UNIVERSITY OF THE FREE STATE

THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS IN SOUTH AFRICA, A CASE STUDY DONE IN THE NORTH-WEST PROVINCE OF SOUTH AFRICA.

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A thesis submitted in fulfilment of the requirements in respect of the Doctor of Philosophy

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DECLARATION

I declare that this thesis submitted for the Doctor of Philosophy degree at the University of the Free State is my independent work and has not been submitted to any other university for degree purposes. Accordingly, I hereby forfeit any copyright of this thesis to the University of the Free State.

Ek verklaar dat hierdie proefskrif wat vir die Doktorandus van Filosofie aan die Universiteit van die Vrystaat deur my ingedien word, my onafhanklike werk is en nie voorheen deur my vir ‘n graad aan ‘n ander universiteit ingedien is nie. Gevolglik verbeur ek hiermee enige kopiereg van hierdie proefskrif aan die Universiteit van die Vrystaat.

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Phillip Venter

ABSTRACT

Emerging farmers in South Africa face numerous challenges that hinder their ability to engage in environmentally-, economically-, and socially sustainable agricultural practices. While certain practices have been proven to lead to greater sustainability in farming, there is a shortage of literature on the extent to which emerging farmers in South Africa implement these practices. The study aimed to explore further the problems emerging farmers face in South Africa hampering their sustainability and to determine the extent to which they engage in mitigating practices. Furthermore, the study aimed to give actionable recommendations to emerging farmers on how they can increase their sustainability by obtaining inputs from industry experts and commercial farmers on how emerging farmers can become sustainable commercial farmers. In this study, the emerging farmers that progressed to become sustainable commercial farmers are referred to as New Generation Future Commercial Farmers (NGFCFs).

The study used a mixed-methods research approach, that included qualitative and quantitative research techniques. The quantitative component included, closed-ended questionnaires to determine factors that influence the sustainability of emerging farmers. These questionnaires were distributed to a group of New Generation Future Commercial Farmers and commercial farmers growing dry beans for the Zamukele and Schoeman Boerdery projects in the North-West Province of South Africa. The questionnaires comprised four sections measuring demographic and background information, economic-, environmental-, and social sustainability. Participants were asked to reply to the statements on a Likert scale of 1 to 5, where 1 meant strongly disagreed and 5 meant strongly agreed. An adapted Logical Framework Analysis (LFA) tool was used for the qualitative component to collect qualitative data from industry experts to determine what they believe is needed to improve emerging farmers' economic-, environmental-, and social sustainability.

The study concluded that NGFCFs would be profitable, environmentally sound, and socially sustainable by applying sustainable agricultural principles. However, there are important sustainability issues NGFCFs need to address to improve their sustainability. The

recommendations to improve their sustainability includes making use of contract farming options like off-take agreements, taking part in private and public partnerships, addressing the lack of not owning essential machinery and contractors not harvesting at the ideal time, taking out crop insurance, being proactive in their crop protection approach, addressing operational cost financing, making use of qualified people to advise on sustainable agricultural practices, discarding of empty crop protection containers correctly, following the instructions on crop protection containers, making use of conservation agriculture and precision agricultural techniques, having a succession plan in place, supporting other local businesses in their local community, improving their knowledge base on financial and business management, improving their knowledge of conservation tillage practices and soil fertility management, and attending farmers days and experimental plots on sustainable agricultural practices and technology.

A Model (NGFCFs Model) was developed to guide all role players on how to help emerging farmers progress to become sustainable commercial farmers, including the role agribusiness partners and government plays in this process. The NGFCFs Model will focus on emerging farmers (producers) growing row crops (produce) under an off-take agreement (agribusiness partner) and will also consider the government (policy maker and service provider). The NGFCFs Model is driven by the off-taker, providing an off-take agreement to a group of already successful emerging farmers growing row crops under the off-take agreement. The NGFCFs Model will help create sustainable NGFCFs, which is essential to achieve sustainable food production, according to the United Nation's Sustainable Development Goals (SDGs) in August 2015 (United Nations, 2015). Sustainable food production by NGFCFs will be critical in supporting the needs of the present and future generations. Sustainable NGFCFs will also help the government achieve its National Development Plan for agriculture by playing an important role in rural economic development and natural resource management and contributing significantly to household food security and improved nutrition (National Planning Commission of South Africa (NDP), 2012).

Keywords: Emerging farmers, New Generation Future Commercial Farmers (NGFCFs), economic sustainability, environmental sustainability, social sustainability, extension officers and rural development.

UITTREKSEL

Opkomende boere in Suid-Afrika staar talle uitdagings in die gesig wat hul vermoë belemmer om by omgewings-, ekonomies- en sosiaal volhoubare landboupraktyke betrokke te raak. Alhoewel daar bewys is dat sekere praktyke tot groter volhoubaarheid in boerdery lei, is daar 'n gebrek aan literatuur oor die mate waarin hierdie praktyke deur Suid-Afrikaanse opkomende boere geïmplementeer word. Die studie het ten doel gehad om die probleme wat opkomende boere in Suid-Afrika in die gesig staar wat hul volhoubaarheid belemmer, verder te verken en om vas te stel in watter mate hulle betrokke raak by versagtende praktyke. Verder was die studie daarop gemik om uitvoerbare aanbevelings aan opkomende boere te gee oor hoe hulle, hul volhoubaarheid kan verhoog deur insette van bedryfskenners en kommersiële boere te verkry oor hoe opkomende boere volhoubare kommersiële boere kan word. In hierdie studie word daar na die opkomende boere wat gevorder het om volhoubare kommersiële boere te word verwys as Nuwe Generasie Toekomstige Kommersiële Boere (NGFCFs).

'n Navorsingsontwerp met gemengde metodes wat kwalitatiewe en kwantitatiewe metodes insluit, is vir hierdie studie gebruik. Vir die kwantitatiewe komponent is geslote vraelyste wat daarop gemik was om die faktore te bepaal wat die volhoubaarheid van opkomende boere beïnvloed, versprei aan 'n groep NGFCFs en kommersiële boere wat droëbone verbou vir die Zamukele en Schoeman Boerdery projekte in die Noordwes Provinsie van Suid-Afrika. Die vraelyste het bestaan uit vier afdelings wat demografiese en agtergrondinligting, ekonomiese-, omgewings- en sosiale volhoubaarheid meet. Deelnemers is versoek om te reageer op die items op 'n 5-punt Likert skaal waar 1 aangedui het dat hulle ten sterkste verskil en 5 aangedui het dat hulle ten sterkste saamstem met elke stelling. Vir die kwalitatiewe komponent is 'n aangepaste Logiese Raamwerk Analise (LFA) hulpmiddel gebruik om kwalitatiewe data van bedryfskundiges in te samel om te bepaal wat hulle glo nodig is om opkomende boere se ekonomiese-, omgewings- en sosiale volhoubaarheid te verbeter.

Die studie het tot die gevolgtrekking gekom dat NGFCFs winsgewend, omgewingsgesond en sosiaal aanvaarbaar sal wees deur volhoubare landboubeginsels toe te pas. Daar is egter

belangrike volhoubaarheidskwessies wat NGFCFs moet aanspreek om hul volhoubaarheid te verbeter. Die aanbevelings om hul volhoubaarheid te verbeter sluit in die gebruik van kontrakboerdery-opsies soos afname-ooreenkomste, die deelname aan private en openbare vennootskappe, die aanspreek van die gebrek daaraan om nie noodsaaklike masjinerie te besit nie en kontrakteurs wat nie op die ideale tye oes nie, die uitneem van oesversekering, om proaktief te wees in hul gewasbeskermingsbenadering, om operasionele kostefinansiering aan te spreek, om gebruik te maak van gekwalifiseerde mense om advies te gee oor volhoubare landboupraktyke, om die instruksies op gewasbeskermingshouers te volg, om gebruik te maak van bewaringslandbou en presisielandboutegnieke, om 'n opvolgplan in plek hê, om ander plaaslike besighede in hul plaaslike gemeenskap te ondersteun, om hul kennisbasis oor finansiële en sakebestuur te verbeter, om hul kennis van bewaringsbewerkingspraktyke en grondvrugbaarheidsbestuur te verbeter, en om boeredae en proefpersele oor volhoubare landboupraktyke en tegnologie by te woon.

’n Model (NGFCFs Model) is ontwikkel om alle rolspelers te lei oor hoe om opkomende boere te help om volhoubare boere te word, insluitend die rol wat agri-sakevennote, en die regering speel in hierdie proses. Die NGFCFs Model sal fokus op opkomende boere (produsente) wat betrokke is by die verbouing van rygewasse (produksie) onder 'n afname-ooreenkoms (agri-sakevennoot), en sal ook die regering (beleidmaker en diensverskaffer) in ag neem. Die NGFCFs Model word deur die afnemer gedryf, wat 'n afneem ooreenkoms verskaf aan 'n groep reeds suksesvolle opkomende boere wat rygewasse verbou ingevolge die afneem ooreenkoms. Die NGFCFs Model sal help om volhoubare NGFCFs te ontwikkel wat noodsaaklik is om volhoubare voedselproduksie te bereik, soos uiteengesit deur die Verenigde Nasies se Volhoubare Ontwikkelingsdoelwitte (SDGs) in Augustus 2015 (Verenigde Nasies, 2015). Volhoubare voedselproduksie deur NGFCFs sal van kritieke belang wees om die behoeftes van die huidige en toekomstige geslagte te ondersteun. Volhoubare NGFCFs sal ook die regering help om hul Nationale Ontwikkels Doelwite te bereik vir landbou deur ‘n belangrike rol te speel in die proses van landelike ekonomiese ontwikkeling en bestuur van natuurlike hulpbronne en deur tot ‘n groot mate by te dra tot huishoudelike voedselsekuriteit en verbeterde voeding (Nasionale Beplanningskommissie van Suid-Afrika (NOP), 2012).

Sleutelwoorde: Opkomende boere, Nuwe Generasie Toekomstige Kommersiële Boere (NGFCFs), ekonomiese volhoubaarheid, omgewingsvolhoubaarheid, sosiale volhoubaarheid, voorligtingsbeamptes en landelike ontwikkeling.

LIST OF ACRONYMS

AGRA	Alliance for Green Revolution in Africa
ARC	Agriculture Research Council
ASFG	African Smallholder Farmers Group
BFAP	The Bureau for Food and Agricultural Policy
BSI	The British Standards Institution
CA	Conservation Agriculture
CASP	Comprehensive Agricultural Support Programme
CBOs	Community-Based Organizations
CF	Conventional farming
DAFF	Department of Agriculture Forestry and Fisheries
DALRRD	Department of Agriculture, Land Reform, and Rural Development
DEA	Department of Environmental Outlook
DPO	Dry bean Producers Organisation
EU	European Union
GDP	Gross Domestic Product
GPFI	G20 Global Partnership for Financial Inclusion, SME finance Sub- Group
HSB	Hendrik Schoeman Boerdery Pty Ltd. (Schoeman Boerdery)
ICM	Integrated Crop Management

IFC	International Finance Corporation
IISD	International Institute for Sustainable Development
LFA	Logical Framework Analysis
NCAT	National Centre for Appropriate Technology
NDP	South African Governments National Plan for Agriculture
NGFCFs	New Generation Future Commercial Farmers
NGOs	Non-Governmental Organizations
OA	Organic Agriculture
OT	Off-taker
OTA	Off-take agreement
PM	Project manager
R	The South African rand (ZAR)
SDG	United Nations Sustainable Development Goals
SFOC	Schoeman Farming Operations Company
SSA	Sustainable Agriculture
STATS SA	Department: Statistics South Africa
UN	United Nations
USDA	United States Department of Agriculture

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DEFINITIONS

Agricultural enterprises: "This means an institutional unit in its capacity as a producer of agricultural goods and services with autonomy in respect of financial and investment decision making, as well as authority and responsibility for allocating resources to produce agricultural goods and services" (Law Insider, 2022).

Agricultural extension: "Agricultural extension can be defined as the entire set of organizations that support people engaged in agricultural production and facilitate their efforts to solve problems; link to markets and other players in the agricultural value chain; and obtain information, skills, and technologies to improve their livelihoods" (Davis, 2009).

Boerdery: The Afrikaans term used for farming.

Cession agreement: The right to use future crop income as the main security for an input cost loan repayment. Agri-financiers typically use a cession agreement on the crop income that will be produced as the main security for loan repayment when using commodity-based financing (Linde, 2014).

Commercial farming: Commercial farming is done for financial gain. Large-scale agricultural or animal production is practice to boost output and profitability. With only a few workers to operate them, technology and machines are utilised (GCSE, 2019). Large-scale commercial farmers have sophisticated technology, can benefit from economies of scale, can raise money and make investments, and can respond to changing consumer demand (White, 2010). Commodities are the focus of commercial farming (World Bank Group, 2016).

Conservation Agriculture (CA): CA tillage includes various techniques, including contour tillage, mulch tillage, ridge tillage, and reduced (minimum) tillage. Reduced soil disturbance will improve the soil environment and have a more negligible negative environmental impact (Bradley, 2002; Palm *et al*., 2014; Busari *et al*., 2015).

Contract farming: It entails a contract containing terms and conditions for the production and marketing of agricultural products, such as the price to be paid, the amount and quality that

are required, the delivery dates, and occasionally specific information on the inputs and production techniques (Smaller *et al*., 2018).

Conventional Farming (CF): "The use of seeds that have been genetically altered using various traditional breeding methods, excluding biotechnology, and are not certified as organic. Some conventional breeding methods have been used for thousands of years to develop plants with faster growth, higher yields, pest and disease resistance, larger seeds, and sweeter fruit. Conventional crops may be grown, simply as commodities, and enter the commodity stream, where they are mixed with other crops, including genetically engineered crops. In addition, they may be grown to meet a requirement set forth by an end market, such as a specific chemical or nutritional requirement. When conventional crops are targeted for a unique end market, farmers often receive premium prices" (United States Department of Agriculture, 2015).

Crop protection: Crop protection is the general strategy or practice of safeguarding yields against a variety of threats, such as pests, weeds, plant diseases, and other organisms that harm crops (Ratcliffe *et al*., 2017).

The digitalisation of agriculture: "The digitalization of agriculture is defined by the conversion of measurements of agricultural inputs and outputs into digitally stored data for use in automated systems and applications that provide information and assist decision-making" (Aguera *et al*., 2020).

Economic sustainability: Economic sustainability for a given farm refers to how well that farm is run to ensure long-term success. Because prices fluctuate and agricultural output is vulnerable to weather, pest, and disease damage, the farm does not need to make a profit every year. However, the farm business will eventually have to pay its debts, such as the opportunity cost of the farmer's time and labor and returns on equity in the farm's land and other assets (Smith, 2016).

Emerging farming: A category of smallholder farming where farmers involved in such farming have the desire to increasingly commercialise their production (Nieuwoudt, 2000). Another way to describe an emerging farmer is someone who wants to farm successfully but needs help from an outside facilitator, given their current physical, mental, and socioeconomic

limitations (Geldenblom, 2003). This study defines emerging farmers, as those that are active in the market and have aspirations to increase their output and sales.

Environmentally sustainable agriculture: There is no common understanding of what constitutes environmentally sustainable agriculture. It encompasses a range of potential courses of action with the dual aims of reducing agriculture's detrimental environmental effects and protecting the natural environment's constituent parts on which agriculture depends. The most appropriate measures will vary depending on the farm and the surrounding environment. These measures are improving resource efficiency and restoring natural capital (Leigh, 2017).

Integrated Crop Management (ICM): The entire farm operation is the focus of the ICM system. In addition to managing pests, it expands integrated pest management to include all facets of agricultural production, such as soil fertility, tillage, crop rotation, and crop variety selection. It connects optimal management methods into an integrated plan (Padgitt *et al*., 2001).

Logframe Analysis (LFA): The LFA organises a project's key components and emphasises their logical connections (Pfenning, 2002).

New Generation Future Commercial Farmers (NGFCFs): Emerging farmers that are in the process of becoming successful commercial farmers.

Organic Agriculture (OA): A farming system where farmers work with nature rather than against nature, using environmentally friendly methods of weed, pest, and disease control to produce food with minimal harm to ecosystems, animals, or humans (Seufert *et al*., 2012; Pimentel and Burgess, 2014).

Precision agriculture (PA): According to Stafford and Deboer (2019), “Precision agriculture is a management strategy that gathers, processes, and analyses temporal, spatial, and individual data and combines it with other information to support management decisions according to estimated variability for improved resource use efficiency, productivity, quality, profitability, and sustainability of agricultural production”.

Qualitative research: This collects data from focus groups through group interviews (typically involving 5–12 individuals), relying on the group's interaction and the moderator's questions to provide insight into specific topics. Qualitative research also involves the studied and collection of a variety of empirical materials, including case studies; personal experiences; introspective; life stories; interviews; and observational, historical, interactional, and visual texts describing routine and problematic moments and meanings in individuals' lives (Aspers and Corte, 2019).

Quantitative research methodology: Research methods that systematically deal with numbers and anything measurable, investigating phenomena and their relationships. It is used to systematically answer questions on anything measurable to investigate phenomena and their relationships (Apuke, 2017).

Smallholder farmers: Can be defined in various ways depending on the context, country, and ecological zone. The term 'smallholder' is often interchangeably used with 'small-scale', 'resource poor', and sometimes 'peasant farmer'. In general terms, smallholder only refers to their limited resource endowment relative to other farmers in the sector. Smallholder farmers are also defined as those farmers owning small-based plots of land on which they grow subsistence crops and one or two cash crops, relying almost exclusively on family labour. Some of the main characteristics of the production systems of smallholder farmers are simple, outdated technologies, low returns, high seasonal labour fluctuations, and women playing a vital role in production. Smallholder farmers differ in individual characteristics, farm size, resource distribution between food and cash crops, livestock and off-farm activities, their use of external inputs and hired labour, the proportion of food crops sold, and household expenditure patterns (DAFF, 2012).

Social sustainability: Is regarded as conceptually elusive and susceptible to debate. The lack of agreement on what the social dimension of sustainability implies for agriculture, is a reflection of the lack of agreement on this topic in the scientific community (Janker and Mann, 2020). "Sustainable development should be done in a way that emphasizes human livelihoods as integral to accomplishing ecological goals through economic development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

Soil degradation: Soil degradation is the term used to describe a change in the soil's physical, chemical, and biological features that results in a change in the status of the soil's health. The consequence is compacted, salinized, acidified, and soil loss due to wind and water erosion (Hegde *et al*., 2011).

Soil fertility: The ability of the soil to give the nutrients plants need for growth is known as soil fertility (Reitsma *et al*., 2015).

Soil health: Soil health is defined as "the continued capacity of soil to function as a vital living system, within the ecosystem and land-use boundaries, to sustain biological productivity, promote the quality of air and water environments, and maintain plant, animal, and human health" (Doube and Vakakattu, 1997).

Subsistence farming: Subsistence farming is the practice of raising animals and cultivating crops solely for human use. Since the farmer's family is the main priority, it is carried out on a small scale. There might not be considerable use of technology or machinery, despite the possibility of heavy labour requirements. Self-sufficiency is what subsistence farmers strive for (GCSE, 2019).

Sustainable Agriculture (SSA): Sustainable agriculture entails raising crops and cattle in a way that concurrently achieves three goals: financial success, social benefits for the farm family and the community, and environmental preservation (Sullivan, 2003).

The North-West Province in South Africa: The North-West Province forms one of the nine Provinces in South Africa. With an estimated population of 4,1 million, the North-West Province ranks 7th regarding population density in South Africa. The North-West Province borders Botswana in the far North-East and North-West, the Limpopo Province in the North-East, Gauteng Province in the East, Free State Province in the Southeast, and Northern Cape Province in the Southwest. The Province consists of mainly flat areas of grassland and scattered trees, with the Magaliesberg mountain range in the northeast extending about 130 km from Pretoria to Rustenburg and the Vaal River flowing along the southern border of the North-West Province.

Zamukele: A Zulu word meaning, you are welcome.

CHAPTER 1

THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS IN SOUTH AFRICA, A CASE STUDY DONE IN THE NORTH-WEST PROVINCE OF SOUTH AFRICA.

1.1. MOTIVATION

The World Bank (Townsend *et al*., 2019) confirmed that agricultural development is crucial for economic growth and one of the most powerful tools to end extreme poverty, boost shared prosperity, and feed a projected 9.7 billion people by 2050. Agriculture can help reduce poverty for 75% of the world's poor, improve food security and benefit the environment (Gomiero and Paoletti, 2011; Heslin, 2015; Norton, 2016).

Creating sustainable farmers is essential to help achieve sustainable food production, as set out by the United Nations (UN) Sustainable Development Goals (SDG) in August 2015 (United Nations, 2015). Sustainable food production by future farmers will be critical to supporting the needs of the present and future generations. According to the Food and Agriculture Organization of the United Nations (2018), sustainably managing the planet's natural resources will also improve the quality of life of farmers, farm families, and farm communities.

The South African government also sees agriculture as playing an essential role in economic development, which can contribute significantly to household food security, leading to the development of the South African Governments National Development Plan for agriculture (National Planning Commission of South Africa, 2012). South Africa's government also cooperated with the Food and Agriculture Organization of the United Nations (FAO) on interventions for agricultural development, food security, and improved nutrition to support rural economic development and natural resources management (FAO, 2017b). The FAO (2017a) states, "Considering the growing pressure on natural resources, new and stronger governance mechanisms will be necessary to address the complex linkages and growing competition. Policies and governance mechanisms must consider the multiple social, economic, nutritional and environmental goals, address possible conflicts, and adapt agricultural development programs accordingly".

It is essential to recognise that investment in agriculture is a key precondition to achieving sustainability goals related to improving food security, creating jobs, creating wealth, and reducing poverty (The Bureau for Food and Agricultural Policy, 2018). Emerging farmers form an integrated part of the larger commercial agricultural sector to increase South Africa's food production, which would help alleviate hunger and aid economic development by improving food availability for the poor through lower prices and higher incomes (British Standards Institution, 2013; Prosperi *et al*., 2014). Rural development is also crucial in achieving social sustainability through poverty reduction and improving livelihoods in rural areas where 75% of the poor live (Sarris, 2001). Rural development can be achieved in different ways through the support and involvement of farms in these communities. According to Statistics South Africa (2014), the single most important investment any country can make is the development of its people

An environmentally-, economically-, and socially sustainable agriculture system is essential to enhance farmers' and the society's quality of life (Krall, 2016; United Nations, 2018) and to sustain the growing need for food production to combat food insecurities for an ever-growing population (National Research Council, 2010). Sustainable agriculture will not only produce safe and healthy food (Benbrook *et al.*, 2008) and make efficient use of non-renewable resources (Wang, 2009), but it will also enhance the quality of the environment by reducing the negative impact of agriculture on nature. In addition, farmers who use the sustainable agriculture system will be rewarded with economic viability and profitability (Corselius *et al.*, 2001; Syed and Miyazako, 2013).

1.2. PROBLEM STATEMENT

Emerging farmers in South Africa need to be part of the United Nations Sustainable Development Goals (SDG) and South African Governments National Plan for Agriculture (NDP) by being economically, environmentally, and socially sustainable farmers. However, farmers, especially emerging farmers in the South African context, face numerous challenges that hamper them from farming sustainably (FAO and Centre for Tropical Agriculture (CIAT), 2020).

According to Ngubane (2018), “Black people who venture into commercial farming are bound to fail. Commercial farming is a capital-intensive business. The battle to secure support forced many struggling black farmers to rent their land to established white farmers. The situation is made worse by the fact that the limited available state support has been hijacked by corrupt elements or a small authoritarian rural elite”.

Besides the naratives by Ngubane (2018) other authors have identified a host of challenges some of the challenges are associated with being economically sustainable which included low profitability (Hofstrand, 2009), access to financing and cost of mechanization (Ajah, 2014), lack of capital assets (Kamara *et al*., 2019), and - infrastructure (Patel, 2016). Challenges associated with environmental sustainability included climate variability and change and overstretched and under-resourced extension staff unable to support emerging farmers on best management practices for environmental sustainability (FAO and Centre for Tropical Agriculture, 2020). In addition, the lack of social entrepreneurship and rural development initiatives hamper social sustainability through poverty reduction and improving livelihoods in rural areas (Sarris, 2001).

