fear it produced, fear of nature and fear of whiteness, was the trauma shaping black life. (hooks, 2008)

It is not that different in South Africa. Farmers stripped of their land lost everything, including their pride and sense of belonging. Mr Nzo, a black small-scale farmer based in Ncerha, Eastern Cape, spoke with a sense of nostalgia and great sadness when he remembered his father's land, which was taken by the apartheid regime.

"Our farm was in Bhoda. It is said my parents were born there. My father had so much livestock there – it is close to Ncerha village. Have you seen that soil? Have you seen the livestock there? In that area, we never experienced drought. There was always a cool breeze that came from the sea nearby. Our livestock never went hungry. Our grass grew the tallest."	*"Mna lentsimi ndisuka kuyo kuse Bhoda kuthiwa abazali bam bazalelwa khona. Utatam wayefuyile pha, kufutshane nase Ncerha kulamhlaba. Ubonile lamhlaba unjani? Ubonile inkomo zapha zinjani? Phayana ke nokuba kune mbhalela iinkomo zapha azibinazo imbhalela ngalamqhumo uvele lwandle. Ulwandle lukufutshane iinkomo zakhona zitya pha, ingca ikhula ibengaka."*

When we talk about farming and land, the issues of blackness and belonging hover like a shadow. Yet the intersectionality of land, belonging and blackness is often unexplored in discussions of agriculture and soil management practices. As I explained in the preceding chapter, agrarian policymakers in post-apartheid South Africa have focused on the commercialisation of land and soil. This capitalist view of land is problematic, however, because it neglects an important understanding of land as being more than a commodity to black rural farmers. The psychological and spiritual relationships between farmers and soil is left unaddressed, producing and perpetuating systems of oppression and domination between farmers and land. Initiatives such as the Massive Food Production Programme (MFPP) and the Cropping Project are a continuation of apartheid, and farmers' relationship with soil becomes a 'violent' one. Pesticides that harm soil organisms are used to terminate and destroy, synthetic fertilisers are used to ensure that soil, like a slave, is overworked and mistreated to produce crops. In a mimicry of the injustices of apartheid, soil is seen only as a means of making money in service to the capitalists.

This repeats the relationship of a master and slave, with the farmer as master and the soil as slave. This changing relationship causes farmers to go on what hooks (2008) calls a mental exile. They have lost the land, but it is still there, transformed to dirt under their feet. What becomes of blackness and belonging to the land of one's ancestors? Apartheid laws reconstructed how black people related to the environment. Being forced to live within the boundaries of the homelands meant physical and mental exile for black people. The structures that were created by apartheid are still intact in the form of violent townships such as Khayelitsha. How do we address violence and inequality in black communities when these geographic spaces still exist? Ultimately, farmers will "feel no sense of place. What they know, what they have, is a sense of crisis, of impending doom" (hooks, 2008).

Lessons from revolutionaries

Black activism on land and farming: Cabralism agropolitical concepts

Within black activism, the question of how colonialism impacted the relationship Africans had with land has always been of paramount importance. In *Notebook of a return to a native land*, Césaire (2013) writes that colonialism has created an agricultural landscape in which black people grow sugarcane and make rum. Fancy drinks will be made out of this rum that the oppressed black

will never taste. The labour of the black slaves on plantations maintains the high lifestyle of France, the mother colony. In the essay "Let's talk about Bantustans", Biko (2017: 95) also rejects the homelands and describes them as "sophisticated concentration camps" where black people could not farm or do pastoral work. Similarly, Fanon describes how the binary structure created by the settlers in colonised countries has killed the culture of the colonised, poisoning the traditions, beliefs, values and customs of the natives:

> That is why we must put the DDT which destroys parasites, the bearers of disease, on the same level as the Christian religion which wages war on embryonic heresies and instincts, and on evil as yet unborn. The recession of yellow fever and the advance of evangelisation form part of the same balance sheet. But the triumphant communiqués from the missions are in fact a source of information concerning the implantation of foreign influences in the core of the colonised people" (Zeilig, 2016: 107).