1.3. HYPOTHESIS

“New Generation Future Commercial Farmers (NGFCFs) will be profitable, environmentally sound, and socially sustainable by applying sustainable agricultural principles”.

1.4. OBJECTIVES

To test the study’s hypothesis whether New Generation Future Commercial Farmers (NGFCFs) applying sustainable agriculture principles will be profitable, environmentally sound and socially sustainable.

The study will evaluate NGFCFs under the three principles of sustainable agriculture:

i. New generation future commercial farmers will be evaluated on their sustainability.

ii. Commercial farmers' views on the sustainability of new generation future commercial farmers will be evaluated.

iii. Industry experts' views on the sustainability of new generation future commercial farmers will be evaluated**.**

In addition, inputs from commercial farmers and industry experts on the sustainability of NGFCFs will also be included.

1.5. LAYOUT OF CHAPTERS

This section gives insight into the chapter framework layout (Table 1) used to test the study's hypothesis of whether New Generation Future Commercial Farmers (NGFCFs) applying sustainable agricultural principles will be sustainable.

Table 1: Chapter framework layout

Chapter 1	**Introduction**
	Motivation
	Problem statement
	Hypothesis
	Objectives
	Layout of chapters
	Limitations of study
Chapter 2	**Literature Review**
	Defining farmer groups

	Overview of farming and description of the geographic study area	
	Perspectives of global agriculture systems	
	The environment and sustainable agriculture	
	Challenges in the South African Agriculture sector	
	Regulatory standards and compliance requirements	
	Supporting farmers	
	Linking agribusiness and farmers	
	Agricultural extension	
	Contract farming benefits and risks for emerging farmers	
	Dry dean production in South Africa	
Chapter 3	**Methodology**	
	Sample	
	Research Design	
	Research methods	
	Quantitative research NGFCFs Commercial Farmers	Qualitative Research Industry expert Background of Zamukele project and Schoeman Boerdery
Chapters 4, 5, 6	**Results**	
	Analysis and findings	

	Quantitative research chapters 4 and 5	Qualitative Research Chapter 6
	Economic sustainability Environmental sustainability Social Sustainability	Economic sustainability Environmental sustainability Social Sustainability
	Conclusions	
Chapters 7	**Conclusion & Recommendations**	
	Conclusion on the hypothesis of the study and summary	
	Recommendations Requirements for producers Requirements for agribusiness partners Government's role	
	NGFCFs Model	

The study occurred in the North-West Province of South Africa, where NGFCFs grow dry beans under an off-take agreement for Schoeman Boerdery. The project is known as the Zamukele project, a Zulu word meaning, you are welcome. Chapter 1 was dedicated to the study's motivation, problem statement, hypotheses, and objectives. Chapter 2 provided a literature review on farming, defining farmers, agricultural systems, the environment and sustainable agriculture, and productivity in agriculture. The chapter also overviewed contract farming, linking emerging farmers and agribusiness, supporting farmers, and dry bean production in South Africa.

The methodology is captured in chapter 3 with the research design, aims, and methods. A background overview of the Zamukele project and Schoeman Boerdery were also included. Feedback on the results was given in chapters 4, 5 and 6, with chapters 4 and 5 containing the

feedback and results of the quantitative research data from the NGFCFs and commercial farmers. Chapter 6 was dedicated to the qualitative research feedback from industry experts on the sustainability of NGFCFs. The conclusion and recommendation for the study can be found in chapter 7.

1.6. LIMITATIONS OF THE STUDY

The case study focused on growers of dry beans for the Schoeman Boerdery in the North-West Province. By doing this, the author aimed to limit the variability of growth factors that could influence the success of growers cultivating dry beans. Al the growers in the group also had access to the same technical advice and growers' contact provided by Schoeman Boerdery.

i. **Scope:** Schoeman Boerdery has seasonal dry bean fixed contracts with 173 commercial producers and 29 emerging producers (Zamukele) in five provinces. In the North-West Province (study area), there are 40 commercial - and 16 emerging farmers (NGFCFs). For the quantitative research, 14 Zamukele and nine commercial farmers growing dry beans for Schoeman Boerdery in the North-West Province participated in the study. Two Zamukele farmers were in their first year of growing dry beans and had insufficient data to complete the questionnaire.
ii. **Inputs of industry experts that are not producers (farmers):** To get a more comprehensive view of the sustainability of NGFCFs, the inputs of 10 industry experts were also gathered by doing a logframe analysis. However, these industry experts were not part of the Schoeman Boerdery dry beans growers advisory board and had n neutral view of the study.
iii. **Time frame:** The time frame for the study was from June 2020 – October 2022.

CHAPTER 2

LITERATURE REVIEW

2.1. INTRODUCTION

This chapter covers farmers' group terminology and gives an overview of farming in Africa, Sub-Sahara Africa, South Africa, and the North-West Province in South Africa, the geographic region of this case study. The chapter also provides a broad overview of global agriculture systems, the environment and sustainability, challenges the South African agricultural sector faces, regulatory standards and compliance requirements impacting the South African agribusiness sector, and the importance of supporting farmers. Next, the chapter narrows its literature review down to emerging farmers and how to link the agribusiness sector and emerging farmers, the importance of extension to emerging farmers, loaning and agricultural insurance to emerging farmers in South Africa, and the risks and benefits of contract farming for emerging farmers. Finally, the chapter closes with an overview of dry bean production in South Africa, the crop grown as part of the case study.

2.2. DEFINING FARMER GROUP TERMINOLOGY

Defining the different farming group terminologies that are used in this thesis.

2.2.1. Subsistence Farming

Subsistence farming is the practice of raising animals and cultivating crops solely for human use. Since the farmer's family is the main priority, it is carried out on a small scale. There might not be considerable use of technology or machinery, despite the possibility of heavy labour requirements. Self-sufficiency is what subsistence farmers strive for (GCSE, 2019).

2.2.2. Smallholder farmers

According to the Department of Agriculture, Forestry, and Fisheries (2012), smallholder farmers are defined in various ways depending on the context, country, and ecological zone. The term ‘smallholder’ is often interchangeably used with ‘small-scale’, ‘resource poor’, and

sometimes ‘peasant farmer’. In general terms, smallholder only refers to their limited resource endowment relative to other farmers in the sector. Smallholder farmers are also defined as those farmers owning small-based plots of land on which they grow subsistence crops and one or two cash crops, relying almost exclusively on family labour. One of the main characteristics of the production systems of smallholder farmers is simple, outdated technologies, low returns, high seasonal labour fluctuations, and women playing a vital role in production. Smallholder farmers differ in individual characteristics, farm size, resource distribution between food and cash crops, livestock and off-farm activities, their use of external inputs and hired labour, the proportion of food crops sold, and household expenditure patterns (Department of Agriculture Forestry and Fisheries, 2012).

2.2.3. Emerging farming

It is a category of smallholder farming where farmers involved in such farming have a desire to increasingly commercialize their production (Niewoudt, 2000). Another way to describe an emerging farmer is someone who wants to farm successfully but needs help from an outside facilitator given their current physical, mental, and socioeconomic limitations (Geldenblom, 2003). This study difines emerging farmers, as those that are active in the market and have aspirations to increase their output and sales.

2.2.4. New Generation Future Commercial Farmers (NGFCFs)

New Generation Future Commercial Farmers (NGFCFs) in this study will be defined as emerging farmers who are in the process of becoming successful commercial farmers.

2.2.5. Commercial farmers

Commercial farming is done for financial gain. Large-scale agricultural or animal production is practice to boost output and profitability. With only a few workers to operate them, technology and machines are utilised (GCSE, 2019). Large-scale commercial farmers have sophisticated technology, can benefit from economies of scale, can raise money and make investments, and can respond to changing consumer demand (White, 2010). Commodities are the focus of commercial farming (World Bank Group, 2016).

2.3. OVERVIEW OF FARMING AND A DESCRIPTION OF THE GEOGRAPHIC STUDY AREA

This section will provide an overview of farming in Africa, Sub-Sahara Africa, and South Africa and describe the North-West Province of South Africa, the geographic area of the case study. The overview of farming includes the importance of farming to each region and its impact on the environment and its people. The study area's geographic layout, climate, and farm size distribution is provided.

2.3.1. Africa

"The challenge of African agriculture is not only enhancing production to meet the increased food demands of the expanding population, but also the judicious use of soils so that their productivity is sustained in the foreseeable future"(Eswaran *et al*., 1997).

Africa's highest agricultural potential remains largely untapped (Goedde, 2019). However, according to the Alliance for Green Revolution in Africa (2017), nearly 70% of the African population is involved in agriculture as smallholder farmers. They farm on average on less than 2 ha, producing 20% of all the world's food on 10% of the globe's land. Therefore, supporting them makes good business sense to achieve global food security, relieve poverty and hunger, grow economies, create jobs (Alliance for Green Revolution in Africa, 2017), and conserve natural resources (Kamara *et al*., 2019).

Even though smallholder farmers' potential is often not brought forward, they drive many of Africa's economies (DAFF, 2012). However, according to the African Smallholder Farmers Group (2013), Africa's smallholder farmers face many challenges preventing them from participating in international markets. These challenges include poor rural infrastructure, high transaction costs, lack of access to quality financial services and modern agricultural technology, and inadequate support from research and extension services (Patel, 2016).

In the opinion of the World Economic Forum, there is an urgent need to maximize training and the application of skills to the agriculture sector in Africa to improve the productivity rate of the agriculture sector in Africa, which is only 36%, the lowest in the world (Patel, 2016).

International efforts to support smallholder farmers tend to focus on boosting productivity by using modern inputs and encouraging smallholders to intergrade into the large agricultural value chains. However, evidence suggests that opportunities created in this way tend to benefit only a small group of wealthier and better-connected smallholders (African Smallholder Farmers Group, 2013). Figure 1 shows a map of Africa, its international boundaries, and the national capitals of the African countries.

Figure 1: Map of Africa (Geology.com, 2008)

2.3.2. Sub-Sahara Africa

According to Nabhan *et al*. (1997), inappropriate land use is a significant cause of declining soil quality, especially in Sub-Saharan Africa. In addition, due to population pressure, there is continuous stress on the limited land resources to provide food security.

In Sub-Sahara Africa, agriculture contributes 23% to the Gross Domestic Product (GDP), and smallholder farmers account for more than 60% of the population (Goedde, 2019). Helping smallholder farmers become more productive, have increasing access to assets and skills, and be less vulnerable to extreme climate conditions, will be essential to ensure that agricultural and rural growth goes hand in hand with poverty reduction (FAO, 2009).

Contrary to popular opinion, Sub-Saharan African input utilization is more complex (Sheahan and Barrett 2014). In their report, Sheahan and Barret (2014) mention that two-thirds reported no use of inorganic fertilizer, 84% do not use agrochemicals and only 1 - 3% use irrigation. Additionally, the report highlighted that input use falls with farm size, and farmers do not significantly vary fertilizer application rates according to perceived soil quality.

Markets serving smallholder farmers in Sub-Sahara Africa must be enhanced to improve sustainable rural development and agricultural productivity, reduce food insecurity and malnutrition, and limit costly food imports. Realizing this goal requires inclusive policymaking processes that recognize the role of women and young people in agriculture (FAO, 2014).

2.3.3. South Africa

The value of the annual turnover reported on the company registration maintained by STATS SA is used to categorize farming operations in South Africa into four classes. According to STATS SA (2017a), medium enterprises have a turnover between R13,500,000 and R22,500,000, and large enterprises have a turnover exceeding R22,5 million. Additionally, micro enterprises have an annual turnover of less than R2 250 000 and small enterprises have one between R2 250 000 and R13 500 000.

In 2016, 3% of South Africa's population engaged in some form of farming, of which 162,000 are considered formal rural farms and 30,000 are commercial farmers that supply more than 80% of the food in South Africa (STATS SA, 2016a).

In South Africa, land reform redistributed provided over three million hectares for agricultural purposes, and a total of 85 774 farm dwellers were assured of their land tenure security during the 25 years between 1994 and 2019 (The Government of the Republic of South Africa, 2019). As a result, the number of households engaged in agriculture was 2,3 million in 2016, with 43.7% listing agriculture as the primary source of household food and 37.5% as an additional source of household food (STATS SA, 2016b).

According to Cousins and Walker (2015), in 2014, the agricultural structure of South Africa was very diverse. As little as 7 000 large-scale commercial farmers made use of sophisticated, specialized, capital-intensive methods to produce for the export of agro-processing and large retailers on private land in addition to 2 – 2.5 million subsistence-orientated smallholder farmers growing food for themselves and selling occasionally. Most of these farmers are in crop production in homestead gardens, with occasional livestock sales by some (See Table 2).

The Comprehensive Agriculture Support Program (CASP) aims to offer post-settlement assistance to the designated recipients of land reform (the hungry, subsistence and household food producers, farmers, and agricultural macro-systems within the consumer environment). The initiative will include information and technology management interventions, technical and advisory support, capacity building and training, on- and off-farm infrastructure, and financial support for product inputs. The main goals are to increase sustainable employment, increase incomes to combat poverty and inequalities in land and business ownership, decrease crime and violence to boost farming efficiency, increase national and household food security, boost investor confidence, and increase domestic and foreign investments. (DAFF, 2019).

Table 2: The agrarian structure of South Africa in 2014

Farmers	Numbers	Key Features
Top 20% of large-scale commercial farmers on private land	7,000	Sophisticated, specialized, and capital-intensive farmers, producing for exports or agro-processing and large retailers. They produce the bulk, perhaps producing as much as 80%.
Medium– to large-scale commercial farmers on private land	9,000	Some farmers succeed, some struggle, and some cannot earn a living from farming alone.
Small- to medium-scale commercial farmers on private land	19,000	Many cannot survive from farming alone, including hobby farmers.
Small-scale commercial farmers in communal areas and land reform contexts	5,000-10,000	Many farmers earn income from off-farm incomes and businesses in addition to farming.
Market-oriented smallholder farmers in communal areas and land reform contexts, supplying tight value chains (e.g. under contract)	5,000-10,000	Many grow fresh produce under irrigation, others are livestock producers, and a few engage in dryland cropping.
Market-oriented smallholder farmers in	200,000-250,000	Many grow fresh produce under irrigation, and others are

communal areas and land reform contexts, supplying loose value chains		livestock producers. Few depend wholly on farming.
Subsistence-oriented smallholder farmers grow food for themselves and sell it occasionally	2-2,5 million	Most crop production occurs in homestead gardens, some of which are quite large. There are occasional livestock sales by some.

Source : (Cousins and Walker, 2015)

Figure 2: Map of South Africa showing the provinces (DALLRD, 2020f)

The agricultural production trend for South Africa is depicted in Figure 3, showing that productivity varied greatly over time. The increase in agricultural production before 1965 was estimated to be 0.65% annually. Because input prices increased quicker than the prices farmers received for their output between 1965 and 1981, growth increased by 2.15%. Due to mechanization and using inputs like fertilizer and crop protection products, productivity

increased quickly between 1981 and 1989, at a rate of 2.98%. Productivity fell to 0.28% between 1989 and 1994 due to high inflation rates that resulted in negative net agricultural revenues. Following 1994, there was positive growth and net farm revenue. But it became stagnant because of the rising input utilization and slowing output growth.

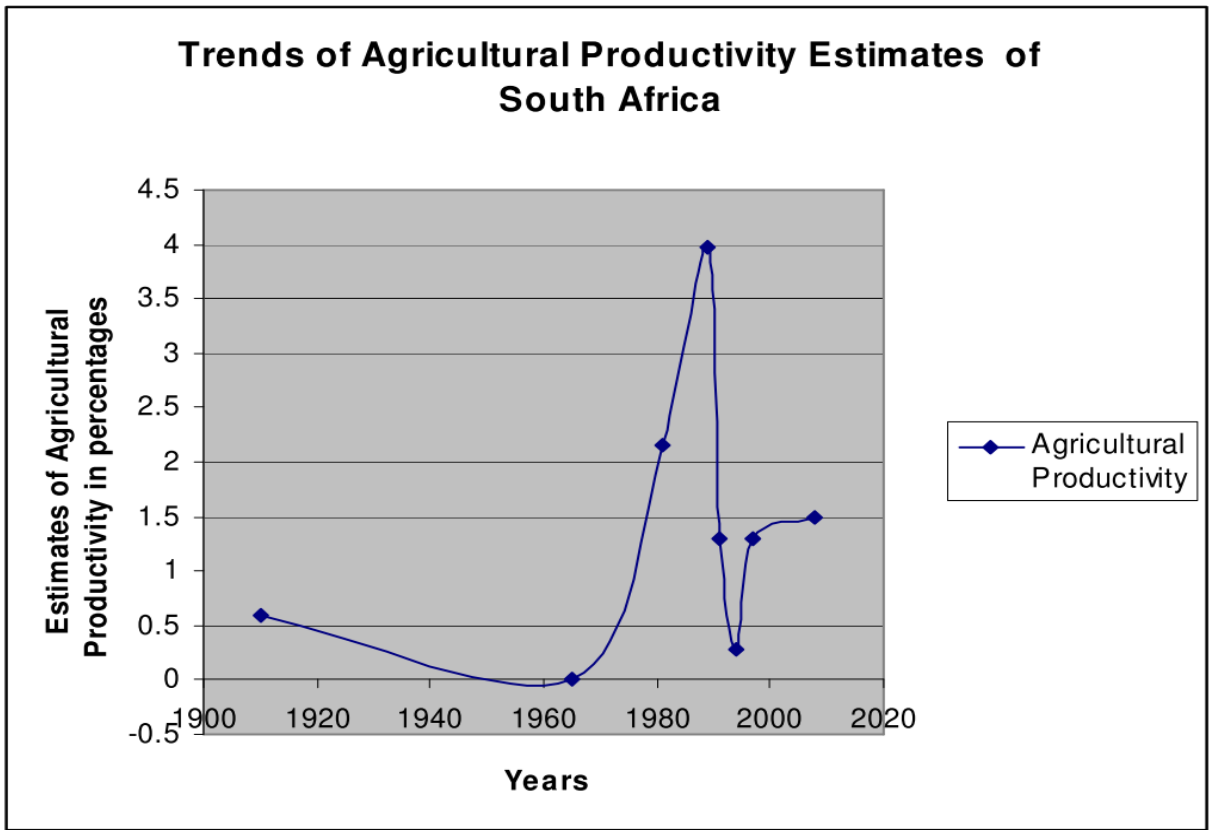


Figure 3: Agricultural productivity estimates from 1910-2008 for South Africa (Ramaila et al., 2011)

2.3.4. Study area North-West Province in South Africa

The North-West Province forms one of the nine Provinces in South Africa, with an estimated population of 4,1 million. However, the North-West Province ranks 7th regarding population density in South Africa.

The North-West Province borders Botswana in the far North-East and North-West, Limpopo Province in the North-East, Gauteng Province in the East, Free State Province in the Southeast, and Northern Cape Province in the Southwest (Figure 2).

The Province consists of mainly flat areas of grassland and scattered trees, with the Magaliesberg mountain range in the northeast extending about 130 km

from Pretoria to Rustenburg and the Vaal River flowing along the southern border of the North-West Province (Figure 4).

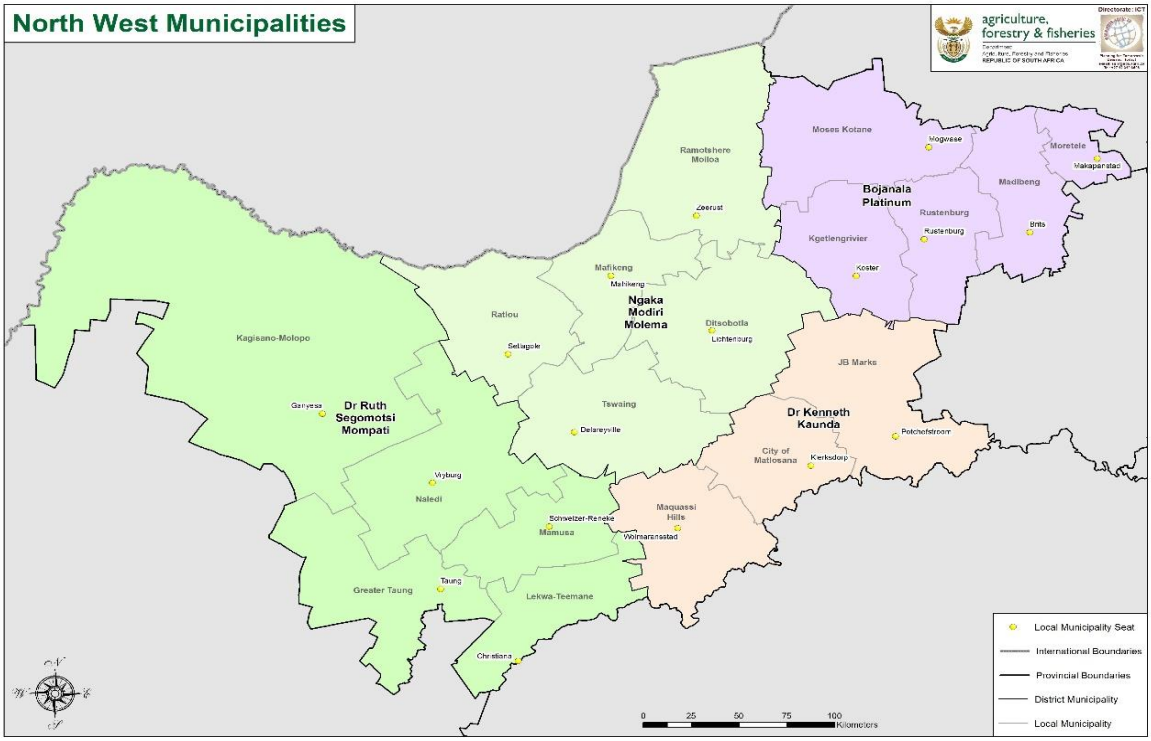


Figure 4: Map of the North-West Province in South Africa (DALLRD, 2020c)

The Northwest Province's minimum annual temperature (Figure 5) ranges from as low as -1.5 °C in the central parts to 5.2°C in the Northern parts of the province. The maximum annual temperature (Figure 6) ranges from 26.4 °C in the East to 27.7 °C in the West. The first frost (5 out of 10 years) (Figure 7) can be expected between 11 – 20 April in the South and as late as June or later in the North. Long-term annual rainfall (Figure 8) is as low as 156 mm per annum in the far West and as high as 752 mm per annum in the Eastern parts.