However, it was arguably Bissau-Guinean revolutionary Amilcar Cabral who extensively analysed the impact of colonial means of production on Lusophone Africa's farming landscape and soil. Decades after Cabral's untimely death in 1973 (Chabal, 1983), his analysis is relevant to modern-day Africa's agricultural landscape and to this study. As a researcher based in the EHS, there is an understanding that research should be open to combining different disciplines with people's lived experiences. Cabral was way ahead of his time because he recognised that agronomy was not limited natural sciences but incorporated people's knowledge and experiences under the colonial regime (Cesar, 2018). He also questioned the true meaning of science and suggested that in order for science to serve humanity it should: "be experimental, promote the collective good of all living beings, including human beings, be explicative, and its ordered elements must be logically consistent (or in accordance with their own reason), and it has to be in accordance with reality" (Wood, 2020: 139).

Interestingly, when the Portuguese government offered Cabral a scholarship (the only African in his class) to study in Portugal (Mendy, 2019), the plan was that he would serve the colonialism agenda. But Cabral was wary of 'colonial science'. I am borrowing the term colonial science from Schiebinger (2005) to describe biased or corporatization of science to serve the interests of colonial powers. Corporatization of science is what farmers in this study describe in chapter one – "we are

defeated by modern science (GM technology)" because it serves multinational corporations, takes away the little money they have and destroys their sustainable agricultural practices based on social cohesion and kinship with nature.

To assess the agricultural landscape in the Lusophone including Cape Verde, Guinea Bissau and Angola, Cabral considered both human and natural histories – prefiguring studies of the Anthropocene (Cesar, 2018). As a trained agronomist, Cabral argued that it was the activities of man that affected the balance between soil and climate (Chabal, 1983). He regarded soil erosion as 'a scar left by historical violence' (Cesar, 2018). In essence, what Cabral posited was that the development of export cropping in the colonies devastated the environment, led to a decline in soil fertility, exploited indigenous peasants and threatened African agriculture (Chabal, 1983). In this way, Cabral situated soil and agricultural problems in the colonies within colonial imposition.

In his final thesis (a requirement to finish his agronomy studies in Portugal) titled: *The Problem of Soil Erosion: Contribution to the Study of the Cuba Region in Alentejo*, Cabral wrote that because the Alentejo region (Portugal) was controlled by a few landowners whose favourable grain prices were protected by a state monopoly, this led to exploitation of landless workers (Saraiva, 2022). The solutions that Cabral suggested to counter soil erosion are similar to what the farmers in chapter six came up with e.g crop rotation and cover crops. Upon finishing his studies in Portugal, Cabral was employed by the colonial regime and conducted a first ever comprehensive agricultural survey of Guinea Bissau (Chabal, 1983). The agricultural survey required him to travel to every village in the country and he learned about how the colonial regime had underdeveloped agriculture and affected soil (Tomás, 2021; Chabal, 1983). For example, Cabral was critical of the groundnut monoculture. His arguments were in economic and environmental terms - it was not a good idea to focus on groundnut which heavily depended on fluctuations and the global markets. Environmentally, he highlighted the importance of crop diversification. This lack of crop diversity shows the colonial single crop agriculture which was meant to serve Portugal but leave farmers themselves destitute and with poor soils. In reference to chapter one, the government in South Africa is currently subsidising farmers who practice monoculture (GM maize). However, farmers have stated the importance of multicropping for improving soil structure and providing them (farmers) with a variety of crops after harvesting.

Cabral's concept of science can be considered as both liberating and decolonising knowledge (Wood, 2020). In Guinea Bissau, where Cabral was stationed for his agronomy work, he recognised that the Balantas (ethnic group) possessed an empirical understanding of the natural environment (Wood, 2020). For example, the Balantas understood that N'contu (also known as African rice) was less affected by salt water than other rice varieties and that its large canopies restrained weed growth. On the other hand, the European merchants at the time didn't think much of the dark-coloured rice – they thought it was of poor quality (Wood, 2020).

Like Césaire (1972), Cabral believed colonialism and capitalism were two sides of the same coin (Rabaka, 2014). This argument was influenced by Karl Marx's criticism of capitalist agriculture. Between 1830 and 1870, soil depletion became a major concern in Europe and North America, and Justus von Liebig and Karl Marx's views were crucial in dealing with the crisis (Foster and Magdoff, 1998). While at first Marx was optimistic about the role of science and technology in capitalist agriculture, he later changed his mind and instead highlighted the negative implications of capitalist agriculture (Saito, 2014). Drawing from Liebig's book on agricultural chemistry, Marx wrote in his book *Capital* (cited in Saito, 2014):

> Capitalist production collects the population together in great centres, and causes the urban population to achieve an ever greater preponderance. This has two results. On the one hand it concentrates the historical motive-power of society; on the other hand, it disturbs the metabolic interaction [Stoffwechsel] between man and the soil, i.e., it prevents the return to the soil of its constituent elements consumed by man in the form of food and clothing; hence it hinders the operation of the eternal natural conditions for the lasting fertility of the soil.

Cabral noted the interdependence of humans and soil (Cesar,2018) and doesn't seem to give the impression that humans are the masters of nature. My understanding of Cabral is that he viewed colonialism as a system that negatively impacted both humans and nature. Instead of referring to mountains as a refuge which offered protection to militants in time of conflict as Cher Guevara had implied, Cabral argued that the people themselves were mountains: "There are no mountains at all. Our people call the hills in Boe region, in the south-east, mountains, because in Guinea we

don't really know what mountains are… As for the mountains, we decided that our people had to take their place, since it would be impossible to develop our struggle otherwise. So our people are our mountains (Cabral, 1972: 77)."

What is also important about Cabral is that he was a realist. One of Cabral's biographers Reiland Rabaka who wrote *Concepts of Cabralism: Amilcar Cabral and Africana Critical Theory*, explains that although Cabral believed culture was part of the liberation struggle, he maintained "an epistemic and experiential openness" (Rabaka, 2014: 256). He believed that innovative ideas from outside of his own culture could be adopted but not copied entirely because "our concrete conditions and unique historical happenings are distinct"(Rabaka, 2014: 256). Again this resonates with this study as I believe that there should not be any epistemically borders where knowledge is concerned. Technology can still be used with old cultural practices but not as a replacement. There should be a balance.

Cabral's views on neocolonialism also resonates with how the ANC government has been functioning since the end of apartheid. Back then he could predict neocolonialism as the next struggle in post-independent Africa (Cabral, 1966). Delivering a speech at a tricontinental conference in Cuba, Cabral (1966) said: "the imperialist action takes the form of creating a local bourgeoisie or pseudobourgeoisie, controlled by the ruling class of the dominating country." To overcome imperialism, Cabral suggested that proletariat, peasants and all other different classes of society should work together. He also suggested that the bourgeoisie should commit 'class suicide' instead of leaning towards their bourgeois attitude. Failure to do away with class struggle as Cabral cautioned has led to South Africa becoming one of the most unequal countries in the world.

Psychological liberation and self-reliance: Inspiration from Fanon and Freire

The fact that the most vulnerable communities in Africa are those that live in rural areas and are depended on small scale farming for survival is a subject of many research papers (Gassner et al., 2019; Diao et al., 2010; Jayne et al., 2003). As mentioned, these are also communities that have suffered immensely under imperialistic regimes. For such communities to reach their full potential, it will take more than a change in policy in agriculture and soil management practices. Fanon and

BCM suggest psychological liberation while Freire proposes praxis, a combination of reflection and action as discussed in this section.

Addressing the psychological trauma of racism: BCM and Frantz Fanon

Fanon's *Wretched of the Earth* was treated as a kind of manifesto among revolutionaries such as Biko in the Global South (Lee, 2015). As Fanon's student, Biko regarded the partnership between the intelligentsia and the masses as an incitement for revolution (Halisi, 1991). *Black skin, white mask* was Fanon's first book, and its issues of race and identity (Lee, 2015) are easily recognisable in the BCM ideology. Fanon views racial difference and white superiority as illusions (Lee, 2015: 95): "The black man is not. No more than the white man." He rejects the binary structure of racism that separates whites and blacks, instead taking a humanist approach beyond race and history and longing for a world where all people have equal freedoms.