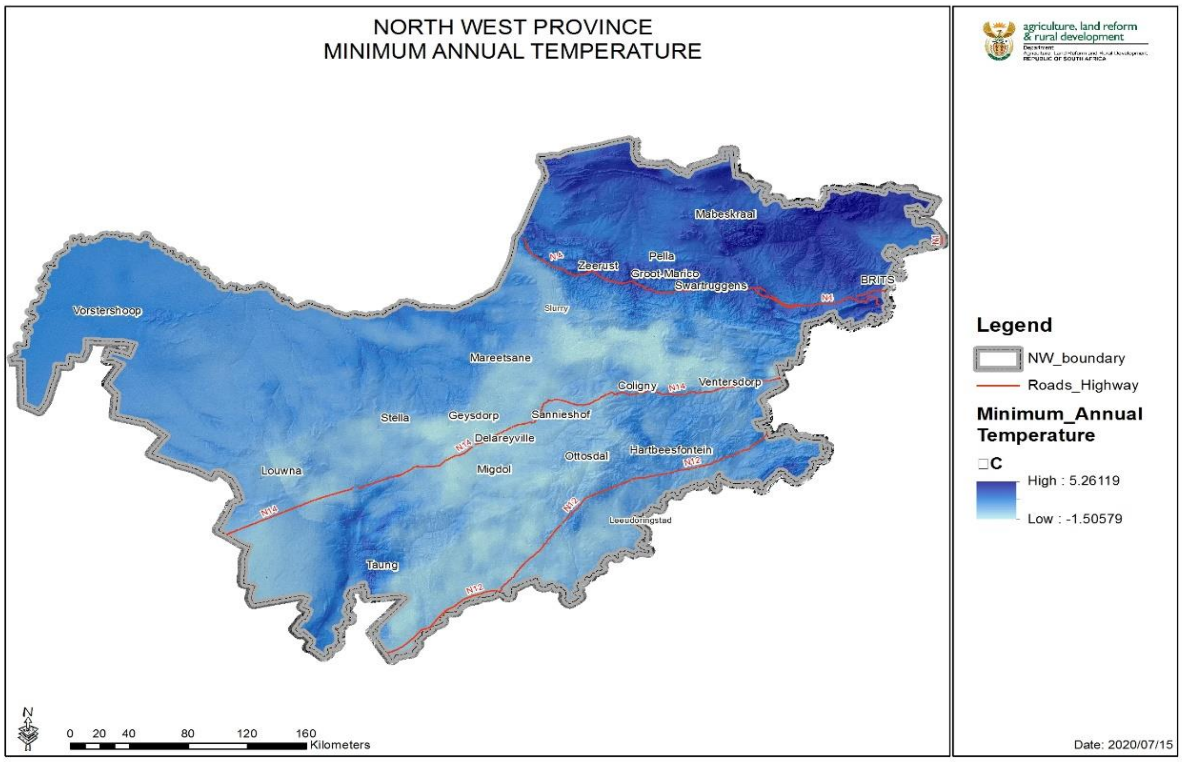


Figure 5: North-West Province minimum annual temperature (DALRRD, 2020e)

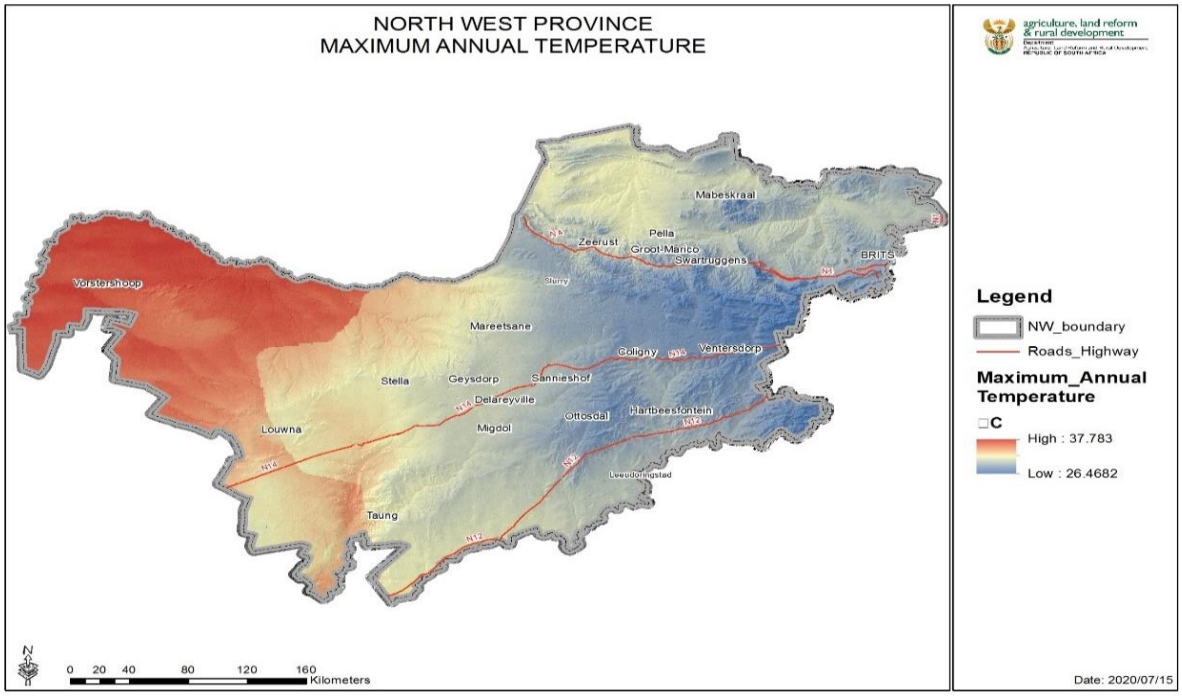


Figure 6: North-West Province maximum annual temperature (DALLRD, 2020d)

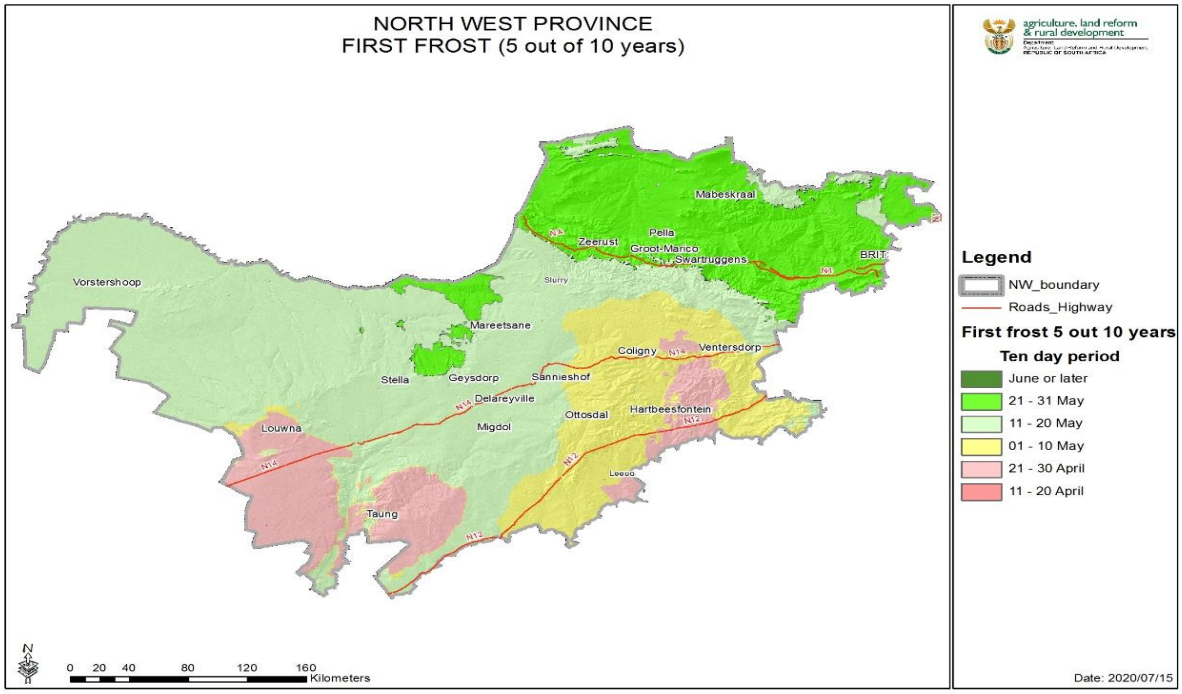


Figure 7: North-West Province's first frost (5 out of 10 years) (DALLRD, 2020a)

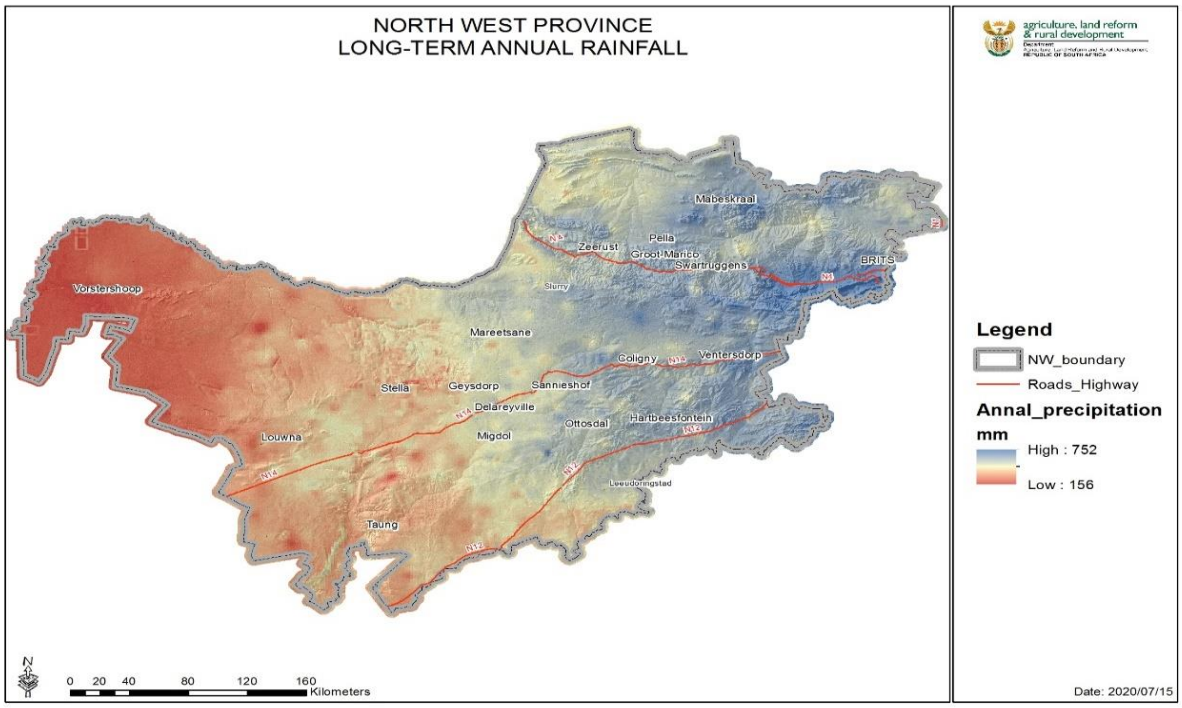


Figure 8: North-West Province long-term annual rainfall (DALLRD, 2020b)

According to the STATS SA census report on commercial agriculture of the North-West Province (2020), "In 2017, 235 large farms (those with an annual income of more than R22,5 million) constituted 4.8% of the total number of farms in the commercial agriculture industry

and accounted for 67.5% of total income and 44.1% of total employment (Figure 9). This contrasted with the 2 415 micro-farms (annual income below R1 million), which made up 49.1% of the total number of farms, but accounted for just 2.1% of total income and 7.7% of total employment".

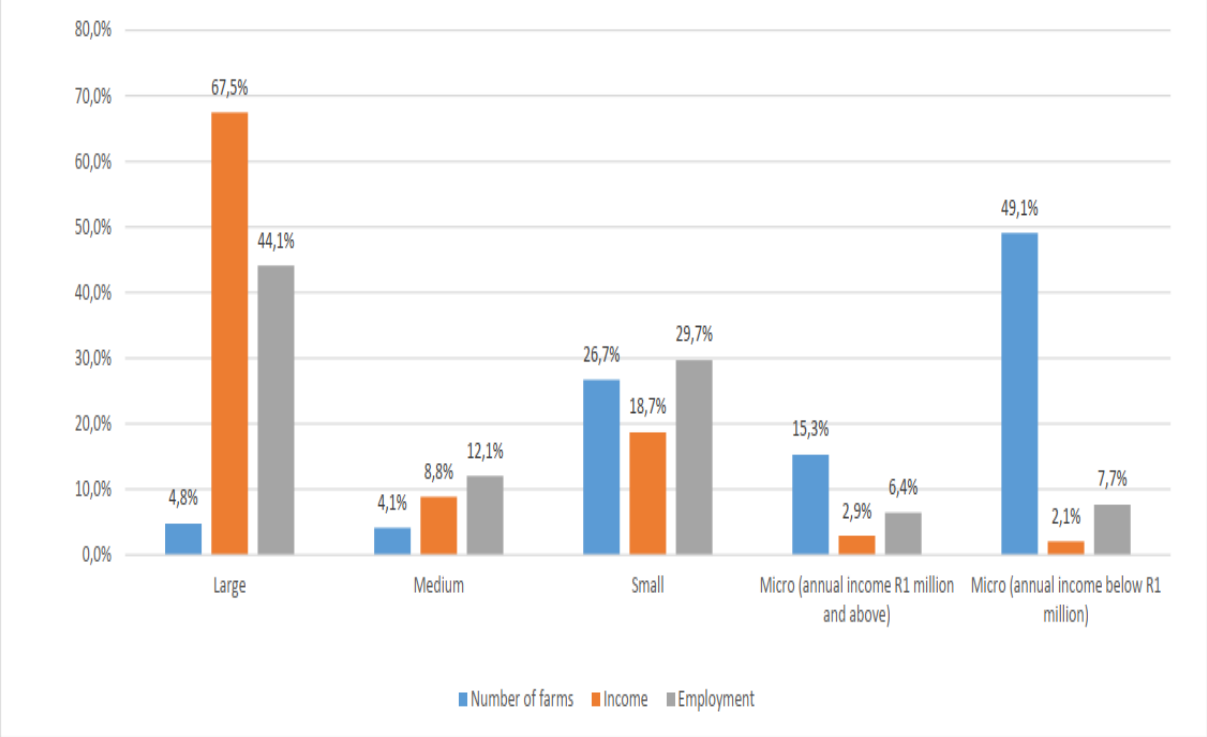


Figure 9: Number of farms, income, and employment in the commercial agriculture industry by farm size, as a percentage of the total, 2017 (STATS SA, 2020)

2.4. PERSPECTIVES OF GLOBAL AGRICULTURE SYSTEMS

Below is a list of definitions of the different global agricultural systems and their impact on the long-term sustainability of agriculture.

2.4.1. Conventional Farming (CF)

Conventional Farming (CF), according to the United States Department of Agriculture (2015), can be defined as "the use of seeds that have been genetically altered using a variety of traditional breeding methods, excluding biotechnology, and are not certified as organic. Some conventional breeding methods have been used for thousands of years to develop plants with faster growth, higher yields, pest and disease resistance, larger seeds, or sweeter fruit. Conventional crops may be grown simply as commodities and enter the commodity stream where they are mixed with other crops, including genetically engineered, or they may be grown to meet a requirement set forth by an end market, such as a specific chemical or nutritional requirement. When conventional crops are targeted for a unique end market, farmers often receive premium prices".

CF systems are very productive compared to organic farms. It's between 8 to 25% more productive and needs, on average, 25% less land to produce the same yield (Theocharopoulos *et al*., 2012; Muller *et al*., 2017). To achieve this productivity, synthetic pesticides, - herbicides, and - fertilizers, in combination with increased use of genetically engineered seeds, are required (National Research Council, 2010; Ratcliffe *et al*., 2017). However, CF contributes to numerous forms of environmental degradation, including air and water pollution, soil depletion, - erosion, and diminishing biodiversity (Bradley, 2002; Horrigan *et al*., 2002; Lal *et al*., 2007; Gauker, 2010; Palm *et al*., 2014). The systems are dependent on the use of fossil fuels that are used to manufacture synthetic fertilizers and pesticides as well as the energy source for agricultural machinery, requiring 45% more energy than organic agriculture to transport and apply fertilizers and pesticides (Wang, 2009; Theocharopoulos *et al*., 2012**;** Pimentel and Burgess, 2014)**.** In addition, CF practices aimed at higher yields per ha strain the ability of the soils to maintain enough replenishment of essential natural minerals, leading to less nutrient-dense food (Montgomery, 2007; Benbrook *et al*., 2008; Balmford *et al*., 2018). The CF system also causes negative long-term effects on human health (Horrigan *et al*., 2002). Additionally, the CF tillage systems tend to induce long-term disturbance of soil properties and reduce fertility and, consequently, over the long-term, leading to compaction, soil erosion, and loss of soil fertility (Dayou *et al*., 2017).

2.4.2. Conservation Agriculture (CA)

CA tillage includes various techniques, including contour tillage, mulch tillage, ridge tillage, and reduced (minimum) tillage. Reduced soil disturbance will improve the soil environment and have a lower negative environmental impact (Bradley, 2002; Palm *et al*., 2014; Busari *et al*., 2015). For example, when farmers use no-till farming systems, they can reduce energy use by up to 70% (Gomiero, 2016). In addition, not ploughing the soil and increasing levels of crop residues will help conserve soil moister (Peigne *et al*., 2009) and effectively minimise topsoil losses due to erosion (Claassen *et al*., 2018).

The increased levels of crop residue led to higher soil carbon, which positively affects the activities of soil macrofauna. In addition, earthworms, a major component of the soil macrofauna, are essential in soil fertility dynamics as their burrowing activities aid in the improvement of soil aeration and water infiltration (Lal, 2004; Liu *et al*., 2006; Kargas *et al*., 2012).

However, according to a study by Pittelkow (2015), in CA, the yields, on average, are 5.7% lower on no-till systems compared to CF tillage systems. Furthermore, lower soil pH has also been reported in no-till systems compared to conventional systems. The buildup of organic matter in the top few centimeters was thought to be the cause of the lower pH in no-till soils, which led to higher electrolyte concentrations and lower soil pH (Hole *et al*., 2005; Cookson *et al*., 2008; Rahman *et al.*, 2008; Busari *et al*., 2015). Additionally, the fact that no-till yielded much less root mass than tilled plots suggested that soil compaction under no-till inhibited root development and the growth of the main root axes. At the same time, conventional tillage improved root penetration (Peixoto, 2019).

CA tillage methods offer various benefits and can be summarised as follows: savings on time and fuel, lower labour requirements and soil erosion, higher agricultural productivity, increase in the moisture retention capacity of the soil, reduced soil compaction and soil crust formation, fewer carbon emissions and air pollution and better surface water quality (Karayel and Šarauskis, 2019).

2.4.3. Organic Agriculture (OA)

OA can be defined as a farming system where farmers work with nature rather than against nature, using environmentally friendly methods of weed, pest, and disease control aimed at producing food with minimal harm to ecosystems, animals, or humans (Seufert *et al*., 2012**;** Pimentel and Burgess, 2014)**.** Reviews and meta-analyses generally support the perception that OA systems are more environmentally friendly than CF systems. For example, studies have found that OA farming systems have greater soil carbon levels, better soil quality, and less soil erosion and groundwater pollution when compared to CF systems (Bengtsson *et al*., 2005; Tuomisto *et al*., 2012; Muller *et al*., 2017).

OA can provide significantly more profit (22 - 35% greater), with a higher benefit/cost ratio of 20 - 24%, than CF (LEAP, 2015; Reganold and Wachter, 2016), mainly due to the price premiums awarded to organic foods (Theocharopoulos *et al*., 2012; Pimentel and Burgess, 2014). In addition, organically grown food also tend to have significantly higher nutrient density than CF-grown food (Muller *et al*., 2017).

Numerous studies have compared yield differences between OA and CF systems. According to these studies, yield averages are between 8 to 25% lower in OA systems compared to CF (De Ponti *et al*., 2012; Seufert *et al*., 2012; Mashele and Auerbach, 2016; Reganold and Wachter, 2016). In addition, the OA system requires up to 35% more labour than the CF systems for maintaining plant and soil health through proper aeration, drainage, fertility, structure, and watering (Pimentel and Burgess, 2014). The higher labour requirements lead to labour costs being 7 - 13% higher in OA than in the CF systems (Hole *et al*., 2005; Pimentel and Burgess, 2014; Reganold and Wachter, 2016).

2.4.4. Integrated Crop Management (ICM)

The entire farm operation is the focus of the ICM system. In addition to managing pests, it expands integrated pest management to include all facets of agricultural production, such as soil fertility, tillage, crop rotation, and crop variety selection. It connects optimal management methods into an integrated plan (Padgitt *et al*., 2001). However, the system requires a high investment in infrastructure because of the integrated system's multiple components and high demand for access to credit and capital. In addition, with the increased complexity of the

system, there are higher risks and a need for higher qualified farmers, managers, technicians, and workers to manage the system (Balbino *et al*., 2014)**.**

According to Rana and Chopra (2013), the ICM system provides synergy among different agricultural divisions and an opportunity to increase economic yield and profitability, which relates to greater sustainability. Due to the interaction of enterprises, it provides a year-round flow of money to the farmer. ICM is also environmentally friendly. In the linked system, waste materials are effectively recycled, and the organic waste available can also be utilized to generate biogas with energy-saving opportunities. Combining crops with livestock enterprises would increase the labour requirement significantly and provide enough scope to employ family labour year-round**.**

2.4.5. Climate-smart agriculture (CSA)

Climate-smart agriculture (CSA) includes soil and water management, crop production, urban agriculture, rangeland management, and agro-processing practices to transition to an all-inclusive green economy.

Soil management practices aim to improve soil health by implementing a nutrient management stewardship approach, providing guidelines on using the right fertilizer source at the correct rate, time, and place. Implementing these guidelines will simultaneously improve fertilizer efficiency and limit economic costs and greenhouse gases. The integrated soil fertility management approaches combine organic fertilizer resources with optimal chemical fertilizers for maintaining and restoring soil fertility. Combining conservation agriculture and integrated soil fertility management approaches is defined as the prime example of this approach due to its effectiveness in improving soil health and productivity whilst mitigating greenhouse gas emissions.

The soil water management approach aims to use water resources efficiently to maintain or improve productivity. This will be achieved by using CSA practices to increase infiltration capacity by improving the physical quality of the soil. These recommended practices include the in-field rainwater harvesting practices of no-till, minimum tillage, contouring, mulching, ridges, and raised beds, which will help improve water use efficiency.

It is essential to use cropping systems that include climate-smart crops that are more drought-tolerant and tolerant to diseases and pests. Additionally, implementing crop rotation, intercropping, and cover cropping, in combination with climate information, will help farmers make climate-smart decisions.

Agri-Parks are being introduced in South Africa to bring agro-processing to production areas. In addition, cold storage facilities within the Agri-Parks will reduce post-harvest losses, transport costs, and greenhouse gas emissions (Mnkeni *et al*., 2019; DAFF, 2018).

2.4.6. Sustainable Agriculture (SSA)

Sustainable agriculture entails raising crops and cattle in a way that concurrently achieves three goals: economic success, social benefits for the farm family and the community, and environmental preservation (Sullivan, 2003).

"Increasingly, it is being recognized that people, profit and the planet dimensions are interlinked, and an important challenge for public and private policy is to take them jointly into account (Figure 10) (Abubakar and Attanda, 2013)".

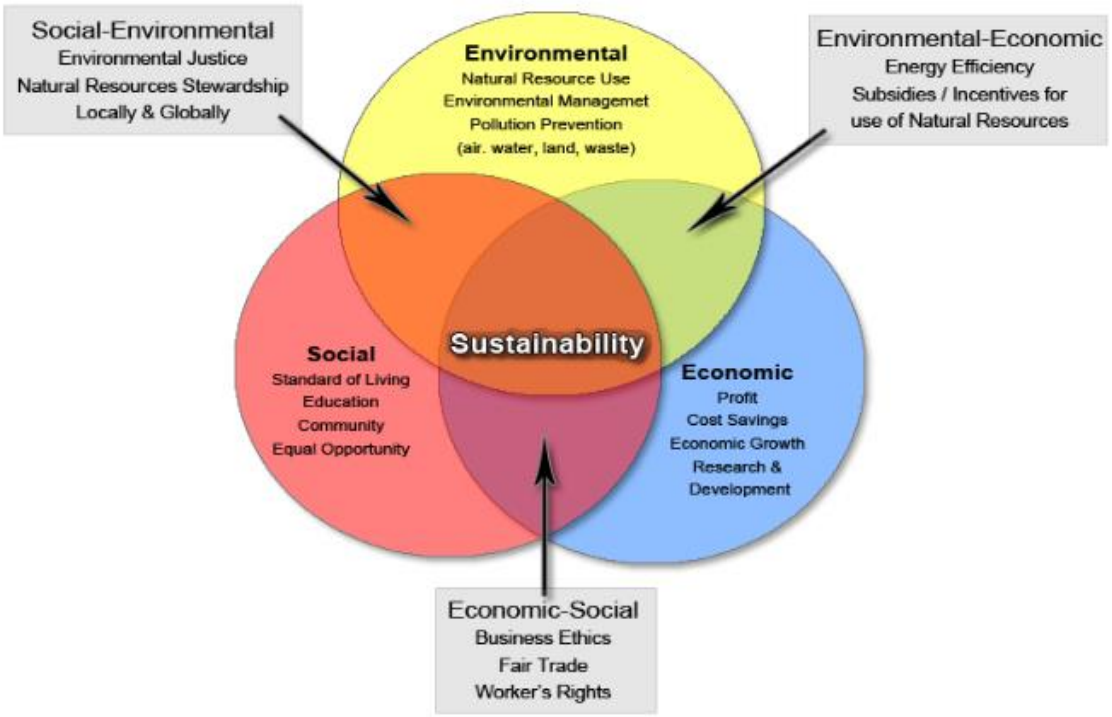


Figure 10: Triangle of sustainability (Abubakar and Attanda, 2013)

An environmentally, economically, and socially sustainable agriculture system is essential to enhance farmers' and society's quality of life (Krall, 2016; United Nations, 2018) and sustain the growing need for food production to combat food insecurities for an ever-growing population (National Research Council, 2010). SSA will not only produce safe and healthy food (Benbrook *et al*., 2008) and make efficient use of non-renewable resources (Wang, 2009), but it will also enhance the quality of the environment by reducing the negative impact of agriculture on natural resources (Gauker, 2010). In addition, farmers using the SSA system will be rewarded with economic viability and profitability (Corselius *et al*., 2001; Syed *et al*., 2013).

2.4.7. Precision Agriculture (PA)

According to Stafford and Deboer (2019), "Precision agriculture is a management strategy that gathers, processes, and analyses temporal, spatial, and individual data and combines it with other information to support management decision according to estimated variability for improved resource use efficiency, productivity, quality, profitability, and sustainability of agricultural production".

2.4.7.1. There are many service offerings associated with PA. A broad overview of some of these services and advantages related to these services include:

i. **Soil Classification:** The evaluation of soils in terms of their physical qualities. Based on this evaluation, these soils are subsequently grouped into different classes according to the taxonomic system applicable. Based on a soil classification survey, maps are produced containing information regarding soil preparation, cultivar and rootstock placement per soil type, plant spacing, row direction, the layout of roads, block placement, general drainage, and the most representative points for probe positioning per irrigation block.
ii. **Chemical soil analyses:** Soil chemistry answers producers' soil nutrient status opportunities and risks before the start of a season. By conducting precision-based soil chemical analysis on a proactive basis, specific areas can be identified where certain nutrient corrections are required. Maps are generated based on chemical analysis. The percentages and ratios of elements to one another are also included in the mapping. These maps are used to variably apply soil corrections like lime, Gypsum, MAP, and K2SO4 to get your soils in balance nutritionally.

iii. **Leaf analyses**: Leaf samples are taken at different phenological stages and GPS-logged, which enables the producer to return to the same spots for the following year's leaf samples. The leaf results are then converted into a report depicting each nutrient's maximum and minimum optimal levels with the actual leaf analysis result. This makes it much easier to visually see where nutrient shortages are and where steps need to be taken to correct nutrient shortages per GPS-logged area.

iv. **Precision pest monitoring:** With this service, the occurrence of pests and diseases is linked to a timeline and geographical coordinates. Interpolating various data points creates a clear image of pest and disease incidences. These data points were obtained through two methods: traps and scouting. Producers can monitor for pests throughout the season and determine where they develop first, thus equipping the producer with the knowledge of when and where the pesticides need to be sprayed to save time and money by only applying crop protection products to the required location.

v. **Yield maps:** Data on crop performance for a specific year is gathered by a yield monitor using GPS position technology. This data contains information on crop mass, moisture, area covered, and location. These variables are used to automatically calculate yield statistics, and yield map variable sones can be built to provide varying rates of inputs for production.

vi. **Precision platforms (MyFarmWeb):** Internet-based platforms on which the farming's geographical data is stored, like MyFarmWeb. The advantages include securely storing farm geographical information in one location, format, and system. Additionally, different data maps can be compared at the push of a button, and information can be interpreted more easily and turned into practical steps to make farming more sustainable and profitable (Agri Technovation, 2020).

2.4.7.2. Value proposition brought by digitalization technology

According to Aguera *et al.* (2020), "The digitalization of agriculture is defined by the conversion of measurements of agricultural inputs and outputs into digitally stored data for use in automated systems and applications that provide information and assist decision-making". Technology's ability to integrate and create interpretable systems that link everything to anything and vice versa allows for a holistic view and risk mitigation. Digitalization can also improve agriculture's response to future challenges for the need for technology to improve

the efficiency with which inputs are turned into outputs, but also conserve scarce natural resources and reduce waste.

Figure 11, below, sets out the complexity of a commercial farming operation and demonstrates the importance of using interoperable systems that are provided by technology that can monitor each sector. If changes are picked up, an early warning system will report and measure the impact on the global picture. Proven digital technology can assist small-scale farmers in obtaining funding to expand their farming operations because of proven outcomes and yields (Sørensen *et al*., 2010).

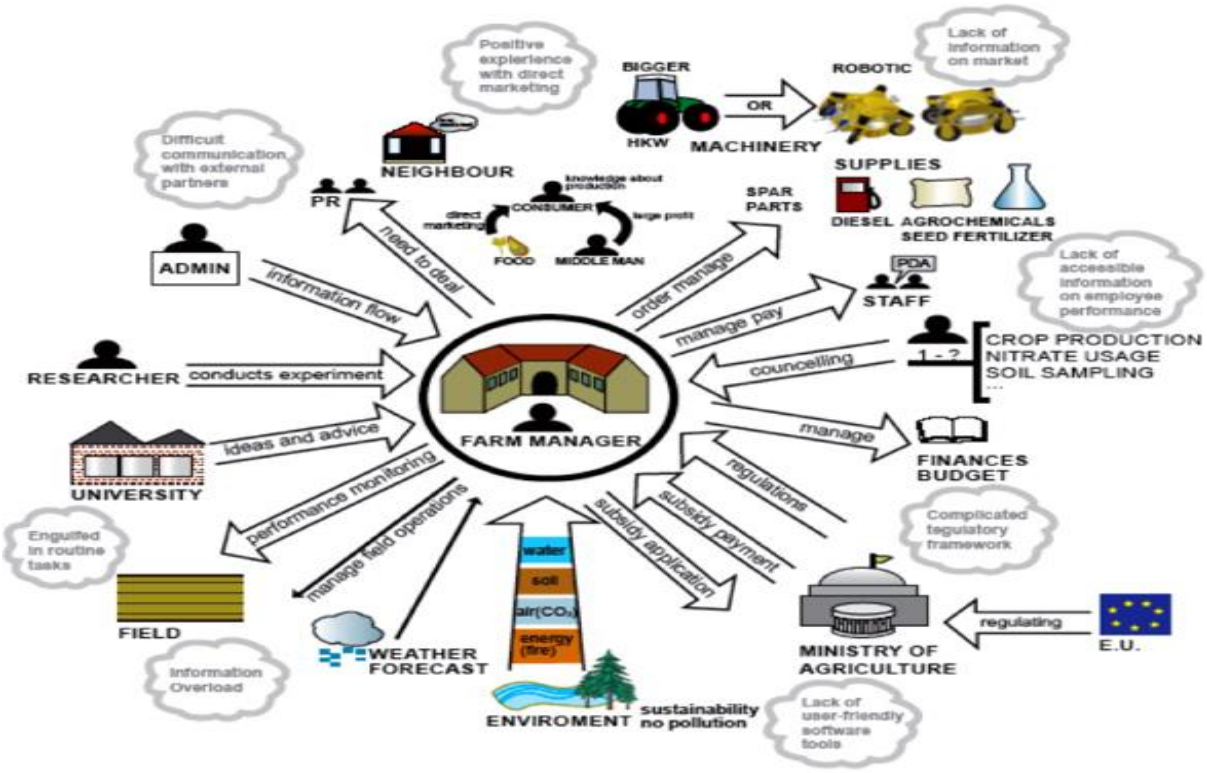


Figure 11: The complexity of a commercial farming operation (Sorensen *et al*., 2010)

Several opportunities exist for digital agricultural solutions to significantly improve resource use efficiency, profitability, transparency, market involvement, and environmental sustainability, according to the FAO and Center for Topical Agriculture (2020). By lowering costs, enhancing decision support, minimizing loss, and boosting the efficiency of sustainable resource use, digital technologies have the potential to improve agricultural value chains.

Digitizing and platforming the entire value chain from agricultural inputs to final consumption holds many benefits for all role players, according to Kenney (2020) (Figure 12). These include

verification, traceability, and transparency in conjunction with machine learning and techniques to improve precision, which should also create greater efficiency and possible profits. Inputs would also be optimized by integrating data across the entire agri-food system, having significant advantages concerning sustainability. Using remote and land sensing allows for the identification and measurement of agricultural run-off, improving pollution identification.

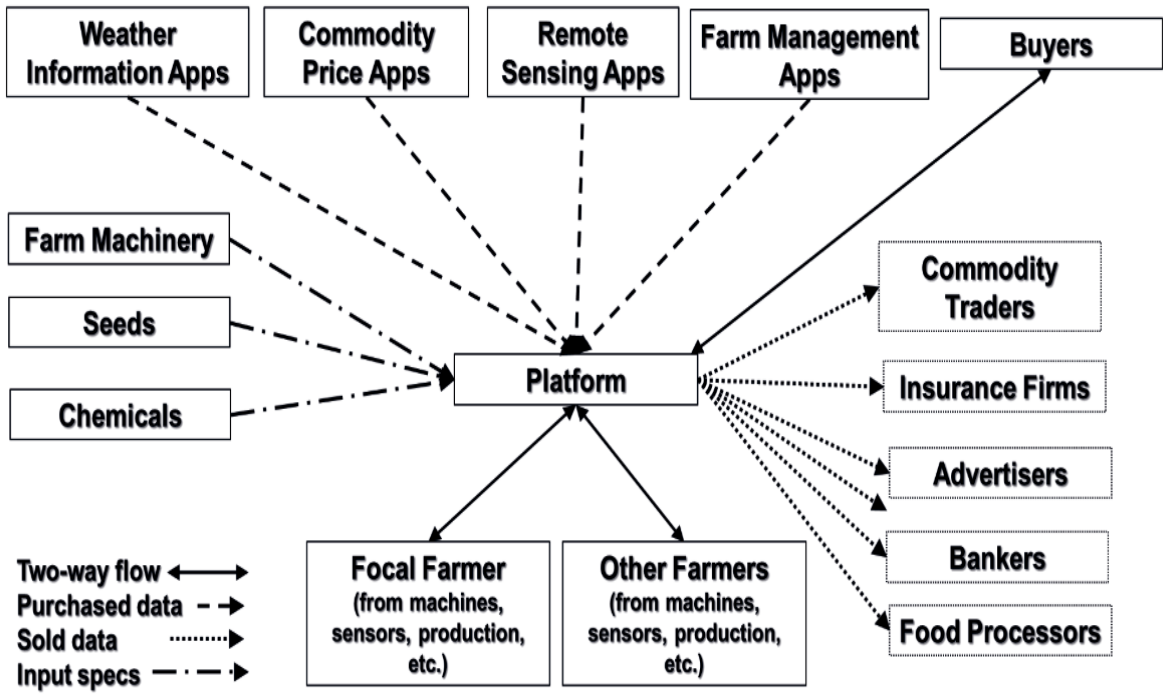


Figure 12: Data flows through an agricultural platform (Kenney *et al.*, 2020)

2.5. CHALLENGES IN THE SOUTH AFRICAN AGRICULTURAL SECTOR

Farmers, especially emerging farmers in the South African context, face numerous challenges hamper them from sustainably farming. These challenges include:

2.5.1. Regulatory standards and compliance requirement challenges

Representing 27% of the nation's agricultural exports, the European Union (EU) is South Africa's second-largest market for agricultural goods. Therefore, South Africa needs to ensure that its market access in the EU is maintained and improved. The EU Green Deal and its Farm

to Fork Strategy are set to impose new rules that would impose further hurdles, which will undoubtedly damage agricultural exports to the EU (Sihlobo and Kapuya, 2021a).

2.5.2. EU Green Deal and its Farm to Fork Strategy

The European Green Deal sets out how to make Europe the first climate-neutral continent by 2050. It maps out a new, sustainable, and inclusive growth strategy to boost the economy, care for nature, improve people's quality of life and health, and leave no one behind. The Farm to Fork Strategy is at the heart of the Green Deal and central to the Commission's agenda to achieve the United Nations' Sustainable Development Goals (SDGs). The Farm to Fork Strategy comprehensively addresses the challenges of sustainable food systems and recognizes the inextricable links between a healthy planet, healthy people and healthy societies (European Commission, 2020).

The Farm to Fork, strategy action plan set out by the commission to the European parliament presented measures that needed to be taken forward with timelines. The measures presented in this action plan included a proposal for a legislative framework for sustainable food systems and developing a contingency plan to ensure food supply and food security. Recommendations were also made to ensure sustainable food production and to stimulate sustainable food processing, wholesale, retail, hospitality, and food services practices. The commission also proposed to promote sustainable food consumption, facilitating the shift toward healthy, sustainable diets and reducing food loss and waste (European Commission, 2020).

2.5.3. What does the EU's Farm to Fork strategy mean for South Africa's agriculture sector?

The South African agriculture sector may face several challenges and risks, including:

i. **Regulatory and policy uncertainty**: Regulations in the Farm to Fork strategy are expected to be implemented by 2022. However, policy cycles and political processes can impose a lag time of between three and five years to align their policy, regulations, and business decisions to the requirements of the food system, leading to a transition phase of regulatory and policy uncertainty (Sihlobo and Kapuya, 2021b).

ii. **High cost of compliance:** Over the years, South African agribusinesses have been required to adhere to strict regulatory standards set by the European Union (EU), as well as an expanding number of private standards pertaining to traceability, authenticity, exposure to allergens, good farming practices, child labour, sustainable farming practices, and various types of certification (Sihlobo and Kapuya, 2021b). "With Fair Trade Certification costing over US $1000 for smallholder farmers, resource-poor farming households can seldom afford such high costs of adopting new regulations and certification. Without financial support, most smallholder farmers will inevitably be excluded from participating in export markets" (Sihlobo and Kapuya, 2021b).

iii. **Increased inequality**: Resource-poor farmers may be excluded from the EU's Farm to Fork strategy if purposeful and strategic interventions to enhance regulatory compliance are not made because they lack the financial and technological means to comply with new standards. According to Sihhlobo and Kapuya (2021b), this will expand the disparity between the formal and informal food systems and deepen the inequality gap.

2.5.4. Other challenges

i. **Ageing farmer population:** On average, the South African farmer is over 60 years old, mainly because of the rapid urbanization of young people seeking opportunities for viable careers and personal growth. Farming is seen as a survival profession rather than a family business.

ii. **Lack of access to finance:** Farming requires a high initial investment, and access to financial services to support up-front costs is a prerequisite to successful farming. However, smallholder and emerging farmers often do not have the title deeds to the land they cultivate, making accessing financial services difficult and reinvestment in the land unlikely.

iii. **Overstretched and under-resourced extension staff:** The ratio of extension officers to farmers is too low (1,147 farmers: 1 extension agent), resulting in farmers experiencing difficulties accessing imperative information for farm management.

iv. **Lack of access to knowledge and training:** Related to the limited access to extension services is low farmer access to knowledge-sharing platforms and initiatives. Smallholder farmers are often geographically remote, with little network coverage, and can generally

not afford premium services beyond those offered by the government to invest in the recommended innovations to increase yield and profit.

v. **Lack of succession planning:** Emerging farmers often do not have succession planning in place and run the risk of becoming unsustainable. One of the main preconditions for keeping agriculture viable and sustainable is the generational renewal of family farming, i.e., retaining young people on farms and in rural communities. The future of food and agriculture lies in the hands of the next generation of family farmers.

vi. **Drought and scarcity of water resources:** Due to its lack of water resources, South Africa has experienced droughts continuously since 2014, which have reduced food production and jeopardized the nutritional security of smallholders.

vii. **Climate variability and change:** Increased variability and shifts in precipitation and weather patterns make accurate rainfall prediction more volatile and the maintenance of livelihoods depending on natural systems increasingly difficult.

viii. **Lack of participation in the value chain:** Poor infrastructure and remoteness make it difficult for smallholders to transport their produce to marketplaces and retail. Additionally, the lack of information is another obstacle farmers face in entering the value chain. Finally, the lack of scale precludes smallholder farmers from the benefits of economies of scale.

ix. **Postharvest food waste:** About 34% of the food produced in South Africa for human use is lost or wasted. This waste occurs mainly between the farm gates and the consumer. Preventing these losses can increase national food security, expand the agricultural economy, and maximize resource use efficiency (FAO and Centre for Tropical Agriculture (CIAT), 2020).

2.6. THE OPPORTUNITIES THAT THE EU's FARM TO FORK STRATEGY BRINGS TO SOUTH AFRICA:

The opportunities that the EU's Farm to Fork strategy brings to South Africa include:

i. **Moving towards low levels of fertilizer and chemical use and reducing soil contamination:** South Africa has existing commercially driven export value chains in place with the EU that already conform to these emerging rules, yet such food systems are still targeting niche

markets in the EU. These niche food systems are driven by extensive, organic, and low-input farm production systems that fit in with the Farm to Fork strategy, ultimately seeking to make these niche markets mainstream. Making this an opportunity for South Africa, local farmers can begin to produce higher volumes at a relatively competitive price.

ii. **High and growing food demand:** Few EU member states have enough land to produce enough food to meet the EU's growing food needs. In South Africa, there is abundant land available that can be put into production to take up a significant portion of the food needs, especially if South Africa can meet the regulatory standards dictated by the Farm to Fork strategy.

iii. **Technical change:** The agro-food system that will boost productivity and bring food prices down to manageable levels is what the EU depends on as a driver. Technical change for South Africa, will entail the adoption of new technologies that will sustainably boost yields and lower the carbon footprint of the agro-food system.

iv. **Business model innovation:** In order for smallholder producers to be able to meet the needs of the Farm to Fork Strategy, multination agribusinesses will need to invest significantly in smallholder production by expanding training, capacity-building, and corporate social responsibility initiatives for them. This investment may result in a greater reliance on smallholder farmers for farm products (Sihlobo and Kapuya, 2021a).

2.7. THE ENVIRONMENT AND SUSTAINABLE AGRICULTURE

The environment plays a significant role in determining the sustainability of the agricultural sector. Under this subheading, the different factors influencing environmental sustainability will be discussed. Leigh (2017) states, “There is no agreed definition of what constitutes environmentally sustainable agriculture. It encompasses a range of possible measures that aim to reduce the effects of agriculture on the environment and to conserve the aspects of the natural environment on which agriculture relies. The most relevant measures will vary from farm to farm and in their wider environmental context. These measures fall into two broad categories: restoring natural capital and improving resource efficiency”. Measures that maintain and restore natural capital and improve resource efficiency include improving soil and water quality, conserving biodiversity, and using modern technology and practices.

2.7.1. Soil degradation

Soil degradation is the term used to describe a change in the soil's physical, chemical, and biological features that results in a change in the status of the soil's health. This results in soil compaction, salinization, acidification, and soil loss from wind and water (Hegde *et al*., 2011). Degradation of the soil is primarily caused by agriculture (Nearing, 2013). When topsoil is exposed in conventional agricultural systems, Kelly (1990) identified three essential phases that can be used to describe how soil erosion happens: The loosening of soil particles occurs in three stages: first, by the bomb-like impact of raindrops or the scouring action of runoff water; second, by flowing water carrying the detached particles down slopes; and third, by the deposition of the soil particles at new locations, such as on top of other soil at the slope's base or in ponds or waterways. Since it contains the most organic matter and nutrients necessary for regular plant growth, the soil that washes downhill is often the most productive.

Agriculture based on conventional methods causes erosion rates to rise to unsustainable levels. In traditionally ploughed fields, the topsoil is lost at a rate of 1 millimeter each year. Contrary to current conventional agricultural methods, no-till farming, yields erosion rates that are significantly closer to those of soil production, which could serve as the basis for sustainable farming (Montgomery, 2007).

According to Young *et al*. (2015), “Soil degradation is potentially reversible through planned ecosystem restoration and by introducing agricultural systems and practices that regenerate soil by building fertility and increasing biological activity and soil organic content”.

2.7.2. Soil health and fertility

The concept of soil health captures the ecological attributes of the soil, which have implications beyond its quality or capacity to produce a particular crop. Soil health has been defined as "the continued capacity of soil to function as a vital living system, within the ecosystem and land-use boundaries, to sustain biological productivity, promote the quality of air and water environments, and maintain plant, animal, and human health" (Doube and Vakakattu, 1997).

The ability of the soil to give the nutrients plants need for growth is known as soil fertility. Soil test results provide one of several approaches for developing a soil-fertility program. Other approaches include calculating a nutrient mass balance, field scouting for nutrient deficiency symptoms, or a combination of the above (Reitsma *et al*., 2015). Soil pH is the cornerstone of a good soil fertility program and affects nutrient availability and toxicity (Agsource Laboratories, 2012).

Providing plants with balanced essential nutrients through applying organic matter and minerals is the basis of healthy soils, which is the foundation of the food system producing healthy crops which nourish people (Ghorbani *et al*., 2008; Vanlauwe *et al*., 2010). Without productive and healthy soil, the prospect of producing enough food to feed an ever-increasing human population is impossible. Both soil health and – fertility is essential factors to consider for improving environmental sustainability (Idowu *et al*., 2019). Alternative management practices also enhance soil health and allow sustained agricultural productivity, including conservation agriculture, which includes good practices through combining no tillage or minimum tillage with a protective crop cover and crop rotations (Bot and Benites 2015).

2.7.3. Crop protection

Crop protection is the general strategy or practice of safeguarding yields against various threats, such as pests, weeds, plant diseases, and other organisms that harm crops (Ratcliffe *et al*., 2017).

Insect, disease, and weed pressures are among the greatest threats to our food supply as they compete for essential nutrients with plants and rob them of their yield and quality. As a result, farmers rely on crop protection products to minimize crop damage and harvest-limiting pressures (CropLife International, 2021).

The use of herbicides provided global food security; moreover, the use of herbicides continues to grow to meet the food demand of the ever-expanding population globally. Using herbicides reduces crop losses and increases productivity through improved weed control. However, according to Hasanuzzaman and Nahar (2020), “Repeated and injudicious use of herbicides creates phytotoxicity, causes adverse effects on the environment, affects nontargeted organisms and causes health risks. It also poses residual trouble to the succeeding crops and

affects the food chain. Detrimental effects of herbicides on the environment are a major threat to agricultural sustainability." It is crucial to combine optimal management practices with current technology, crop diversification, and available modern technologies in order to increase agriculture's productivity and sustainability. Using bioherbicides can reduce our reliance on synthetic chemical herbicides, which may be a smart way to reduce environmental pollution and health concerns while maintaining ecosystem balance. To reduce the use of synthetic chemical herbicides, researchers are also developing transgenic crops and transferring herbicide-resistant genes at a molecular level (Hasanuzzaman and Nahar, 2020).

According to Pogăcean and Gavrilescu (2009), "Pesticides should be used only as a last alternative when other methods have failed to manage pests to acceptable levels. Due to the known harmful effects of pesticides to humans and wildlife". Alternatives include integrated pest management, biological controls such as pheromones and microbial pesticides, and genetic engineering.

Appropriate packaging is essential in ensuring that crop protection products are safely delivered to the end user. Additionally, to maintain a healthy ecosystem, farmers must follow a responsible and ethical approach to disposing of crop protection containers. To preserve the health of farmers, their communities, and the environment, the crop protection sector is taking the lead in ensuring that the development, use, and proper disposal or recycling of empty crop protection containers is managed responsibly (CropLife International, 2019).

2.7.4. Crop diversity, cover crops, and crop rotation

Increasing crop diversity on a farm can contribute to soil conservation, wildlife habitat, and increased populations of beneficial insects. In addition, cover crops in the off-season after harvesting a grain or vegetable crop can provide several benefits, including improved soil quality and fertility, weed suppression, and erosion control (Legg and Viatte, 2001). Cover cropping has many benefits, including shielding the soil from sunlight, wind, and heavy rainfall, thus improving soil structure, water infiltration, and root penetration while enhancing soil microbial communities. Additional benefits include improving soil fertility by improving nutrient cycling and retention and reducing soil erosion, crusting, and nutrient leaching (Wright *et al*., 2014).

Crop rotation with different crops plays an essential role in the development and distribution of bio pores and the dynamics of microbial communities through the recycling of crop residues, thus contributing to the development of soil structure and helping prevent soil degradation (Ball *et al*., 2005).

2.7.5. Loss of biodiversity

Agricultural intensification and expansion directly impact local biodiversity through land conversion to farmland, resulting in the displacement of local populations and loss of ecosystem services. With the extinction of numerous agricultural species and varieties, extensive industrialized agriculture also contributes significantly to the depletion of crop biodiversity. It accounts for 37% of threats to bird species listed as threatened species (Ludwig *et al*., 2007; Gomiero *et al*., 2011).