In *Black skin, white mask,* Fanon grapples with race, class and identity in a society that refuses to accept his blackness. Fanon explains the psychological trauma of a black self in a white-dominated world: he does not want to defend his identity as a black person or convince anyone that he, as a black man, has worth. This book evidently influenced Biko's 1970 essay "Black souls in white skins" (Macqueen, 2018), in which Biko attacks racism and argues that true unity can only happen when mutual respect exists and all people enjoy similar freedoms. Fanon lived in Algeria when it was a French colony and, as a black person, was part of the struggle for its liberation. According to a biography of Fanon titled *Frantz Fanon: Towards a revolutionary humanism* (Lee, 2015), the three years he spent in Algeria as a psychiatrist provided him with the vantage point to observe the overall effects of French colonialism. His relocation to the newly independent Tunisia afforded him the freedom to express his support for Algeria's anti-colonial struggle and broaden his thinking on postcoloniality. His lived experiences in Algeria were reinforced by events in other African countries, such as the anti-apartheid struggle in South Africa, the Mau Mau uprising in Kenya, the independence of Ghana and Kwame Nkurumah's pan-African rhetoric.

As a psychiatrist, Fanon addressed the issues of inferiority inflicted by colonialism. He understood that it was not enough to end oppression and colonialism, and he emphasised the need for psychological liberation among black people (Lee, 2015). The Black Consciousness ideology is

built on the understanding that the apartheid system was responsible for inflicting psychological trauma on black people. If unaddressed, that trauma would manifest in many different ways even after the struggle against apartheid was won. “The colonised man will first manifest this aggressiveness which has been deposited in his bones against his own people” (Zeilig, 2016: 114)). And indeed, post-apartheid South Africa is in turmoil. In a recent interview (eNCA, 2018), Mamphela Ramphele was asked why post-apartheid South Africa was haunted by kidnappings, femicide, violence, etc., and how the country could return to the values of Black Consciousness. In response, Ramphele emphasised that the first step to liberation was psychological liberation:

> Sadly we threw away that legacy. Instead of broadening Black Consciousness into human consciousness, we threw it all away and thought by pronouncing ourselves to be a non-racial society, we would be. We can’t be. The very fact that you define yourself in the negative – non-racial – instead of simply another African country where colour coding doesn’t matter. We missed the opportunity.

Ramphele added, however, that the first step now was to acknowledge that the country is in turmoil coming out of a system that dehumanised both the oppressed and the oppressor. Ramphele is not the only surviving member of the BCM to take a swipe at the ruling ANC, as Barney Pityana wrote a scathing open letter in 2013 calling for the then president, Jacob Zuma, to quit public office due to his weak leadership (Macqueen, 2018).

Memorial lectures and occasions honour Biko and the BCM, but the legacy of Black Consciousness has suffered historical erasure and is reflected in the country’s downward spiral. Biko’s death in detention in 1977 and the banning of the organisations promoting Black Consciousness were big blows. The ANC, like some white liberals, did not understand or embrace the BCM and what it stood for. In exile, Oliver Tambo, president of the ANC, remarked that the BCM “posed a tremendous threat at the theoretical level only” (Halisi, 1991: 102). In 1978, while in prison, Mandela brushed off the Black Consciousness ideology as an imitation from America that disregarded the role of progressive whites such as missionaries, professionals and businessmen (in Macqueen, 2018). M-Afrika (2019) notes that the BCM was marginalised in the transitional negotiations that led to the first democratic elections in 1994.

However, Ramphele (2013) writes in her autobiography that Mandela urged her to carry on the legacy of Biko and the BCM. This change of heart was not evident in his tenure as president and beyond, however, and the government has neglected the BCM ideology. Instead of working with farmers to improve their agriculture, the government has instead opted for a top-down approach, where farmers are told what to do to succeed in commercial agriculture. This model is expensive and ignores farmers' own knowledge systems, promoting the notion that they cannot succeed as modern-day farmers without western education.

Fanon, like Césaire, criticises black elites who now not only occupy the oppressor's former settlements but have appropriated their former oppressor's behaviour (Lee, 2015). Instead of developing their country, these bourgeoisie, or native intellectuals, as Fanon called them, are fixated on and obeisant to the former 'mother' country and foreign capitalists:

> The native intellectual has assimilated to the culture of the coloniser and exists apart from the unity and will of the people. The native intellectual has clothed his aggressiveness in his barely veiled desire to assimilate himself to the colonial world. He has used his aggressiveness to serve his own individual interests. (Lee, 2015: 159)

It has been argued that the customs that drove apartheid and colonial regimes are still in place in the 'new' South Africa, and the current government is administering them instead of changing them (Maserumule, 2015). This 'poison' continues to affect our lives, giving the BCM relevance to this day (Maserumula, 2015).

Black self-reliance: BCM and Paulo Freire

*"*To the oppressed, and to those who suffer with them and fight at their side" wrote Paulo Freire in *Pedagogy of the oppressed.*

Freire undoubtedly played a significant role in the ideology of the BCM. But Cabral's influence on Freire is evident. Fanon and Freire both wrote from lived experiences. Experiencing poverty despite coming from a middle-class background, Freire felt solidarity with poor kids in the poverty-stricken outskirts. But Freire (2000) also understood that the best way to help the oppressed was to work with them, not to work on their behalf. This is borne out in some of the

BCM's initiatives in local black communities. For example, although the BCM members attended university and were considered privileged in terms of social standing, they knew they needed to fight with the people and not just for the people (Price, 1992). Biko even organised a training workshop to understand the methodology behind Freire's *Pedagogy of the oppressed* (Pityana, 1991). Biko and 15 others attended the training sessions for over four months and then returned to local communities to conduct research and to practice what they had learned. The idea behind this was also for students to pay it forward in their communities by sharing skills and knowledge following Freire's model (Macqueen, 2018).

Like Fanon, Freire argued that the oppressed had internalised their oppression and the image of their oppressor and his ways, and he noted the dichotomy caused by oppression. He highlighted the relationship of dominance between the two parties, both dehumanised, with the oppressors treating the oppressed as objects. For the oppressed, the struggle is also to fight to be treated with dignity, to be seen as human. To be rid of these feelings of inferiority, Freire (2000) suggests that the oppressed should replace them with autonomy and a sense of responsibility.

> Attempting to liberate the oppressed without their reflective participation in the act of liberation is to treat them as objects which must be saved from a burning building; it is to lead them into the populist pitfall and transform them into masses which can be manipulated (Freire, 2000: 65).

Biko and the BCM could foresee the danger of this in post-apartheid South Africa. Here Freire, like Fanon, emphasises the dangers of physical violence under oppression but also of epistemic and psychological violence. The masses should take part in their liberation but also be psychologically prepared for the aftermath of liberation. They live in an oppressive environment, so even when they think about liberating themselves, their model of liberation emulates their oppressor's. There is a danger that after liberation, the oppressed will become oppressors themselves (Freire, 2000).

Accordingly, Freire posed a question: "How can the oppressed, as divided, unauthentic beings, participate in developing the pedagogy of their liberation (Freire, 2000: 48)?" To free themselves

from the 'domestication'[10] brought by oppression, Freire suggests praxis, the combination of action and reflection:

> To achieve this praxis, however, it is necessary to trust in the oppressed and in their ability to reason. Whoever lacks this trust will fail to initiate (or will abandon) dialogue, reflection and communication, and will fall into using slogans, communiques, monologues and instructions. Superficial conversions to the cause of liberation (Freire, 2000: 66).

The best way for praxis to work is for the oppressed to think together, without anyone taking the lead. Freire also critiques the 'Banking concept of education' in which knowledge is a gift bestowed by those who consider themselves knowledgeable upon those whom they consider to know nothing. Projecting an absolute ignorance onto others, a characteristic of the ideology of oppression, negates education and knowledge as processes of inquiry. The teacher presents himself to his students as their necessary opposite; by considering their ignorance absolute, he justifies his own existence. The students, alienated like the slave in the Hegelian dialectic, accept their ignorance as justifying the teacher's existence – but, unlike the slave, they never discover that they educate the teacher.

In short, the teacher deposits the knowledge and the learner collects it. The students have no voice and do not share knowledge with the teacher. They reproduce the knowledge they receive from the teacher, but they do not think independently or critically on their own. Freire proposes that instead of telling the learner what to do, the teacher must exchange ideas with the learner so that the relationship is beneficial to both the teacher and the learner (Freire, 2000). Biko and his comrades understood this method, which manifested in projects such as the Zingisa Educational Project (Wilson, 1991), still going today (I even interviewed an employee of Zingisa for this study). This method also influenced Biko's leadership style, recognising that teaching should not be separated from learning and that a good teacher allows students to voice their own views and experiences (Wilson, 1991).