2.7.6. Climate change

Climate change will change rainfall patterns, increase global temperatures, and result in floods and droughts being more severe and frequent (Ludwig *et al*., 2007). According to an FAO report published in 2016, “Climate change threatens all dimensions of food security. It will expose both urban and rural poor to higher and more volatile food prices. It will also affect food availability by reducing the productivity of crops, livestock, and fisheries. It will also hinder access to food by disrupting the livelihoods of millions of rural people who depend on agriculture for their incomes”.

The agriculture sector is not only among the most vulnerable to climate change but also a significant contributor to greenhouse gas emissions from crop and livestock activities, contributing some 5 billion metric tonnes of CO^2eq to the atmosphere each year, with synthetic fertilizer contributing 13% to the total amount of greenhouse gas emissions (FAO, 2014; Reganold and Wachter, 2016). Greenhouse gases include water vapour, carbon dioxide, nitrous oxide, and other gases. The emission of greenhouse gasses into the earth’s atmosphere plays a significant role in climate change and global warming (Kweku *et al*., 2017).

2.7.7. Weather-related hazard (disaster) and risk for agriculture

Sustainable development's social, environmental, and economic pillars are at risk from disasters. Agriculture is still being struck the worst by the disaster, which is developing faster and more unpredictablely than anticipated. The Sustainable Development Goals (SDGs) and the Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR) must be achieved during the next ten years (SDG). Therefore, despite the increasing difficulties, it is crucial to create agricultural systems that are disaster and climate resilient to enhance current and future generations' nutrition and food security (FAO, 2021).

Substantial increases in agricultural risk and destabilization of farm income are due to increases in global climate changes, climate variability, and extreme weather occurrences. The sources of weather-related risks to agriculture are diverse, including drought, floods, and storms. Moreover, the impact on the production of weather-related hazards is outside the farmer's control, making agriculture most vulnerable and exposed to climate change.

Effective risk management involves proactively planning to reduce the impact and consequences of unfavourable weather events. The first two main components of risk management are predicting an unfavourable event and taking steps to lower the likelihood that it will happen. The second is taking the appropriate procedures to minimize any potential effects should the unfavourable event occur. Measures to reduce the impact of climate variability and the impact of extreme weather on crop production include structural and non-structural measures. Strategies like windbreaks, water harvesting, and irrigation are structural measures. Crop insurance and weather forecasts are non-structural methods (Gobin *et al*., 2013).

2.7.8. Water crisis

With around 70% of all water withdrawals and almost 90% of all water consumption worldwide, agriculture is the largest global user of freshwater resources (Figure 13). (Mancosu *et al*., 2015).

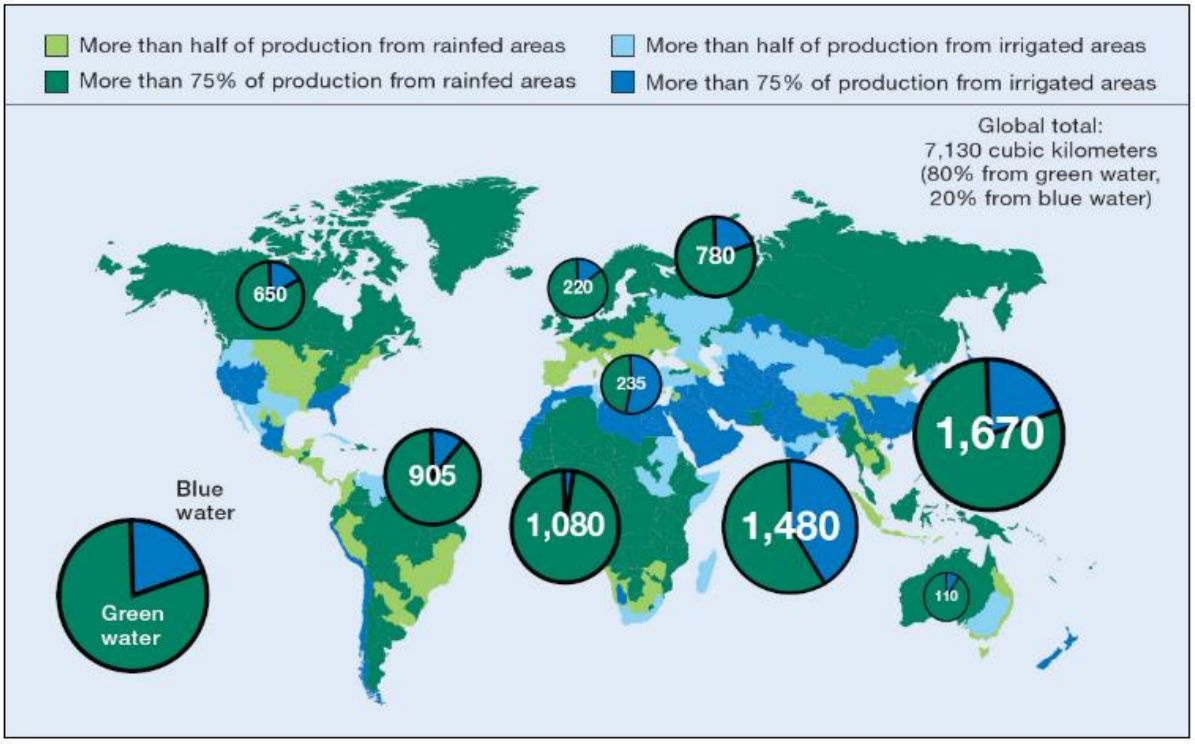
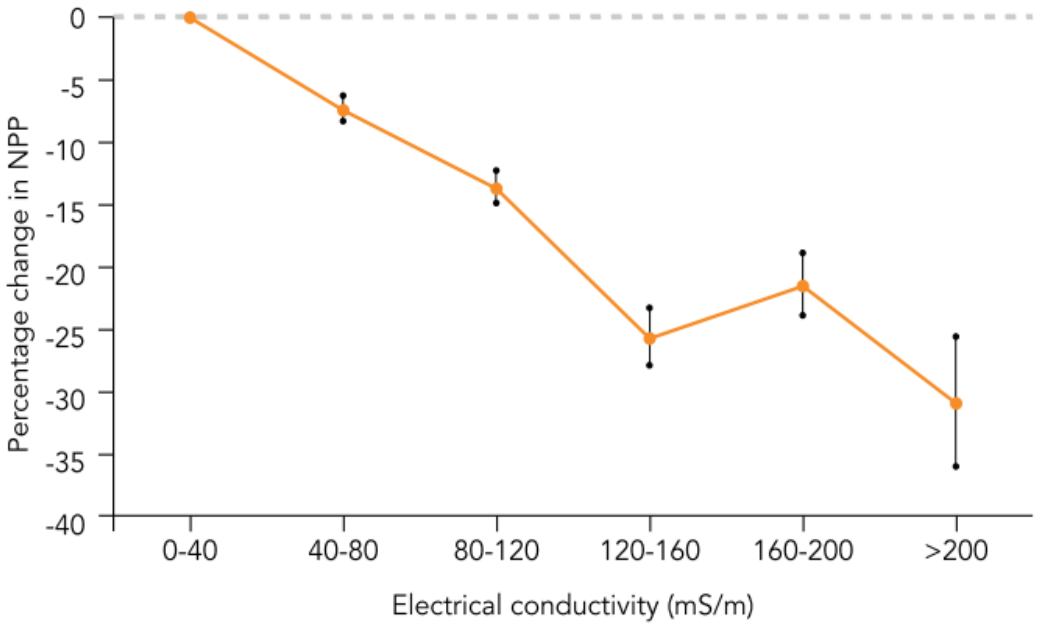


Figure 13: Annual freshwater withdrawals in agriculture per country (%), referring to total water withdrawals in 2012 (Mancosu *et al*., 2015)

Water availability and accessibility are the most significant constraining factors for crop production. Factors like increasing water scarcity due to drought resulting from climate change, global population growth rate, and growing demand for food in the future has an immediate impact on farming water use for irrigation. An estimated future increase in irrigation water requirements by over 50% in developing regions and by about 16% in developed regions is expected. The most significant relative increases in irrigation water requirements are projected to occur in Africa (+300%) and Latin America (+119%) from 2000 to 2080 (Mancosu *et al*., 2015).

It is worth mentioning that agricultural productivity is significantly hampered by saline water (Figure 14). When salt concentrations are high enough, they can draw water out of a plant, causing it to become dehydrated and finally die. Highly salinized water stops plants from absorbing water through roots. Salt can deprive plants of essential nutrients. Saline water causes enough food loss annually to feed 170 million people, or a nation the size of Bangladesh, every day for a year (Damania *et al*., 2019).



Note: mS/m = millisiemens per meter; NPP = net primary productivity.

Figure 14: Impact of salinity in surface water on agricultural productivity (Damania *et al.*, 2019)

2.8. RURAL DEVELOPMENT AND SOCIAL SUSTAINABILITY

Social sustainability, or the social dimension of sustainability, is regarded as conceptually elusive and susceptible to debate. The lack of agreement on what the social dimension of sustainability implies for agriculture, reflects the lack of agreement on this topic in the scientific community (Janker and Mann, 2020).

According to Eizenberg and Jabareen (2017), "Sustainable development should be done in a way that emphasizes human livelihoods as integral to accomplishing ecological goals through economic development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

Rural development is key in promoting social sustainability through poverty reduction and improving the livelihoods in rural areas where 75% of the poor life (Sarris, 2001). Rural development can be achieved in different ways through the support and involvement of farms in these communities. Farming contributes significantly to the overall state of rural regions in

terms of employment, business opportunities, and infrastructure (European Commission, 2000).

2.9. SUPPORTING FARMERS TO HELP WITH THEIR SUSTAINABILITY, ECONOMICALLY AND OTHERWISE

Support to farmers needs to be provided by government departments, the private sector, Non-Governmental Organizations (NGOs), Community-Based Organizations (CBOs), and other stakeholders (DAFF, 2003). In addition, the private sector plays an essential role in developing technologies to raise productivity in agriculture by investing in R&D (Fuglie, 2016).

2.9.1. Linking agribusiness and emerging farmers

The changes in food and agricultural markets, vertical integration, and alliances of agricultural supply chains worldwide increase consumer demand for differentiated agriculture. The need for higher levels of managed coordination has led to major concerns for developing countries. Consumer demands for quality standards, food safety, and safe handling involve specialized production, packing techniques, and refrigerated transport, all of which require large capital investments, which small and medium-sized enterprises cannot easily afford. The danger is that the consumers' and corporations' requirements and rules (supermarkets) can act as effective barriers to participation in the high-value chains for some small emerging farmers (Dorward *et al*., 2008; Kirsten and Sartorius, 2002).

DAFF suggested South African agriculture co-operative development. As a result, it will be feasible to group smallholder farmers into primary co-operatives, creating opportunities that smallholder farmers would not be able to explore on their own. Agricultural co-operatives can potentially improve smallholder farmers' production and income by assisting them in negotiating better rates for seeds, fertilizer, transport, and storage, as well as by providing them with improved market options and bargaining leverage. Engaging in agro-processing activities might also assist farmers in increasing their access to markets and capturing more of the value chain (DAFF, 2012).

Some commercial farmers in South Africa establish their own division to identify and support emerging smallholder farmers so that they can produce under contract and, in the process, establish themselves as sustainable and profitable agricultural enterprises under the guidance and mentorship of the commercial farmer. These divisions provide technical and operational support, access to markets, relevant research and best practice advice, logistical assistance, and assistance with the financing and procurement of agricultural inputs.

2.9.2. Agricultural extension

According to Davis (2009), "Agricultural extension can be defined as the entire set of organizations that support people engaged in agricultural production and facilitate their efforts to solve problems; link to markets and other players in the agricultural value chain; and obtain information, skills, and technologies to improve their livelihoods".

Extension programs were initially conceived as a service to share (extend) research-based knowledge to the rural sector to improve the lives of farmers. The main focus of extension programs in developing countries was increasing yields, training farmers, and technology transfer. However, extension today includes helping farmers with marketing issues and partnering farmers with service providers and essential agencies to improve their chances of being sustainable farmers in the long run. According to the Thematic Group on Sustainable Agriculture and Food Systems (2015), emerging farmers require professional extension services that can help them with decision-making by providing information on more effective farming methods and practices based on the latest research. However, according to a recent study done by Davis *et al*. (2019), "Most extensionists considered extension as a professional or technical practice to improve farmer practices followed by those who consider it as "helping farmers" to improve their well-being. There were also some who considered extension as a way to fight social injustice".

2.9.3. Lending to emerging/small-scale farmers in South Africa

According to a case study by Qwabe (2014), "Small-scale farmers face several challenges; a lack of capital for investment contributes significantly to the lowering of small-scale farmers' productivity levels". In addition, farmers' risks associated with weather and markets make loans to them riskier than other sectors, making it more difficult for the agricultural sector to secure funds.

The criteria and procedures for lending to small-scale farmers by financial institutions relate to their enterprise viability, meaning small-scale farmer need to produce business plans, financial statements, off-take agreements, etc., as evidence of their viability. In addition, small-scale farmers will only be granted a loan if there is some certainty that planned yields and product quality will be realized, and expected market prices for their produces will be obtained. However, it is extremely difficult for small-scale farmers to meet financial institutions' criteria for lending, given their low levels of capacity and skills.

Financial institutions generally operate on the economic return of investments and consider the cost and risks of doing business with the farming enterprise. There are, however, some innovations that financial institutions can take to mitigate some risks of doing business with small-scale farmers. These innovations include risk mitigation strategies like hedging (insurance, contracts like off-take agreements, futures contracts, etc.) to address market-related risks and recommending that farmers take out appropriate insurance cover to control production risks associated with theft, fire, and damage.

The funding framework in South Africa does not appear to be geared toward emerging farmers and instead caters to existing commercial farmers (Mtombeni *et al*., 2020).

2.9.4. Agricultural insurance smallholder farmers

Natural phenomena beyond their control, such as extreme weather or crop loss from pests and diseases, are increasingly impacting smallholder farmers' income and way of life. However, less than 20% of smallholder farmers worldwide have insurance to protect them from the effects of unforeseen disasters. This is largely because they are unaware of insurance and lack understanding about it, in addition to the high cost of premiums. On the other hand, insurance providers have largely overlooked smallholder farmers due to the lower profitability of the customer segment caused by the cost of acquiring and servicing rural customers. However, insurance companies have made progress in accessing smallholder farmers through the emergence of index insurance, making payouts based on a predetermined index rather than on-farm visits. This overcomes some of the challenges faced with indemnity-based models, such as high operational costs and the cost of premiums.

Insurance can help unlock agricultural credit as it serves as collateral for loans and eases the process of assessing farmers' creditworthiness. However, few smallholder farmers may realize the benefit of buying an insurance policy to protect against defaulting on the loans. It is, therefore, important to educate smallholder farmers on how insurance works and the value it offers (Raithatha and Priebe, 2020).

Governments have an important role to play by designing policies and laws that enable the growth of agricultural insurance markets and not only provide demand and supply subsidies. Strategically, governments can join risk pools, which will attack private providers and strengthens reinsurance services, ultimately leading to increased adoption of well-designed insurance products and services for smallholder farmers (Nshakira-Rukundo *et al*., 2021).

2.9.5. Contract farming's benefits and risks for emerging farmers

In a constantly fast-changing world with globalization and expanding agribusiness, emerging farmers might find it challenging to participate in the bigger market economy fully. This is mainly because these farmers rarely have the necessary backwards and forward market linkages in place and lack reliable and cost-efficient inputs such as extension advice, credit, seed, fertilizers, insurance, and crop protection. Moreover, they also lack access to profitable – and guaranteed markets for their output. Contract farming provides such linkages and could offer an opportunity for emerging farmers to farm commercially (Eaton and Sheperd, 2001).

Contract farming has existed for decades for many agriculture commodities. It entails a contract containing terms and conditions for the production and marketing of agricultural products, such as the price to be paid, the amount and quality that are required, the delivery dates, and occasionally specific information on the inputs and production techniques (Smaller *et al*., 2018).

2.9.5.1. Benefits of contract farming

There are benefits for both the producer and the buyer. Key benefits for the producer include access to high-value markets with favourable terms, receiving inputs at lower cost, access to improved technology increasing productivity, reducing price fluctuation risk because of pre-setting contract prices, and the opportunity to access credit from contract firms (Ncube, 2020).

Controlling commercial risks by establishing a price in advance and controlling production risks by securing agricultural products in the needed quantity and quality following their stipulated production method are the buyer's main advantages (Smaller *et al*., 2018). In addition, spreading production over many emerging farmers also spreads the risks of disease, pests, or drought, lowering the risk of securing adequate agricultural produce (Sheperd, 2013).

2.9.5.2. Risks of contract farming

The main risks for the producer are caused mainly by the power differential between them and the buyer, which leads to an unfair or non-transparent price structure and inspection procedures and an unbalanced risk distribution. This increases the risk of producers becoming dependent on the companies in the long run for access to the market, information, and technology (Smaller *et al*., 2018).

Farmers run the risk of businesses not upholding their end of the bargain. This could happen if the business decides the project is not profitable enough or doesn't provide inputs or services at the appropriate time (Sheperd, 2013). Companies could also refuse to accept products of sub-quality standards (Van Gent, 2007).

“On the other hand, buyers of agricultural commodities in contract farming arrangements have often provided farmers with farm inputs on credit as well as agricultural extension services, in anticipation of obtaining high-quality output only to experience side-selling of the farm output by the farmers” (Ministry of Agriculture Malawi, 2016).

2.10. DRY BEAN PRODUCTION IN SOUTH AFRICA

Because they are an essential source of protein for South Africa's low-income population, dry beans are a vital crop for the country. Dry beans are a great source of low-glycemic index carbohydrates and essential nutrients. In South Africa, a minimal area of land is dedicated to dry bean farming compared to maize, for instance, another staple food. The lack of commercial dry bean farming is blamed mainly on the competition with grain crops like maize and wheat and inconsistent dry bean breeding funding (Agricultural Research Council, 2015). According to du Plessis *et al*. (2002), small white beans (15–25 g/100 seeds) are used mainly

for canning purposes, making up only 10 to 20% of local production. South Africa produces only 75% of the dry beans consumed in the country, and the others are imported (DAFF, 2010).

Dry bean is an annual crop that grows optimally at temperatures of 18 to 24 °C with an ideal annual rainfall of 600 – 650mm during the growing season. The clay content of between 15 and 35% is suitable, with an optimum soil pH (H_2O) of 5,8 to 6,5. Additionally, dry beans do not grow well in soils that are compacted.

According to the Dry Bean Producers Organisation's Chris Kleingeld (2021), the total production cost (Table 3) for small white bean dryland products for a targeted 1.5 ton/ha is R17 477.60/ha. The highest costs include seed R4 290.00, crop protection (herbicides and pest control) R3 486.98, fertilizer (at - and after planting) R2 946.50, crop insurance R1 732.01, and labour R1 453.23.

Table 3: Dryland dry bean production cost (R/ha) for a targeted yield of 1.5ton/ha (Kleingeld, 2021)

Timing	Type of cost	Description of cost	Cost	
Pre-plant	**Direct Costes**		**921.75**	a
		Herbizide	379.50	
		Labour	542.25	
	Allocated coste		**1 138.80**	b
		Tillage of land (Fuel)	330.81	
		Tillage of land (Fixed costs)	499.71	
		Tillage of land (Repair and maintenance)	308.28	
Total Cost Pre-plant (A)			**2 060.55**	(a + b)
Ad Planting	**Direct Cost**		**6 380.84**	c
		Seed	4 290.00	
		Seed Treatment	204.00	
		Fertilizer	1 843.46	
		Labour	43.38	
	Allocated Cost		**322.45**	d
		Plant of land (Fuel)	71.70	
		Plant of land (Fixed cost)	172.25	
		Plant of land (Repair and maintenance)	78.50	
Total Cost at Planting (B)			**6 703.29**	
Total Cost Pre- and ad Planting			**8 763.84**	
After Planting	**Direct Cost**		**4 904.60**	e
		Fertilizer	1 103.04	
		Pest Control	2 489.73	
		Herbizide	617.75	
		Labour	694.08	
	Allocated Cost		**819.76**	f
		Treatment of crop (Fuel)	158.61	
		Treatment of crop (Fixed cost)	414.75	
		Treatment of crop (Repair and maintenance)	246.40	
Total Cost after Planting (C)			**5 724.37**	(e + f)
Total Cost Pre-, ad and after Planting (A+B+C)			**14 488.20**	
With and after Harvesting	**Direct Cost**		**173.52**	g
		Labour	173.52	
	Allocated Cost		**332.36**	h
		Harvesting of land (Fuel)	66.13	
		Harvesting of land (Fixed cost)	195.82	
		Harvesting of land (Repair and maintenancel)	70.41	
	Variable Cost		**751.50**	i
		Cleaning Cost	600.00	
		Pacing material	151.50	
Total Cost with and after harvesting (D)			**1 257.38**	(g + h + i
Variable Cost (E)		Crop insurance	**1 732.01**	
Totale Coste (A + B + C + D + E)			**17 477.60**	

CHAPTER 3

METHODOLOGY

3.1. INTRODUCTION

In this chapter, the research methods will be discussed. The sample size and the different groups and parties taking part in die research will be provided, and their characteristics will be discussed. The research design, data-gathering processes, the measuring instrument, and statistical analyses will also be explained.

3.2. SAMPLE

Clearance from the general/human research ethics committee (GHREC) from the University of the Free State was granted on the 29th of March 2021.

Ethical Clearance number: UFS-HSD2020/1722/293.

Hendrik Schoeman Boerdery Pty Ltd. also granted permission for the study

3.2.1. Quantitative sample

Data collection took place in the North-West Province. The data was collected by the author as well as the extension officers for Schoeman Boerdery, overseeing the Zamukele project, and Schoeman Boerdery dry bean growers (commercial farmers) between May 2021 and December 2021.

The sample consisted of 14 New Generation Future Commercial Farmers (NGFCFs) and nine commercial farmers forming part of the Schoeman Boerdery dry bean production group and the Zamukele project (Figure 15). According to Roos (2020), the Schoeman Boerdery established a dedicated division within the group in 2018, Zamukele, translated from Zulu to English as “you are welcome”. Their sole focus is to Identify and support emerging smallholder farmers so that they can produce dry beans on contract and, in the process, establish

themselves as sustainable and profitable agricultural enterprises under the guidance and mentorship of Schoeman Boerdery and its dedicated extension officers. The project aims to receive 1200-2000 tons of dry beans within three years (2020/2021 season) from more than 50 emerging producers and in five years (2022/2023 season) to receive 3000-4000 tons of dry beans from more than 120 producers. In the process, they aim to contribute to job creation, putting sustainable small and medium-scale farming enterprises in the rural agricultural sector on track to become sustainable commercial farmers. Additionally, they aim to improve food security and economic growth, revitalize the agricultural value chain, increase investments and partnerships, transfer skills and continuously support producers' increased exports.

Schoeman Boerdery is the biggest producer of small white beans to the local canning industry, with more than 30 years of experience supplying choice-grade beans to partners such as KOO and the Rhodes Food Group. The fixed seasonal contract is in place with all producers, contracting 152 commercial producers, 61 emerging (Zamukele) producers in five Provinces, and receiving 26 500 tons from these producers in the 2019/2020 season that were cleaned and screened to canning quality. In the study area, namely the North-West Province, there are 40 commercial farmers and 16 New Generation Future Commercial Farmers.

Schoeman Boerdery conducts annual, comprehensive trials in multiple locations to establish best practices in dry bean production, optimum yield and production, and optimum soil health and conditions.

The partners of the ZAAF project include:

- The Dry bean Producers Organisation (DPO)
- The Agriculture Research Council (ARC) guidelines for cultivar choices
- Guidelines for best agricultural practices for dry bean production
- Trifert / Agron is doing soil- and leaf sampling and providing fertilizer inputs
- The University of Pretoria
- Grain SA is doing the initial screening and identifying emerging farmers for the project
- Tiger Brands' off-take agreement
- Rhodes Food Group off-take agreement

The Schoeman Boerdery support consists of the following:

- A dedicated team of technical and operational support
- Access to the market, both international and local
- Relevant research and best practice advice
- Logistical assistance
- Assistance with the financing and procurement of seed
- Assistance with the procurement and fertilizer inputs
- The set-up of our Zamukele concept, where emerging farmers operate under the guidance and mentorship of Schoeman Boerdery and its experienced extension officers

The program has grown to such an extent that Schoeman Boerdery has employed two full-time extension officers to help the emerging farmers in the Zamukele project.

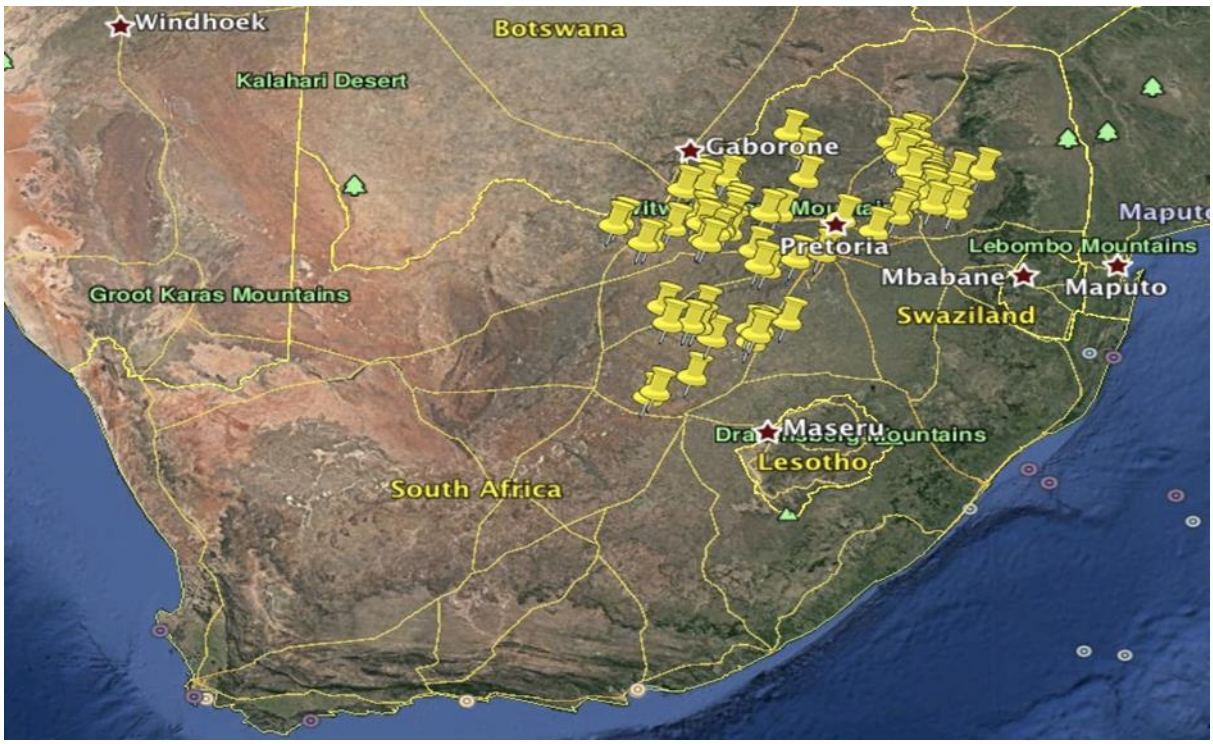


Figure 15: Map reflecting commercial and Zamukele dry bean producers in South Africa (Roos, 2020)

According to Kallie Schoeman, the Managing Director of Schoeman Boerdery (2020a), Schoeman Boerdery is a fourth-generation family-owned concern. It originated in 1919, and they were able to celebrate their centenary in 2019, following their motto of "As good as the best, better than most" (Figure 16).

Figure 16: Schoeman Boerdery operations company emblem (Schoeman, 2020a)

Schoeman Boerdery has five business divisions in South Africa. The first and second divisions are located in Delmas in the Mpumalanga Province. The first division grows cash crops, and the second is a grain and bean-handling plant. The third division is situated in Hopetown in the Northern Cape province, growing cash crops and pecan nuts. The fourth business is in Marble Hall in the Limpopo province, which has a citrus production and packaging division. The fifth and final business division, TriFert, also in Marble Hall in the Limpopo province, manufactures fertilizers. The Company employs 133 managerial and administrative staff and 880 permanent labourers, increasing to 3300 in peak planting and harvesting seasons. Currently, five family members are involved with the day-to-day running of the business:

- Kallie Schoeman – Managing Director
- Kobus Fourie – Non-Executive Director
- Hendrik Schoeman – Director (Citrus)
- Brent Parrott – Director (Highveld)
- Jacques Roos – Director (Commercial)

Source:(Schoeman, 2020c)

Farming practices are mainly very productive conventional agriculture (CF) systems, using synthetic pesticides and herbicides as well as synthetic fertilizers in combination with

genetically engineered seeds. With cash crop production, tillage is mainly done after harvesting with an offset disc or chisel ploughing. They use precision technology like soil classification to determine soil potential and variable seed placement of genetically modified cultivars adapted to the specific farm climate, precision soil analyses, and yield mapping for variable fertilizer and lime application. Synthetic fertilizer top dressing in the form of urea is broadcast before tillage, and granular, liquid NPK synthetic fertilizers are band placed during planting. Lime spreading is being done according to soil analysis. Synthetic herbicides and -pesticides are used according to the recommendations of crop protection specialists (Parrott, 2020).

According to Kallie Schoeman (2020b), threats to agribusiness in South Africa are political insecurity and land reformation, the competition of the mining industry with agriculture for natural resources, and failing infrastructure like roads, rails, ports, and electricity – and water supply mainly due to the lack of maintenance, rural insecurity, farmers being price-takers, labour unions, and labour and climate change.

3.2.2. Qualitative sample

The qualitative research method involves the Logistical Framework Analysis (LFA) tool, discussed below. Part of the LFA process requires a group of stakeholders with expertise to formulate informed and reliable opinions. The participant selection criteria included excellent skills, knowledge, and experience related to the research topic and problem. Based on the latter, ten experts from various areas of expertise related to agriculture were selected, each holding a post-graduate level of education. The participants' expertise ranged from economics, academics, soil scientists, and agricultural- and social sustainability experts, covering knowledge on all spheres of agricultural sustainability, including economic, social, and environmental spheres. The qualitative data collection took place with the participants during an in-person group session in the Free State Province at an institution for Higher Education. The institution provided a network base that assisted in selecting and linking the research with the relevant experts. Although the qualitative participants are not the primary sample group for the research, their contribution is equally valuable to addressing the research problem through detailed qualitative data.

3.3. RESEARCH DESIGN

This study used a mixed-methods research design incorporating qualitative and quantitative methods to explore the problems emerging farmers face in South Africa, which hampers their economic, environmental, and social sustainability and determine the extent to which they engage in mitigating practices. The first part of the research captured quantitative data, followed by the capturing of qualitative data in the second and final part of the research design.

3.3.1. Quantitative analysis (questionnaires)

Quantitative research methodology can be defined as the holistic steps a researcher employ in embarking on research work. Therefore, a quantitative research deals with quantifying and analysing variables to get results. It involves the utilization and analysis of numerical data, using specific statistical techniques to answer questions like who, how much, what, where, when, how many and how (Apuke, 2017). According to Rajagopali and Bojin (2003), "Quantitative research methods are research methods dealing with numbers and anything measurable in a systematic way of investigation of phenomena and their relationships. It is used to answer questions on anything measurable systematically to investigate phenomena and their relationship".

For the quantitative component, a uniquely designed questionnaire was distributed to a group of emerging and commercial farmers growing dry beans for the Zamukele and Schoeman Boerdery projects in the North-West Province of South Africa. This questionnaire contained closed-ended questions aimed at determining the factors influencing emerging farmers' sustainability. The questionnaires comprised four sections measuring demographic and background information, economic-, environmental-, and social sustainability. Participants were asked to reply to the statements on a Likert scale of 1 to 5, where 1 meant strongly disagreed and 5 meant strongly agreed.

The New Generation Future Commercial Farmers' (NGFCF's) questionnaire was used to determine their perceptions regarding various factors influencing their sustainability (Appendix 1). The questionnaires for the commercial farmers (Appendix 2) were used to determine their perceptions regarding various factors that influence emerging farmers' sustainability.

The completed questionnaires were coded appropriately and captured electronically. Data were scanned for outliers and potential errors. No systemic errors or outliers were found.

3.3.1.1. Explanations of calculations used to analyse data

Descriptive statistical analysis included frequency tables for categorical data and measures of central tendency (mean, median, and mode) for continuous variables. Inferential statistics were used for comparisons, and statistical significance was accepted as $p < 0,05$.

3.3.1.2. Frequency Tables

i. **The term valid in the frequency tables** refers to the number of participants with 'correct' data for what was being asked/measured.
ii. **Frequency:** is a measure of the number of occurrences of a particular score in each data set. A frequency Table is a method of organizing raw data in a compact form by displaying a series of scores in ascending or descending order and their frequencies (the number of times each score occurs in the respective data set). A frequency table typically includes a column for the scores and a column showing the frequency of each score in the data set.
iii. **Percentage:** is calculated using the sample Total (n) to determine the percentage of participants selecting a particular category (missing data included in total) **((Frequency / Total (n)) × 100 = answer in Percent (%)**
iv. **Valid percentage:** is calculated using the total number of participants who answered the question (missing data excluded).

Note: If you don't have any missing data, the percentage and valid percentage will have the same value (Statistical Package for the Social Sciences (SPSS), 2021).

3.3.1.3. Descriptive statistics

i. N: sample size
ii. $\bar{X}$**:** The mean is the average (sum of all scores divided by the total number of scores):

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

iii. **Coding:** indicates what each value represents.

iv. **Median:** is the value/number in the middle when the data is ordered in numerical value. The higher the mean, the more agreed upon the statement is, and vice versa.

$$\text{Median} = \begin{cases} x_{\frac{n+1}{2}} & \text{if } n \text{ is odd} \\ \frac{x_{n/2} + x_{n/2+1}}{2} & \text{if } n \text{ is even} \end{cases}$$

v. **Standard deviation:** is the average spread in data to both sides (hence the ±) of the mean

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$

vi. **Mode:** is the value/number occurring most often in the data. So, if the mode is 5, most participants strongly agreed with the statement because, according to the coding, 5 = strongly agreed.

Note: The mean, median, and mode are all measures of 'central tendency' (how the numbers are distributed around the middle).

vii. **Minimum:** is the lowest response by a participant(s) in the data.

viii. **Maximum:** is the highest response by a participant(s) in the data.

Source: (Field, 2013)

3.3.1.4. Line graphs

i. **p-value:**

$$\text{p-value} = \frac{\Gamma\left(\frac{(n+1)}{2}\right)}{\sqrt{n \cdot \pi}\,\Gamma\left(\frac{n}{2}\right)} \int_{-\infty}^{t} \left(1 + \frac{x^2}{n}\right)^{-\left(\frac{(n+1)}{2}\right)} dx$$

The results are statistically significant when *p* is smaller than 0,05. Conversely, if the *p*-value is larger than 0,05, the results are more likely due to chance (Eilers, 2021).

3.3.1.5. Additional information gathered (soil forms)

In addition to the questionnaire, information was collected regarding the different soil forms observed on the farms of the NGFCFs. This was done to determine the suitability of the different soils for dry bean production and the potential risk that each soil form presents. Each soil form's potential yields (estimated tonnage/ha) and potential risk associated with the soil were then calculated as a percentage of the total hectares represented by the specific soil.

The observation was done by a qualified soil scientist provided by Agri Technovation (Pty) Ltd. The soil's potential indicates the soil's ability to support crop production before any management practices are applied to improve the soil's potential. Therefore, it is vital to remember that the soil's potential to support crop production will be enhanced by using management practices applicable to the situation, such as cultivation, correct fertilizer, liming practices, etc.

The soils of seven farms were classified according to the South African Soil Classification system (1991). The soils were investigated to a depth of 1.2m using a mechanical soil corer (Figure 17). A qualified soil scientist extracted and classified the undisturbed cores (Figure 18) and then calculated the potential of the soil observed (Ferreira, 2021).

Figure 17: An example of Hutton soil, viewed in a profile hole (Ferreira, 2021)

Figure 18: Example of soil cores viewed in the length of the soil profile (Ferreira, 2021)

3.3.2. Qualitative analysis

A Logical Framework Analysis (LFA) used in this study gives very accurate qualitative research data, which was the aim of the study. The LFA organises a project's key components and emphasises their logical connections (Pfenning, 2002). LFA comprises three main steps: (1) outlining the strategic context, (2) the analytical phase, and (3) the planning phase. The analytical phase is further divided into three parts: (2.1) problem analysis, (2.2) objective analysis, and (2.3) strategic analysis. The analytical phase is illustrated in a schematic, resembling a tree, since LFA follows a logical cause-and-effect pathway (Van Rooyen *et al*., 2002). The latter approach takes context into consideration and assists in gaining an understanding of a situation systematically (Sithomola, 2018).

For the qualitative component, the LFA tool was adapted and used mainly in the analytical phase to gain the perspectives of ten industry experts on what is needed to overcome the problems faced by emerging farmers and improve their economic- environmental- and social sustainability. As described by Van Niekerk *et al*. (2011), LFA principles were used to capture industry experts' views and insights, through a discussion group, on the core problems NGFCFs face regarding sustainability, the negative causes of the problems, and the effects associated with these causes.

Part of the aim during the analytical phase was to formulate the problem and objective trees for each element of sustainability, including economic, social, and environmental. In the formulation of a problem tree, the core problem is represented by the stem in the middle. The causes of the core problem form the tree's roots and flow into the tree trunk. From the core problem, the negative effects branch upwards, forming the tree branches. After constructing the problem tree, a positive version of the problem tree is formulated, called the objective tree. The objective tree represented the participant’s core objectives and the activities required to reach their goals. In objective trees, the stem represents the core objective, the roots being the required activities and the branches the desired results. Finally, the construction of the problem trees and the objective trees allow for the construction of a strategy involving recommendations for a path forward based on the holistic overview of the problems and potential opportunities captured by the trees at each element of sustainability.

CHAPTER 4

THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS IN SOUTH AFRICA

4.1. INTRODUCTION

In this chapter, the author will test the study's hypothesis of whether New Generation Future Commercial Farmers (NGFCFs) applying sustainable agriculture principles will be sustainable. NGFCFs will be evaluated under the three principles of sustainable agriculture: economic, environmental, and social sustainability. A uniquely designed questionnaire (quantitative research component) containing closed-ended questions aimed at determining the factors influencing emerging farmers' sustainability was distributed to a group of 14 emerging farmers growing dry beans for the Zamukele project at Schoeman Boerdery in the North-West Province of South Africa. The questionnaires comprised four sections measuring demographic and background information, economic-, environmental-, and social sustainability. Participants were asked to reply to the statements on a Likert scale of 1 to 5, where 1 meant they strongly disagreed and 5 meant they strongly agreed. The questionnaire for the NGFCFs was used to determine their perceptions regarding various factors that influence their sustainability.

4.2. ECONOMIC SUSTAINABILITY

Economic sustainability for a given farm refers to how well that farm is run to ensure long-term success. Because prices fluctuate and agricultural output is vulnerable to weather, pest, and disease damage, the farm does not need to make a profit every year. However, the farm business will eventually have to pay its debts, such as the opportunity cost of the farmer's time and labour and returns on equity in the farm's land and other assets (Smith, 2016).

4.2.1. Overview of the potential associated with soil forms

The influence of annual rainfall on the different soil forms' potential and the estimated tonnage/ha potential for dry bean production associated with the different soil forms was obtained through the soil survey (Tables 4 and 5). This information was then used to

determine the dry land and dry bean yield associated with the different soil forms as influenced by annual rainfall (Table 6). The soil scientist estimated that in an average rainfall year, 81.34% of soils have the potential yielding between 2 tons/ha and 2 tons plus/ha, 10.67% between 1 – 1.5ton/ha, and 7.99% of the soils yields lower than 0.5 ton/ha (Table6).

Table 4: The impact of annual rainfall on the different soil forms and yield potential

	Annual rainfall		
Soil Form	**High**	**Average**	**Low**
Avalon	Medium-high	High	Medium-high
Bainsvlei (luvic)	High	High	Medium
Brandvlei	Medium-low	Low	Low
Coega	Medium-low	Low	Low
Clovelly	High	Medium	Medium-low
Clovelly (luvic)	High	Medium-high	Medium
Glencoe (luvic)	Medium	Medium	Medium-low
Hutton	High	Medium	Medium-low
Katspruit	Low	Low	Medium
Pinedene (leached)	Medium	Medium	Medium

Pinedene	Medium	Medium-high	Medium
Sepane	Low	Medium-low	Low
Westleigh (luvic)	Low	Medium-low	Medium

Source : (Fereira , 2021)

Table 5: The estimated tonnage/ha for dry bean production (Ferreira, 2021)

Estimated tonnage/ha	
2+	High
2	Medium-high
1,5	Medium
1	Medium-low
0,5	Low

Table 6: Dryland and dry bean yield associated with the different soil forms as influenced by annual rainfall (%) (Ferreira, 2021)

		High Rainfall			Average rainfall			Low rainfall		
Soil Form	**A**	**A**	**b**	**c**	**a**	**b**	**c**	**a**	**b**	**c**
Avalon	26.67%	26.67			26.67			26.67		
Bainsvlei (luvic)	4.00%	4.00			4.00				4.00	
Bansvlei	1.33%		1.33				1.33			1.33
Coega	1.33%		1.33				1.33			1.33
Clovelly	2.67%	2.67				2.67			2.67	
Clovelly (luvic)	24.00%	24.00			24.00				24.00	
Glencoe (luvic)	2.67%		2.67			2.67			2.67	
Hutton	1.33%	1.33				1.33			1.33	
Katspruit	5.33%			5.33			5.33		5.33	
Pinedene (leached)	1.33%		1.33			1.33			1.33	
Pinedene	26.67%		26.67		26.67				26.67	
Sepane	1.33%			1.33		1.33				1.33
Westleigh (luvic)	1.34%			1.34		1.34			1.34	

Total	**100.00%**	**58.67**	**33.33**	**8.00**	**81.34**	**10.67**	**7.99**	**26.67**	**69.34**	**3.99**

A. The percentage (%) of different soil forms represented from the total hectares (NGFCFs)

a. High – medium high yields (2 - > 2 ton/ha)

b. Medium – medium yields (1 - 1.5 ton/ha)

c. Low yields (0.5 ton/ha)

4.2.2. Small white bean economic sustainability

The economic sustainability of the NGFCFs was calculated by determining the participants' profitability. Profitability was calculated by subtracting the production cost per ha, from the income per ha, for the 2020/2021 season. Schoeman Boerdery provided the production cost budget, the contract price for the small white beans, and the yields obtained for the Zamukele project participants for the 2020/2021 season. In addition to calculating the profitability of NGFCFs, the questionnaire also gathered information on other factors affecting the economic sustainability of NGFCFs.

4.2.2.1. Small white bean dryland income

The income (R/ha) was calculated by multiplying the contracted price per ton for the small white beans by the yield (kg/ha), divided by 1000 (Table 7). The contracted price for the small white beans for the 2020/2021 season was R12 800/ton.

From the income in Table 7 and small white bean yields in Table 8, 35.7% of the NGFCFs yielded between 1001 -1250kg/ha, giving them a potential income between R12 800 and R16 000/ha, followed by 28.6% of participants yielding between 751-1000kg/ha, giving them a potential income between R9 600 and R12 800/ha. On the high end of the scale, 14.3% of the participants yielded between 1251-1500kg/ha, giving them a potential income between R16 000 and R19 200/ha. On the low end of the scale, 7.1% of the participants yielded 501-750kg/ha, giving them a potential income between R6 400 and R9 600/ha, and 14.3% of the participants yielded 500kg or less, leaving them with a potential income of R6 400/ha or less.

Table 7: The income (R/ha) for small white beans for the 2020/2021 season

Yield (Kg/ha)	Contracted price (R/ton)	Income (R/ha) (a)
500 Kg	R12 800	R6 400
750 Kg	R12 800	R9 600
1000 Kg	R12 800	R12 800
1250	R12 800	R16 000
1500 Kg	R12 800	R19 200

(a) The income (R/ha) was calculated by multiplying the contracted price per ton (R12 800) for small white beans by the yield (kg/ha), divided by 1000.

Table 8: Small white beans yield kg/ha for the NGFCF's 2020/2021 season

		Frequency	Percentage	Valid Percent
Valid	<500kg/ha	2 a	14.3	14.3
	501-750kg/ha	1 a	7.1	7.1
	751-1000kg/ha	4 b	28.6	28.6
	1001-1250kg/ha	5	35.7	35.7
	1251-1500kg/ha	2	14.3	14.3
	Total	**14**	**100.0**	**100.0**

Source: (Mdluli, 2022)

(a) Hail damage and deductions.

(b) 2 of the 4 participants averaged less than 830kg/ha caused by hail damage and deductions.

According to Success Mdluli (2022), the technical advisor from Schoeman Boerdery, unpredictable weather patterns caused losses. During the 2020/2021 season, hail damage late in the season hurt the economic sustainability of 5 farmers, causing them to yield lower than the breakeven yields for the season, and they did not have insurance coverage to help them cope with these losses. Literature shows emerging farmers lack knowledge about the importance of taking out insurance policies (Raithatha and Priebe, 2020). It's also important to mention that, on average, for all the participants, a 10.5% yield deduction took place during the cleaning proses mainly due to foreign material caused by incorrect harvester settings and poor weed control on fields before harvesting. Other causes of deduction were split grain, caused by late harvesting. Yield deductions, because of dark spots on grain caused by bollworms not being managed correctly by not being proactive in their crop protection approach, lead to unnecessary deductions and yield losses, which need to be taken into consideration.

4.2.2.2. Small white bean dryland production cost

The small white bean dryland production cost per ha was calculated as R10 624.00/ha (Table 9). From this cost, R6 443.92/ha (60.65%) was financed by Schoeman Boerdery and only deducted on fulfilment of contractual commitment on delivery. The inputs funded by Schoeman Boerdery include Fertilizer (R2 849.46/ha), Seed treatment (R205.96), Seed (R2 308.50), and Cleaning Cost (R1 080.00).

Table 9: Small white bean dryland production cost for the 2020/2021 season for the Zamukele farmers

Description	Cost/ha (R)
*Fertilizer	R2 849.46
*Seed Treatment	R205.96
Crop protection	R1 278.32
*Seed	R2 308.50
Labour	R767.20
*Cleaning Cost	R1 080.00
Harvesting	R852.70
Fuel	R1 282.50
Total direct input cost	**R10 624.00**

*Costs that were Financed by HSB and deducted on fulfilment of contractual commitment (Mdluli, 2021).

4.2.2.3. Profitability

The Profitability was calculated by doing a profitability sensitivity scale, where the profit/loss per ha was calculated. The profit/loss (R/ha) was then calculated by subtracting the production cost (R10 624) from the income per ha (Table 10). From the profitability sensitivity scale below, the breakeven yields that the NGFCFs needed to achieve to cover direct inputs were 830kg/ha, calculated by dividing the direct input cost (R10 624/ha) by the contract price for small white beans (R12 800/ton).

Table 10: Profitability sensitivity scale for NGFCFs growing dryland small white beans for the 2020/2021 season

Yield (Kg/ha)	Income (R/ha)	Profit/Loss (R/ha) (a)
500 Kg	R6 400	(R4 224)
750 kg	R9 600	(R1 024)
830 Kg (b)	**R10 624**	**R0.00**
1000 Kg	R12 800	R2 176
1250 Kg	R16 000	R5 376
1500 kg	R19 200	R8 576

(a) Profit/Loss (R/ha) = Income (R/ha) – R10 624/ha production cost.

(b) 830kg/ha breakeven yield.