Ramphele (1991) acknowledges that this method of self-help among the poor is easier said than done. For example, how do you get people living in extreme poverty in the homelands, battling to

[10] In this context, domestication as a form of mastery or control over others (Swanson et al., 2018).

survive on a daily basis, to spearhead their own development? In Tanzania, Nyerere's self-help model of *ujamaa*, which influenced the BCM, had failed (Ramphele, 1991). Instead of continuing to work together for the common good, peasants in Tanzania instead exercised their power by withdrawing from Nyerere's initiatives, bringing the Tanzanian economy to a halt. Ramphele and her BCM peers fell prey to similar issues, and differences of class, age and gender resulted in contradictions and problems for self-help at community level (Ramphele, 1991). Nevertheless, Ramphele contends that the BCM projects liberated and empowered activists.

Conclusion

I have argued that the BCM matters in all debates about the emancipation of black people. The BCM matters in debates of land, soil and the environment, because black people are attached and connected to the environment. In addition to racial oppression and exploitation, agrarian policies were entirely based on Eurocentric notions of knowledge and the idea of an expert being someone who uses technocratic solutions and Western references. I used the ideology of the BCM to argue that the current government, like past oppressive regimes, characterises rural populations as non-thinkers and automatons to be controlled. Drawing on the likes of Amilcar Cabral, Frantz Fanon and Paulo Freire, the Black Consciousness ideology pushed for self-reliance and self-determination. The BCM was vital for fostering unity among black South Africans and advocating for physical and psychological liberation at a time when hope for the oppressed had reached its nadir.

The BCM is not a revolutionary panacea that could have saved racialised and oppressed South Africans, but movements like this should be a constant feature in our quest to overcome socioeconomic disparities. This chapter charts South Africa's growth from a country ravaged by racial inequalities and draconian laws to a democratic nation still ravaged by deep scars and unresolved trauma. The lion's share of the blame lies with the state, because the state has a monopoly on law making and has continued with neoliberal and anti-poor economic policies (discussed further in Chapter 4). The state has failed to emancipate people economically, but also psychologically and epistemically. Poor people must become the drivers of their own lives instead of depending on the largesse of a benevolent state for social grants.

CONCLUSION

Entrenching a feedback system in the rural farming landscape

In Chapter one of this research, 'Technology changes everything', I presented farmers' experiences and perceptions of GM technology and concluded that it is unfair to disregard farmers' indigenous knowledge. I demonstrated the importance of preserving indigenous farming practices embedded in culture and tradition. In chapter three, I highlighted how the post-apartheid agrarian policies have affected modern-day farming in rural Eastern Cape. This chapter explored a history of nationalism in South Africa and how the nationalists who came into power were driven by an elitist agenda.

I argued that the main aim for both Afrikaner and African nationalists was to be assimilated into the British-driven economy. Hence policies under these two nationalist regimes were never about the poor masses but maintained the status quo of the former colonist, Britain. Britain's interest in South Africa was driven by minerals, and the exploitation of black labour ensured an accumulation of capital. Poor small-scale farmers spend their last cents buying GMO seeds, pesticides and synthetic fertilisers so that "they too can become rich one day". But that "one day" will never come, and the money they spend simply profits already-rich corporations like Bayer.

I highlight the encroachment of GMO corporations on customary and small-scale agriculture, illustrating that capitalism has no bounds and is continuously searching for new frontiers upon which to push the commodity mode of production and consumption. The intimate relationship that small-scale farmers developed with the land has been lost, as have the rituals and culture from that relationship. As explained in the introduction, capitalism causes a metabolic rift, disturbing the interaction between humans and the earth.

In Chapter four I argue that different knowledge systems can be used in combination to address problems, and I avoided being fervently anti- or pro-technology. Anti-technology protesters, who often present a romanticised view of rural farming in which people live harmoniously with nature, sometimes fail to acknowledge that a variety of knowledge systems can address modern-day problems. Pro-technology protestors often disregard indigenous practices and view them as backward and can see no place for them in the fast-paced modern world. In this way, I have

highlighted the challenges of failing to decolonise knowledge in post-apartheid South Africa. I argue in this research that a syncretic solution can best help farmers adjust to changing times.