It is possible to determine the percentage of economically sustainable participants and participants with the risk of being unsustainable. Most participants (35.7%) indicated their average long-term dryland small white beans yield was between 1001-1250kg/ha, leaving them with n potential profit of between R2 176 – R5 376/ha. In the highest yield category (1251-1500kg/ha), 14.3% of the participants indicated they achieved 1251-1500kg/ha, leaving them with a potential profit between R5 376 - R8 576/ha. In the category 751 – 1000 kg, 14.3% of the participants achieved yields higher than the required breakeven of 830kg/h, leaving them with a potential profit of R2 176. The average yield needed to break even is 830kg/ha, meaning that 35.7% of the participants stand the risk in the long run of being economically unsustainable, with potential losses of R1 024/ha and greater. The 35.7% is made up of 14.3% of participants in the yield category <500kg/ha, 7.1% of participants in the yield category 500-750kg/ha, and 2 participants (14.3%) in the yield category 751-1000kg/ha, yielding less than 830kg/ha. Notably, the latter mentioned that 35.7% of participants were negatively impacted by unpredictable weather patterns (hail damage) during the harvesting season and deductions

mainly due to foreign material caused by incorrect harvester settings and poor weed control on fields before harvesting.

4.2.2.4. Other factors affecting the economic sustainability of NGFCFs, according to participants

It is important to mention that most (35.7%) NGFCFs indicated that farming makes up 71 - 90% of their annual income, and for 28.6% of the participants, farming made up more than 90% of their annual income (Table 11).

Table 11: NGFCF's annual income through farming

		Frequency	**Percentage**	**Valid Percentage**
Valid	31-50%	1	7.1	7.1
	51-70%	4	28.6	28.6
	71-90%	5	35.7	35.7
	More than 90%	4	28.6	28.6
	Total	**14**	**100.0**	**100.0**

Having a holistic view of the NGFCF's farming enterprise is important. Thus, income from other crops, livestock, and other ventures must also be considered when determining the economic sustainability of the farming unit.

NGFCFs planted a mean of 249,64ha, with a minimum of 70,00ha and a maximum of 550,00ha. Of the total hectares planted, the mean number of hectares planted under dryland small white beans was 148,57ha, with a minimum of 20ha and a maximum of 500ha. Other crops also planted by NGFCF included maize and sunflower (all the participants planted these two crops), 28.6% of the participants also planted soybeans, and 7.1% groundnuts. Other forms of income included livestock farming (21.4%), beekeeping (7.1%), and income from a shop (7.1%) (Table 12).

Table 12: Other forms of income for the NGFCFs

		Frequency	Percentage	Valid Percentage
Valid	None	9	64.3	64.3
	Beekeeping	1	7.1	7.1
	Livestock	3	21.4	21.4
	Shop	1	7.1	7.1
	Total	**14**	**100.0**	**100.0**

The most important factor specified by NGFCFs influencing their economic sustainability was the lack of not owning machinery, followed by the weather conditions. This is in line with the findings by Kane Dane (2020). He found that farmers who did not own the necessary machinery had difficulties doing farming operations appropriately, resulting in yield losses and lowered profitability.

Participants were also asked to give feedback on other factors influencing their economic sustainability, as seen in Figure 19. Most (92.9%) NGFCFs agreed to some extent with the statement that difficulty accessing finance hampers their ability to farm sustainably, with 50% strongly agreeing. In addition, lack of extension officer support and land availability on the market were also important factors hampering economic sustainability. These findings align with previous studies, showing that lack of capital for investment is a prevalent problem for small-scale farmers in South Africa (Qwabe, 2014). Therefore, better support on the ground in the form of more professional agricultural extension systems is needed (Thematic group on sustainable agriculture and food systems, 2015).

The least agreed-with statement was that a lack of farming experience hampers economic sustainability (50% disagreed to some extent, while 14.3% strongly disagreed).

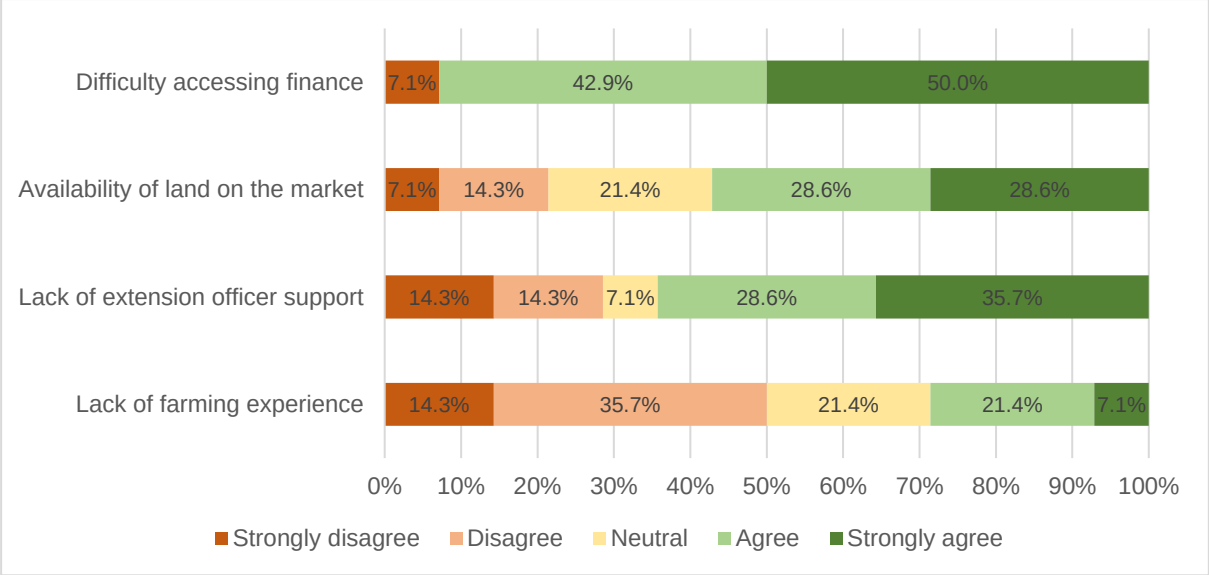


Figure 19: Other factors hampering the economic sustainability of NGFCFs

The participants also gave feedback on cost factors influencing economic sustainability (Figure 20). The most agreed-upon statement was that labour cost is a significant cost (92.9% agreed to some extent), followed by contractor fees (78.6% agreed to some extent). In comparison, the least agreed upon statement was that the interest payable on loans is a high cost (42.8% disagreed to some extent). Labour and harvesting costs are inputs not financed directly by Schoeman Boerdery.

These findings are not surprising as literature shows that emerging farmers in South Africa experience financial constraints due to barriers to participation in high-value chains (Kirsten and Sartorius, 2002; Dorward *et al*., 2008). Additionally, the funding framework in South Africa favours commercial farmers rather than emerging farmers (Mtombeni *et al*., 2020).

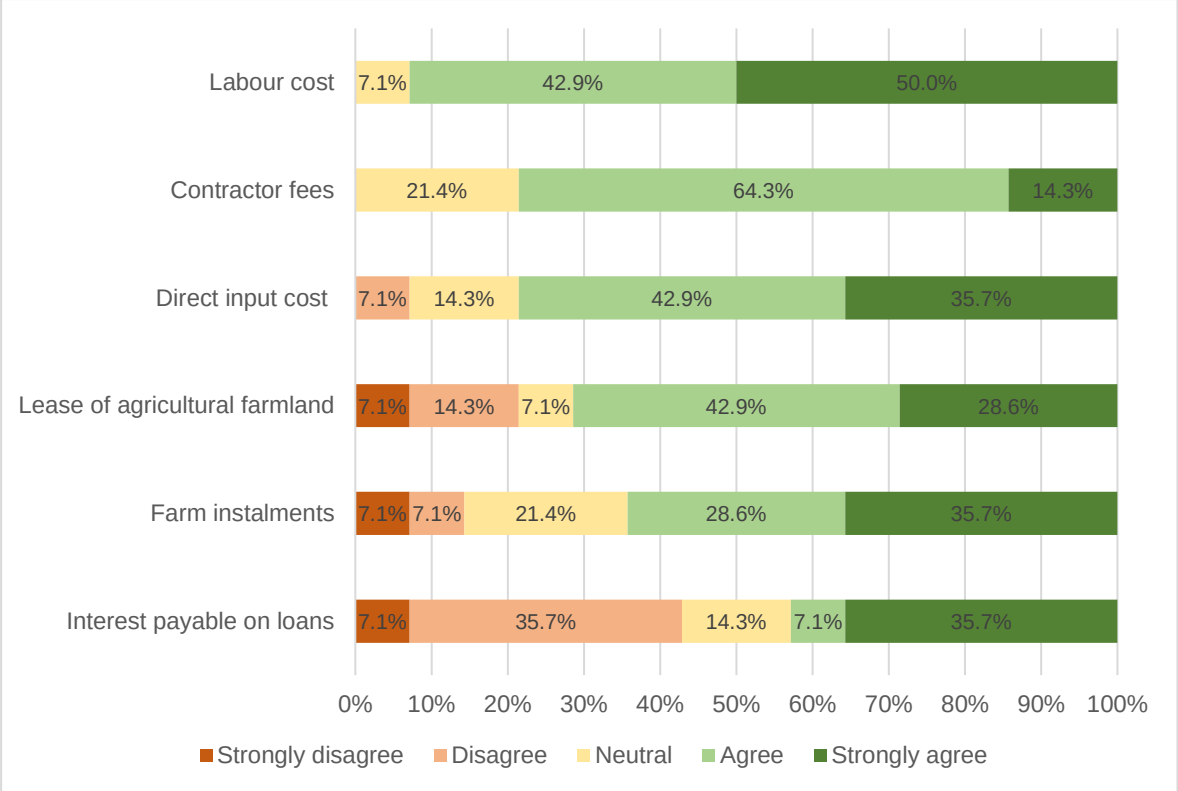


Figure 20: Cost factors influencing NGFCF's economic sustainability

Finally, participants were asked to give feedback on the perceived value Schoeman Boerdery brings to them to help them in their economic sustainability quest (Figure 21). The statements NGFCFs most strongly agreed with were: Schoeman Boerdery brings; assistance with the financing and procurement of seed, -relevant research and best practice advice, - access to market, - assistance with the procurement and fertilizer inputs and setup. The statement NGFCFs disagreed with the most was that Schoeman Boerdery brings logistical assistance (28.5%).

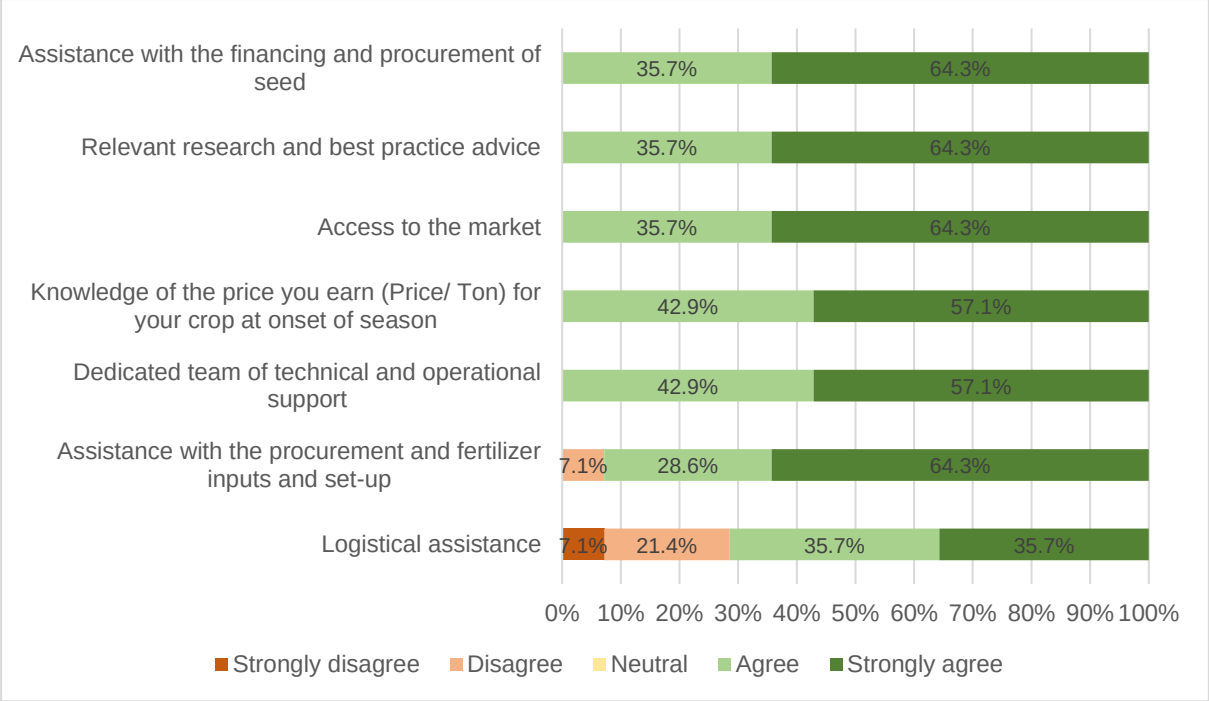


Figure 21: The value of Schoeman Boerdery to help NGFCFs to become economically sustainable

4.2.3. Conclusion economic sustainability

Most (64.3%) NGFCFs applying sustainable agriculture principles will be economically sustainable, with 14.3% earning a potential profit of between R5 376 – R8 576/ha, 35.7% earning a potential profit of between R2 176 – R5 376/ha and 14.3% with a potential profit of R2 176/ha. Notably, this group of NGFCFs was negatively impacted by unpredictable weather patterns (hail damage) during the harvesting season and deductions mainly due to foreign material caused by incorrect harvester settings and poor weed control on fields before harvesting. Nevertheless, considering all the factors regarding economic sustainability, the NGFCFs performed remarkably well, considering that 10.67% of the soil forms have the potential to yield, on average, between 1 and 1.5 tons/ha in an average rainfall year.

Finally, it is important to remember that economic sustainability for an individual farm means that it is managed in ways that ensure it is profitable over the longer run. The farm does not have to make a profit every year; prices vary, and agricultural production is subject to weather, pest- and disease damage. But over the longer term, the farm operation must cover its costs, including the opportunity cost of the farmer's time and effort and returns to equity in land and other assets (Smith, 2016). Contracts (off-take agreement), similar to what the Hendrik

Schoeman Boerdery have in place with the Zamukele farmers, where production -, and cleaning costs can be financed and only deducted on fulfilment of contractual commitment on delivery, can improve the economic viability of NGFCFs.

The factors that need to be addressed to help NGFCFs become more economically sustainable include operational cost financing, lack of extension officer support, access to crop insurance, proactive crop protection training, lack of owning essential machinery, and high contractor fees.

4.3. ENVIRONMENTAL SUSTAINABILITY

There was no common understanding of what constitutes environmentally sustainable agriculture. It encompasses a range of potential courses of action with the dual aims of reducing agriculture's detrimental environmental effects and protecting the natural environment's constituent parts on which agriculture depends. The most appropriate measures will vary depending on the farm and the surrounding environment. These measures are improving resource efficiency and restoring natural capital (Leigh, 2017). Measures that maintain and restore natural capital and improve resource efficiency include improving soil and water quality, conserving biodiversity, and using modern technology and sustainable cultivation practices.

The results from the questionnaire on the environmental sustainability of NGFCFs will be used to test the study's hypothesis of whether NGFCFs applying sustainable agriculture principles will be environmentally sustainable NGFCFs. Environmental sustainability will be evaluated on whether NGFCFs applied cultivation techniques and management strategies to minimise environmental damage. Additional information was obtained through a soil survey that was done by Ferreira (2021), a soil scientist from Agri Technovation, to get a better understanding of the soil as a natural resource and use for the cultivation of small white beans during the 2020/2021 season by the NGFCFs.

4.3.1. Overview of the soils used by the NGFCFs to cultivate dry white beans

The different soil forms obtained through the soil survey and the explanation of the various diagnostic horizons are summarized in Tables 13 and 14.

Table 13: Soil forms observed and explanatory diagnostic horizons (Ferreira, 2021)

Soil Form:	**Diagnostic horizons:**		
	Topsoil	**Subsoil**	
Avalon (Av)	Orthic A	Yellow Brown apedal B	Soft plinthic B
Brandvlei (Br)	Orthic A	Soft Carbonate B	
Bainsvlei (Bv)	Orthic A	Red Apedal B	Soft plinthic B
Coega (Cg)	Orthic A	Hard Carbonate B	
Clovelly (Cv)	Orthic A	Yellow Brown apedal B	Unspecified
Glencoe (Gc)	Orthic A	Yellow Brown apedal B	Hard plinthic B
Hutton (Hu)	Orthic A	Red Apedal B	Unspecified
Katspruit (Ka)	Orthic A	G-Horizon	
Pinedene (Pn)	Orthic A	Yellow Brown apedal B	Unspecified material with signs of wetness
Sepane (Se)	Orthic A	Pedocutanic B	Unconsolidated material with signs of wetness
Westleigh (We)	Orthic A	Soft plinthic B	

Table 14: Diagnostic horizon descriptions (Ferreira, 2021)

Diagnostic horizon	Descriptions:
Orthic A	Surface horizon that cannot be classified as an organic, humic, vertic or melanic topsoil. It is viewed as normal topsoil.
Yellow Brown apedal B	The yellow-brown horizon is typically found within 100-400mm from the surface. This horizon is characterized by the diagnostic yellow-brown colour and apedal (structureless) properties and is naturally well-drained. Good oxygen exchange occurs in the profile resulting in the diagnostic yellow-brown colour. This colour results from the oxidation of iron-rich minerals (predominantly goethite).
Soft plinthic B	The soft plinthite is typically found within 500-900mm from the surface. This horizon is characterized by the presence of iron- and or manganese oxides that form black, red, and yellow concretions, created through the repeated fluctuation of wet and dry periods in the shallow subsoil caused by poor drainage. It can serve as a limiting layer to crops sensitive to prolonged periods of wetness in their root zone.
Soft Carbonate B	The soft carbonate is typically found within 100-400mm from the surface. Soft carbonate is a physiochemical limiting layer.

Red Apedal B	The red apedal horizon is typically found 100-400mm from the surface. This horizon is characterized by the diagnostic red colour and apedal (structureless) properties. The red apedal horizon is naturally well-drained. Very good oxygen exchange occurs in the profile resulting in the diagnostic red colour. This forms through the oxidation of iron-rich minerals (predominantly hematite).
Hard Carbonate B	The hard carbonate is typically found within 200-400mm from the surface. Hard carbonate is a physiochemical limiting layer.
Hard plinthic B	This horizon is typically found within 500-900mm from the surface. This horizon is characterized by the relict accumulation of iron- and or manganese-oxides, which formed and continuously hardened. This occurred under fluctuating wet conditions and is an indication of poor drainage. Hard plinthite is a physical limiting layer.
G-Horizon	This gleyed horizon is subject to water-saturated conditions (waterlogging) for extended periods of the year. These conditions lead to substantial reduction and poor oxygen exchange (anoxic conditions), leading to the appearance of low chroma colours, typically grey. In severe cases, this horizon can appear slightly green. Crops sensitive to wetness in their root zone should not be planted on these soils.
Pedocutanic B	The horizon is typically found within 100-300mm from the surface. It is characterized by a moderate to strongly developed structure ranging from fine to coarse angled.

	The horizon is typically enriched with clay through illuviation (vertical migration of clay).
Unconsolidated material with signs of wetness	The signs of wetness are typically found within 500-900mm from the surface. This horizon is characterized by iron reduction and bleaching forming from long-term wet conditions in the subsoil and indicates poor subsoil drainage. Therefore, it can serve as a limiting layer to crops sensitive to prolonged periods of wetness in their root zone.

From the soil survey, the percentages of the area covered by the different soil forms were calculated and can be seen in Figure 22. There were 13 soil forms identified from the differed plots, with the primary soil forms being the Avalon and Pinedene, each covering 26.67% of the area, closely followed by the Clovelly (Luvic), covering 24% of the area. The remaining ten soil forms ranged from only 1.33% - 5.33%.

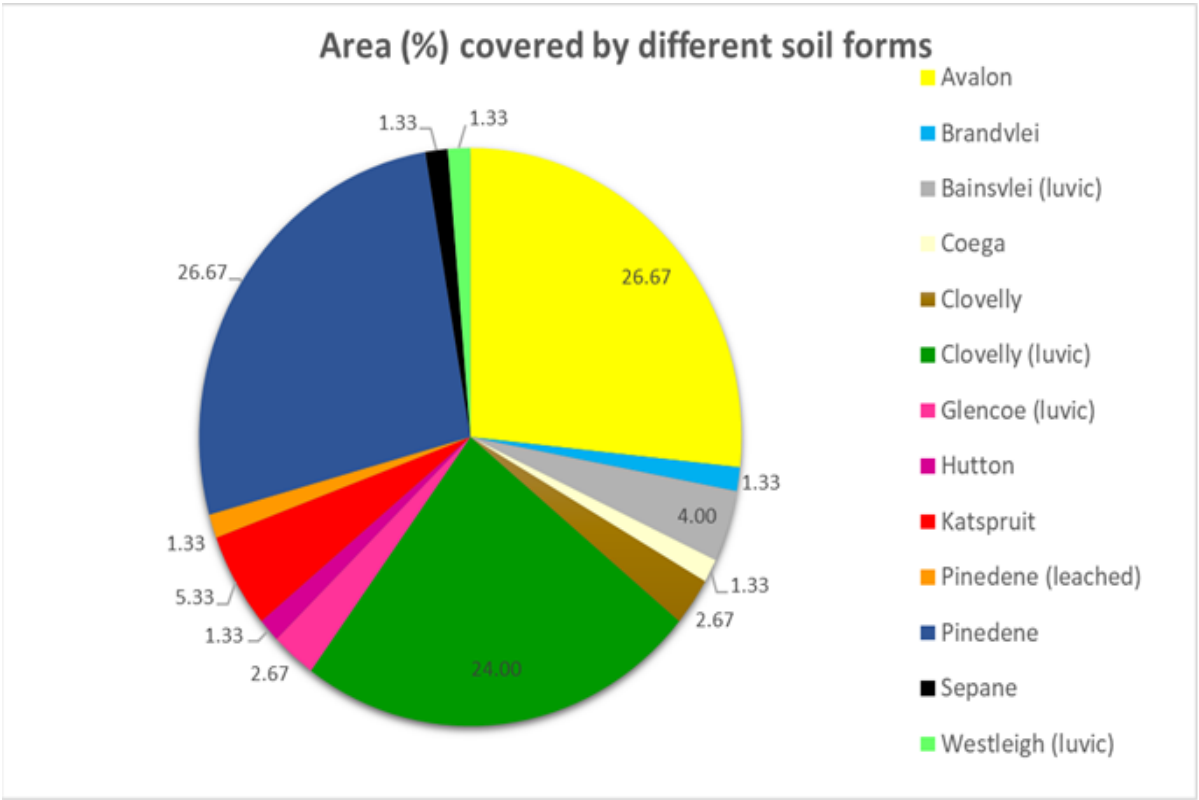


Figure 22: Percentage covered by different soil forms for the NGFCFs (Ferreira, 2021)

The potential risks associated with the different soils (summarized in table 15) include the risk of soil being prone to compaction, being prone to drought stress, and having very poor drainage. It is a concern that 88% of the soils of the participants were inclined to compaction (Table 16), with both the Avalon and Pinedene soil forms at 26.67%, making up the biggest percentage of soils being prone to compaction. Figure 23 shows Avalon soil prone to compaction, presenting a risk for an otherwise highly suitable soil for bean production. Compaction, in this instance, is due to a lack of proper soil cultivation after cattle grazed the previous crop. The high risk of NGFCF's soil for compaction is a major concern as it can lead to soil degradation (Hegde *et al*., 2011), which can hurt the environmental sustainability of the NGFCFs.

Table 15: Risk associated with soils (Ferreira, 2021)

Soil Form	Risk
Avalon	Minimal, but can compact.
Bainsvlei (luvic)	Minimal, but can compact.
Brandvlei	Shallow soft carbonate.
Coega	Hard carbonate.
Clovelly	Minimal, but prone to drought stress and compaction.
Clovelly (luvic)	Minimal, but prone to drought stress and compaction.
Glencoe (luvic)	Limited depth if shallow and compaction.
Hutton	Minimal, but prone to drought stress and compaction.
Katspruit	Very poor drainage.
Pinedene (leached)	Leached and poor subsoil drainage and compaction.
Pinedene	Minimal but poor subsoil drainage and compaction.
Sepane	Heavy clay and poor subsoil drainage.