In Chapter five, I compiled a soil testing kit based on focus group interviews with the farmers about their indigenous assessment of soil. This is an act of self-reliance, motivated by the philosophy of BCM and Paulo Freire's *Pedagogy of the oppressed*. This gave farmers autonomy over their soil management practices and helps farmers who cannot afford to send their soils to a lab for testing. To drive the point home, Chapter six weaves together the work of revolutionaries to explain the struggle for economic and psychological emancipation and environmental justice for black people. This chapter articulates the interconnectedness of these different aspects to define African environmentalism.

The message I am conveying in this thesis is that we will have the same problems in the next 50 or hundred years if we continue to detach ourselves from the multispecies approach, a humanist approach that recognises the importance of every living creature and considers the voices of the most vulnerable communities. As Amilcar Cabral has suggested, we should commit class 'suicide' if the aim is to change the world for the better. Without change of policy to accommodate the poor and nature, we will continue to grapple with challenges that impact the environment, economy, social justice and political stability.

During my work on this thesis I came across a cross-examination between Steve Biko and apartheid judge Wessel Boshoff. Biko (2017) was asked by Boshoff if black people knew enough about government affairs to vote: "Assuming now they vote on a particular policy, such as foreign investment, now what does a peasant know about foreign investment?"

Biko responded: "I think, my Lord, in a government where democracy is allowed to work, one of the principles that is normally entrenched is a feedback system, a discussion in other words between those who formulate policy and those who must perceive, accept or reject policy. In other words, there must be a system of education, political education, and this does not necessarily go with literacy. I mean Africa has always governed its people in the forms of various chiefs, Chaka and so on, who couldn't write."

For me, Biko's answer is profound and relevant in post-apartheid South Africa in that it speaks for the most vulnerable, the small-scale farmers who participated in this study. Biko's answer encourages the government and policymakers to listen to dissenting voices – such as rural small-scale farmers, who have the right to choose what methods work best for their situation. A quarter of a century into democracy, the South African government's logic is an extension of apartheid and colonial strategies. It is not economic development but toxic development. Around the globe, black people continue to fight for economic emancipation and racial and environmental justice. Every time we think the battle is won, a different system is entrenched that continues to subjugate people of colour and vulnerable communities. In the 28 years of democracy, I have learned that people often refer to apartheid and colonialism as just bad memories. But their lasting impact has worked against black people's psyche, their blackness, their relationship with land and belonging.

These research findings show that the power of healing lies in reconnecting people to their lands, soils, seeds and the environment at large, because even in post-apartheid South Africa, oppressed communities remain constrained by laws that are not pro-poor. It is almost impossible to recall a time in history when black people were not susceptible to economic oppression, social isolation and stigmatised for their blackness. Despite these struggles, there has always been resistance, assertion and awakening of some sort. In closing, I dedicate the poem below to racialised and vulnerable communities around the world. Written by Langston Hughes (2021), a key figure in the Harlem Renaissance, it explains how far black people have come. Titled "The Negro speaks of rivers", Hughes likened the history of black people to ancient rivers that go deep – rivers like the Nile and the Congo that are rich in history. Yet despite the painful history that blacks carry, like these ancient rivers they continue to flow powerfully:

I've known rivers:
I've known rivers ancient as the world and older than the flow of human blood in human veins.
My soul has grown deep like the rivers.
I bathed in the Euphrates when dawns were young.
I built my hut near the Congo and it lulled me to sleep.
I looked upon the Nile and raised the pyramids above it.

I heard the singing of the Mississippi when Abe Lincoln went down to New Orleans, and I've seen its muddy bosom turn all golden in the sunset.

I've known rivers:

Ancient, dusky rivers.

My soul has grown deep like the rivers.

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Appendix A: Questionnaire

Farming communities

February/March 2019

Department of Biology/ Environmental Humanities South. University of Cape Town, South Africa.

Phone: 0761005590. Email: phakisin@gmail.com

Name:……Today's date:……

Address:……

City, Province:……

Demographics

1. Ethnic origin (check only one):

‰ White

‰ Black:

‰ Black: Motswana

‰ Black: Sotho

‰ Black: Zulu

‰ Black: Pedi

‰ Black: Tsonga

‰ Black: Venda

‰ Black: Xhosa

‰ Black: Swati

‰ Coloured

‰ Asian

‰ Other: _____

2. Gender

Male

Female

3. Please circle the highest level of school completed:

(No formal education) (primary) (high school) (college/university) (graduate school)

4. Are you currently (check only one):

‰ Married

‰ Single

‰ Separated

‰ Divorced

‰ Widowed

5. Which age group do you fall under?

‰ 16-24

‰ 25-34

‰ 35-44

‰ 45 and above

Farming History

6. How long have you been a farmer?

‰ 5 years and less

10 years and over

20 years and over

7. Are you…

Full-time farmer – depend on farming for livelihood

Part-time – I have another job – use farming as a substitute for my income

Other

8. **I specialise in…**

Monocropping (name the crop)

Polycropping (name the crops)

‰

9. Are you part of a farming initiative?

Yes (mention its name and mandates)

No

10. How long have you been part of this farming initiative? (Only answer this question if you answered 'yes' to question 9)

5 years and less

10 years and above

20 years and above

11. Is the initiative funded? (Only answer this question if you answered 'yes' to question 9)

Yes (mention who or which organisation is/was funding it)

No

12. Are there other farming initiatives that you were part of but no longer part of?

Yes (explain why you are no longer part of them)

No

Farming practices (choice of seeds)

13. Where do you get your seeds from?

I buy them (mention supplier)

I reuse saved seeds or exchange them with other farmers

Other

14. What kind of seeds do you use?

Organic seeds

Hybrid seeds

Genetically modified seeds

Other

I am not sure

I don't know

15. Do you know and understand the meaning of genetically modified crops?

I know about them but don't understand what they are

I know and understand them (explain)

I know and understand them – currently using them. (Explain why you chose them)

I don't know them

Other

16. If you use GM seeds, what is/was your experience with them?

I still use them and I can't complain (Is there anything special you noticed about them?)

I used to use them but stopped (provide a reason)

Other

17. Have you received any kind of training from the government/NGO/individual about GMOs or other farming techniques that you were not familiar with?

Yes (explain)

No (Do you wish to receive training of this nature?)

Farming practices (Soil and herbicide use)

4. What is soil to you?

……..

5. What do you regard as harmful practices to your soil?

‰……

6. How do you know when your soil is healthy or not healthy?

‰ I see the change in colour (explain)

‰ I can smell it (explain)

‰ Other

7. What do you use to keep your soil healthy?

Compost (explain what it contains)

Herbicide (mention its name)

Other

8. What is your understanding with regards to herbicide use?

……..

9. Which herbicide are you familiar with?

……..

Have you received any training about herbicide use or how to keep your soil fertile?

Yes (explain)

No

10. What is your main worry regarding your soil and crops?

Thank you for your help!

Appendix B: Ethics Letter

Environmental Humanities South

School of African and Gender Studies, Anthropology and Linguistics
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12 March 2021

Re: Confirmation of Research Ethics Approval -Ms Nteboheng Phakisi (EHS007)

This is to confirm that Ms Nteboheng Phakisi's (PHKNTE001) research proposal, "Farmers perspective on production of genetically modified (GM) crops and the impact of using herbicides on soil productivity in South Africa" under the supervision of Professor Lesley Green has been reviewed academics affiliated to the EHS research centre. Ms Phakisi presented her proposal to the Centre in November 2018.

EHS is satisfied that the research carries no significant risk of harm to human subject. We are further satisfied that appropriate informed consent and confidentiality data protection mechanism are in place. It is a condition for the acceptance of Ms Phakisi's proposal that she complies consistently with strict ethical standards. This will entail proceedings only on the basis of the consistently informed consent of interviewees and will require regular monitoring of ethical issues which may emerge as the project develop.

Please contact the Centre should you have any questions or concerns regarding the above.

Regards,

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Appendix C

Eastern Cape Provincial Growth and Development Plan 2004–2014

Appendix D

Food Production Policy document