Westleigh (luvic)	Fluctuation water table.

Table 16: Showing soil form % of total hectares with risk for compaction

Soil Form	**% Of total Hectares with risk of compaction**
Avalon	26.67%
Bainsvlei (luvic)	4.00%
Clovelly	1.33%
Clovelly (luvic)	24.00%
Glencoe (luvic)	2.67%
Hutton	1.33%
Pinedene (leached)	1.33%
Pinedene	26.67%
Total	**88.00%**

Figure 23: An extreme example of soil compaction and the effect thereof on the root of the beans, the soil shown here is an Avalon soil type

4.3.2. Cultivation techniques and management strategies used by the NGFCFs to grow small white beans

Several techniques and strategies have been proven to promote environmental sustainability, including doing soil surveys, conservation cultivation practices like no-till or minimum-till (Karayel and Šarauskiset, 2019), organic farming (Šrůtek and Urban, 2008; Seufert *et al*., 2012; Pimentel and Burges, 2014), crop rotation (Ball *et al*., 2005), the use of cover crops (Legg and Viatte, 2001), and making use of support and advice to help support them in decision-making on new, more effective farming methods and practices based on the latest research (Thematic Group on Sustainable Agriculture and Food Systems, 2015).

4.3.2.1. Soil Surveys

According to Ditzler *et al*. (2017), "A soil survey describes the characteristics of the soils in each area, classifies the soils according to a standard system of classification, plots the boundaries of the soils on a map, and makes predictions about the behaviour of soils. The different uses of the soils and how management's response affects them are considered. The

information collected in a soil survey helps develop land-use plans and evaluates and predicts the effects of land use on the environment". From this citation, doing a soil survey should be the first step farmers take to make sure that they use and manage their soils in an environmentally sustainable way (Table 17).

From the questionnaire, it is evident that most NGFCFs strongly agreed (71.4%) or agreed (21.4%) that doing a soil survey is essential to help them achieve environmental sustainability. However, 7.1% strongly disagreed with this statement.

Table 17: Doing a soil survey is essential to help achieve environmental sustainability (NGFCFs)

		Frequency	**Percentage**	**Valid Percentage**
Valid	Strongly disagree	1	7.1	7.1
	Agree	3	21.4	21.4
	Strongly agree	10	71.4	71.4
	Total	**14**	**100.0**	**100.0**

4.3.2.2. Conservation cultivation practices

Conservation cultivation practices like no-till and minimum-till are recommended to ensure environmental sustainability. From the questionnaire, 42.9% of the participants used minimum-till, 14.3% used no-till, and 42.9% used conventional cultivation tillage. However, 88% of the soils of the participants are prone to compaction, and 42.9% (Table 18) of participants use conventional tillage systems, highlighting a major concern towards having a long-term negative impact on environmental sustainability. As noted, conventional farming practices contribute to numerous forms of environmental degradation, including air and water pollution, soil depletion, soil erosion, and diminished biodiversity (Bradley, 2002; Horrigan *et al*., 2002; Lal *et al*., 2007; Gauker, 2010; Palm

., 2014). In contrast, conservation tillage methods use less time and fuel, resulting in lower labour requirements and less soil erosion, while stimulating higher agricultural productivity, increased moisture retention capacity of the soil, reduced soil compaction and soil crust formation, fewer carbon emissions and air pollution, and better surface water quality (Karayel and Šarauskis, 2019).

Table 18: Types of cultivation done by NGFCFs

		Frequency	**Percentage**	**Valid Percentage**
Valid	Conventional	6	42.9	42.9
	No-till	2	14.3	14.3
	Minimum till	6	42.9	42.9
	Total	**14**	**100.0**	**100.0**

4.3.2.3. Steps taken by NGFCFs to improve or maintain soil health and – fertility

Only some NGFCFs applied organic amendments (35.7%), and one participant used No-tillage to improve soil health. As noted, organic amendments and conservation tillage improve soil health by increasing microorganisms' abundance, diversity, and activity (Tahat *et al*., 2020). It is also encouraging that most NGFCFs rotated crops (92.9%) to improve soil health. However, only 21.4% made use of cover crops. In addition, 78.6% of participants took steps to improve soil fertility by taking soil samples (soil testing) to balance their soils, and 64.2% of these participants indicated they use fertilizer programs based on their soil test results to balance their soil (Table 19).

Table 19: Steps taken by NGFCFs to improve or maintain soil health and - fertility

Steps taken to improve or maintain soil health and - fertility	Percentage
Organic amendments	35.7%
Crop rotation	92.9%
Cover crops	21.4%
Soil Testing	78.6%
Balance soil according to the soil test	64.2%

4.3.2.4. Whether NGFCFs made use of qualified people to advise them on environmental sustainability practices

Farmers need assistance in making decisions by being informed about innovative, more productive farming techniques and practices based on the most recent research. This may include research on how to farm with nature for good results, now and in the future. In order to accelerate sustainable agricultural progress, better support systems are needed on the ground, including more professional extension systems (Thematic Group on Sustainable Agriculture and Food Systems, 2015).

All the NGFCFs used qualified people for advice on sustainable agricultural practices. They reported that it is important to get regular visits from extension officers. Extension officers guide them on the best management practices applicable to the situation to help them prevent soil erosion, improve soil health and fertility, use the correct crop protection products and guidelines to store these products and discard empty containers safely.

However, only 35.7% of the participant got regular visits from the government extension officers, and only 42.9% reported that they got sound advice from the government extension officers. The advice participant received from the government's extension offers included advice on crop rotation, cover crop options, soil samples, correct tillage options, - crop protection chemicals, and – cultivars. This finding aligns with the literature, showing that

better support systems are needed on the ground for emerging farmers. These include more professional extension services that can help farmers with decision-making by providing information on more effective farming methods and practices based on the latest research (Thematic group on sustainable agriculture and food systems, 2015).

All NGFCFs used qualified persons to advise them on crop protection products, and 92% followed the instructions on the label for the use and application. More than half (57.1%) of the NGFCFs strongly agreed that it is important to follow guidelines to safely store crop protection products and discard empty crop protection containers (Tables 20 and 21). However, it is a concern for environmental sustainability that 14.2% of the participants disagreed, and 7.1% of the participants had a neutral view on discarding empty crop protection containers and did not follow the instructions on the label for the use and application of crop protection products.

Table 20: NGFCFs that follow guidelines to store crop protection products safely

		Frequency	**Percentage**	**Valid Percentage**
Valid	Agree	6	42.9	42.9
	Strongly agree	8	57.1	57.1
	Total	**14**	**100.0**	**100.0**

Table 21: NGFCFs that follow guidelines to discard empty crop protection containers safely

		Frequency	Percentage	Valid Percentage
Valid	Disagree	1	7.1	7.1
	Neutral	1	7.1	7.1
	Agree	4	28.6	28.6
	Strongly agree	8	57.1	57.1
	Total	**14**	**100.0**	**100.0**

4.3.2.5. Conclusion environmental sustainability

New Generation Future Commercial Farmers (NGFCFs) applying sustainable agricultural principles will be environmentally sustainable. Most (92.8%) of the participants agreed that the first step farmers need to take to ensure that they use and manage their soils in an environmentally sustainable way is doing soil surveys. More than half of the participants (57.2%) also used conservation cultivation practices like no-till and minimum-till. All the NGFCFs used qualified people for advice on sustainable agricultural practices. They reported that it is important to get regular visits from extension officers to guide them on the best management practices applicable to the situation to prevent soil erosion, improve soil health, and fertility, use correct crop protection products and guidelines to store these products and discard of empty containers safely. Most (92.9%) participants rotated crops to improve soil health. Additionally, 78.6% of participants took steps to improve soil fertility by taking soil samples (soil testing) to balance their soils, and 64.2% of these participants indicated they use fertilizer programs based on their soil test results to balance their soil.

The most important factor that needs to be addressed to help NGFCFs become more environmentally sustainable is the lack of guidance from extension officers to help the farmers implement sustainable agricultural practices. Few farmers received proper guidance from qualified extension officers on best management practices to prevent soil erosion, improve

soil health and fertility, use correct crop protection products and guidelines to store these products safely and discard empty containers. There was also a lack of advice on; using crop rotation, cover crop options available, taking soil samples, and using correct tillage options, crop protection chemicals, and cultivars. Other factors that need to be addressed are using more environmentally friendly cultivation practices to replace conventional tillage practices and making more use of organic amendments and crop rotation.

4.4. SOCIAL SUSTAINABILITY

Social sustainability, or the social dimension of sustainability, is seen as an open and contested concept and conceptually elusive. The lack of congruence on what the social dimension of sustainability means for agriculture reflects the lack of consensus on the social dimension of sustainability in the scientific discourse (Janker and Mann, 2020).

Rural development is key in promoting social sustainability through poverty reduction and improving the livelihoods in rural areas where 75% of the poor life (Sarris, 2001). Rural development can be achieved in different ways through the support and involvement of farms in these communities. Farming contributes significantly to the overall state of rural regions in terms of employment, business opportunities, and infrastructure (European Commission, 2000).

According to Eizenberg and Jabareen (2017), “Sustainable development should be done in a way that emphasizes human livelihoods as integral to accomplishing ecological goals through economic development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. Food security is essential for economic development and for improving people’s livelihoods. Without long-term food security, social sustainability is inconceivable (Roy and Satpati, 2012).

Emerging farmers form an integrated part of the larger commercial agricultural sector to increase South Africa’s food production. This would help alleviate hunger and aid economic development by improving food availability for the poor through lower prices and higher incomes. Not only is food production important, but safe, quality food produced in a

sustainable and ethically responsible way is also important (British Standards Institution, 2013; Prosperi *et al*., 2014).

4.4.1. Rural development

Rural development is key in achieving social sustainability through poverty reduction and improving livelihoods in rural areas where 75% of the poor live (Sarris, 2001). Rural development can be achieved in different ways through the support and involvement of farms in these communities. Farming contributes significantly to the overall state of rural regions in terms of employment, business opportunities, and infrastructure (European Commission, 2000). According to STATS SA (2014), the single most important investment any country can make is the development of its people.

All New Generation Future Commercial Farmers (NGFCFs) indicated that they provide part-time jobs, and 45.5% indicated that they also provide full-time jobs (Figure 24). In addition, half (50%) of the NGFCFs strongly agreed that it is important to use labour from your local community, 42.9% agreed, and 7.1 had a neutral opinion on the subject.

Most NGFCFs indicated that they support other businesses (85.7%) and families (78.6%) in their local community. Two NGFCFs who supported local families provided training to improve skills to improve work efficiency. One of the participants who supported local families specified that they provide some of their products to those in need, such as beans for soup and maize for mielie meal. Some (27.3%) NGFCFs who supported local families provided logistics and transport to and from work.

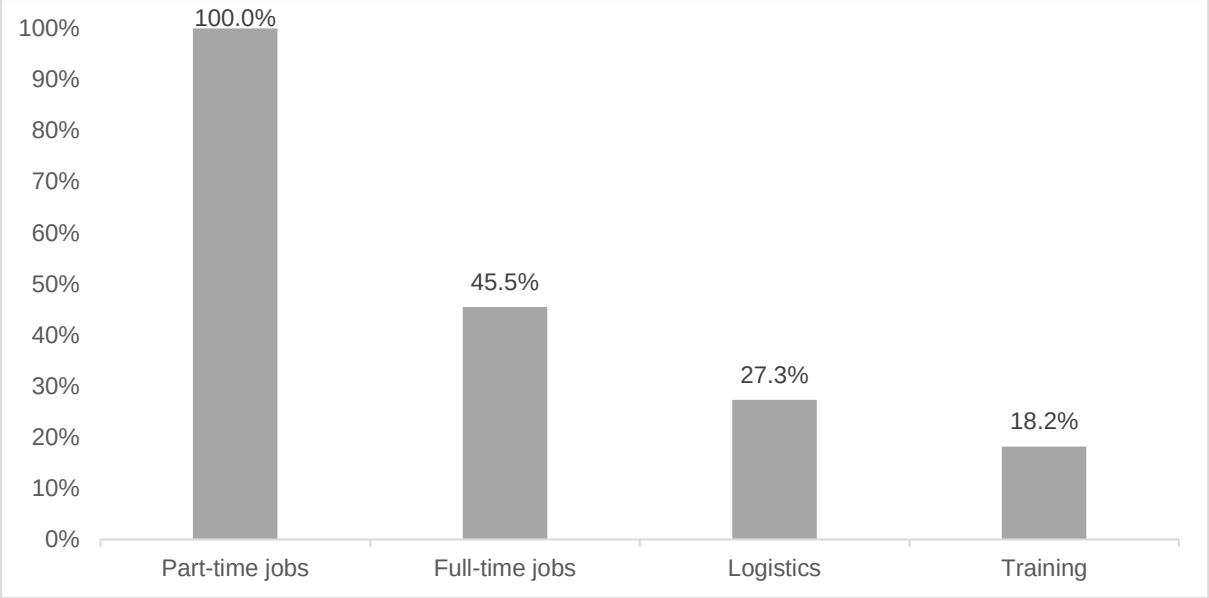


Figure 24: Ways of supporting families from local communities (NGFCFs)

More than half (57.1%) of the NGFCFs strongly agreed that providing a safe environment for your workforce is important; 35.7% agreed, and 7.1% of participants had a neutral opinion (Table 22).

Table 22: The importance of providing a safe environment for your workforce (NGFCFs)

		Frequency	**Percentage**	**Valid Percentage**
Valid	Neutral	1	7.1	7.1
	Agree	5	35.7	35.7
	Strongly agree	8	57.1	57.1
	Total	**14**	**100.0**	**100.0**

4.4.2. Succession planning

Farmers must have succession planning in place to help achieve social sustainability. According to Mr Lourie Bosman, previous Agri SA President (2021), “Farming calls for several skills, amongst which is the need to manage the labour force professionally and with the necessary

sensitivity. The farmer is often the employer, human resource manager, social worker and even mentor – all roles originating from a close relationship and involvement in the lives of labourers and their families". From the questionnaires, most (78.6%) NGFCFs have succession planning in place. Notably, the 21.4% of NGFCFs who do not have succession planning in place run the risk of being socially unsustainable (Table 23).

Table 23: NGFCFs on having succession planning in place

		Frequency	**Percentage**	**Valid Percentage**
Valid	Yes	11	78.6	78.6
	No	3	21.4	21.4
	Total	**14**	**100.0**	**100.0**

4.4.3. Conclusion socials sustainability

New Generation Future Commercial Farmers (NGFCFs) applying sustainable agriculture principles will be socially sustainable. Although all the emerging farmers indicated that they provide part-time jobs to local families, less than half provided full-time jobs, and even fewer helped with logistics or provided training to these families.

Rural development has been recognized as a key factor in promoting social sustainability, and farmers can influence rural development by supporting and becoming involved with the local communities. However, the results made it apparent that local families lack support from the emerging farmers participating in the study.

4.5. CONCLUSION ON WHETHER NGFCFs APPLYING SUSTAINABLE AGRICULTURAL PRINCIPLES WILL BE SUSTAINABLE

In this chapter, the author set out to test the study's hypothesis of whether NGFCFs applying sustainable agricultural principles will be sustainable. In conclusion, NGFCFs will be

economically-, environmentally-, and socially sustainable if they apply sustainable agricultural principles.

The principals (important factors) identified under the three principles of sustainable agriculture that need to be applied/addressed by NGFCFs to become even more sustainable are:

i. Accessing operational cost financing
ii. Addressing the lack of extension officer support
iii. Taking out crop insurance
iv. Being proactive to crop protection approaches
v. The lack of owning machinery
vi. Addressing high contractor fees and contractors not harvesting at the ideal time
vii. The lack of extension officer support
viii. Making use of qualified people to advise on sustainable agricultural practices
ix. Making use of more environmentally friendly cultivation practices to replace conventional tillage practices
x. Making more use of organic amendments and crop rotation
xi. Correctly discarding empty crop protection containers
xii. Rural development by supporting and becoming involved with the local communities

CHAPTER 5

COMMERCIAL FARMERS' VIEWS ON THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS

5.1. INTRODUCTION

In this chapter, the commercial farmers' views on the sustainability of the New Generation Future Commercial Farmers (NGFCFs) will be evaluated under the three principles of sustainable agriculture: economic-, environmental-, and social sustainability. A uniquely designed questionnaire (quantitative research component) was distributed to nine commercial farmers growing dry beans for the Schoeman Boerdery in the North-West Province of South Africa. This questionnaire contained closed-ended questions aimed at determining the factors influencing emerging farmers' sustainability. The questionnaires comprised four sections measuring demographic and background information, economic-, environmental-, and social sustainability. Participants were asked to reply to the statements on a Likert scale of 1 to 5, where 1 meant strongly disagreed and 5 meant strongly agreed. The questionnaires for the commercial farmers were used to determine their perceptions regarding various factors influencing the sustainability of the emerging farmers.

5.2. ECONOMIC SUSTAINABILITY

Commercial farmers' views on the economic sustainability of NGFCFs were divided into the views of the commercial farmers on the most important factor that influences the economic viability of NGFCFs, factors to consider increasing productivity (income), and cost factors (expenses) influencing the economic sustainability of NGFCFs.

5.2.1. The views of Commercial farmers on the most important factors that influence the economic viability of NGFCFs

The single most crucial factor specified by commercial farmers influencing the economic sustainability of NGFCFs was the lack of financial and farm management skills (33.3%) and insufficient knowledge of farming (22.2%) as the second most important factor that could influence economic sustainability (Table 24). Other factors also listed were the insufficient

ability to manage input costs and the lack of will to produce more than what you need, thus being more than subsistence farmers, correlating with the finding of Ahmad *et al*. (2006) and Khapayi and Celliers (2016). Finally, commercial farmers also viewed insufficient farm security as a risk to environmental sustainability, given the issues of severe and violent crime and theft in rural areas, including the farming community in South Africa, as highlighted by the national rural safety strategy (South African Police Service, 2018).

Table 24: The most important factor that would influence NGFCF's economic viability

		Frequency	**Percentage**	**Valid Percentage**
Valid	Not answered	1	11.1	11.1
	Lack of financial and farm management skills	3	33.3	33.3
	Insufficient knowledge of farming	2	22.2	22.2
	Insufficient ability to manage input costs	1	11.1	11.1
	Insufficient farm security	1	11.1	11.1
	The lack of will to produce more than what you need	1	11.1	11.1
	Total	**9**	**100.0**	**100.0**

5.2.2. The views of commercial farmers on the factors NGFCFs need to consider increasing their productivity (income)

The most agreed-upon statements (based on the mean) were that doing a soil survey to determine the best soil for the crop could increase productivity and that doing soil sampling and fertilizing could increase productivity accordingly ($\overline{X}$ = 4,89 ± 0,33 respectively). The

commercial farmers' views correlate with the view of Ditzler *et al*. (2017) that doing a soil survey should be the first step farmers take to ensure that they use and manage their soils sustainably. Furthermore, according to Benbi *et al*. (2006), balanced fertilization programs can be developed by doing soil sampling to help sustain crop productivity. Sagwal and Kumar (1994) also confirm that "the balanced used of fertiliser remains the most economical and undoubtedly most important for sustainable agriculture".

The least agreed-upon statement was that harvesting at the optimal time could increase productivity ($\overline{X}$ = 4,33 ± 0,71). Most commercial farmers (based on the median) agreed with all the statements regarding increased productivity (median = 5,00) except the statement that says harvesting at the optimal time could increase productivity, which was slightly less agreed with (median = 4,00) (Table 25).

Table 25: Statistics for factors that could increase productivity according to commercial farmers

		a.	b.	c.	d.	e.	f.	g.	h.
N	**Valid**	9	9	9	9	9	9	9	9
	Missing	0	0	0	0	0	0	0	0
Mean		4.78	4.67	4.44	4.33	4.67	4.89	4.89	4.67
Median		5.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00
Mode		5	5	5	4*	5	5	5	5
Std. Deviation		0.441	0.707	0.726	0.707	0.500	0.333	0.333	0.500
Minimum		4	3	3	3	4	4	4	4
Maximum		5	5	5	5	5	5	5	5

**Multiple modes exist. The smallest value is shown.*

Coding: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

a. Making use of qualified advice could increase productivity
b. Making use of crop protection products could increase productivity
c. Planting at the optimal date could increase productivity
d. Harvesting at the optimal time could increase productivity
e. Planting with quality and adapted seeds for your area could increase productivity
f. Doing a soil survey to determine the best soil for crops could increase productivity
g. Doing soil sampling and fertilizing could increase productivity accordingly
h. Correct soil tillage practices could increase productivity

5.2.3. Commercial farmers' views on the most important cost factors NGFCFs need to consider for economic sustainability

The most agreed-upon statement (based on the mean) was that direct input cost is a big cost ($\overline{X}$ = 4,56 ± 0,53), while the least agreed-upon statement was that lease of agricultural farmland is a big cost ($\overline{X}$ = 3,67 ± 0,71) (Table 26). Commercial farmers (based on the median) mostly agreed with direct input cost as a big cost (median = 5,00), while all other statements regarding cost were slightly less agreed with (median = 4,00). Rajendran *et al*. (2016) also confirm this statement from commercial farmers that production costs challenge any farmer's continuity to produce sustainable crops efficiently.

Table 26: Cost factors to consider for economic sustainability (commercial farmers' views)

		a.	b.	c.	d.	e	f.
N	**Valid**	9	9	9	9	9	9
	Missing	0	0	0	0	0	0
Mean		4.00	3.67	4.11	4.56	4.00	3.89
Median		4.00	4.00	4.00	5.00	4.00	4.00
Mode		4	4	4	5	4	4
Std. Deviation		1.000	0.707	0.928	0.527	0.707	0.601
Minimum		2	2	2	4	3	3
Maximum		5	4	5	5	5	5

Coding: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

a. Interest payable on loans is a big cost

b. Lease of agricultural farmland is a big cost

c. Farm instalments are a big cost
d. Direct input cost (seed, fertilizer, etc.) is a big cost
e. Labour cost is a big cost
f. Contractor fees are a big cost

The view of commercial farmers regarding direct input cost as an important factor to manage to achieve economic sustainability is confirmed by the Grain SA (2022) report, highlighting the fact that "input prices have risen on average over a one-year period, with seed by 6%, fertiliser by 128%, agrochemicals by 18% and fuel by 40%. A typical grain producer's direct input costs are 50% higher year-on-year. The impact on small-scale producers is detrimental because these farmers do not necessarily have the opportunity to make early purchases or have the benefit of economies of scale". The short-term solution would be to increase productivity and ensure optimal profitability by using and placing inputs more efficiently and accurately. This would mean farmers would require expertise, sophisticated knowledge and access to modern technology.

5.2.4. Conclusion economic sustainability factors

Commercial farmers' views on the economic sustainability of NGFCFs were divided into factors to consider to increase productivity, cost factors and, most important factors influencing economic viability.

The single most important factor specified by the commercial farmers influencing the economic sustainability of NGFCFs was the lack of financial and farm management skills (33.3%) and insufficient farming knowledge (22.2%) as the second most important factor influencing economic sustainability. The most agreed-upon statements, specified by commercial farmers, on the factors NGFCFs need to consider to increase their productivity (income) included: doing a soil survey determining the best soil for the crop and doing soil sampling and fertilizing. Commercial farmers view direct input cost as the most important cost factor NGFCFs need to manage for economic sustainability by increasing productivity by using and placing inputs more efficiently, accurately and using modern technology.

5.3. ENVIRONMENTAL SUSTAINABILITY

Commercial farmers' views on the environmental sustainability of NGFCFs were gathered under two headings, namely, (1) making use of qualified people and (2) the correct use, storage, and discarding of crop protection products. In addition, their views on how NGFCFs can achieve environmental sustainability by improving soil health and fertility and preventing soil erosion will also be provided.

5.3.1. Making use of qualified people to protect the environment

Most commercial farmers either agreed or strongly agreed (44.4% respectively) on using qualified people to advise NGFCFs on sustainable agricultural practices (Table 27). It is essential to use the advice received on environmental sustainability actions like tillage, soil fiscal, chemical and biological factors, use of environmentally safe crop protection programs, and disposal of empty crop protection containers. The effect of not making use of the advice received on agricultural production will negatively influence the farmers' ability to solve problems and obtain information, skills, and technologies to improve their sustainability (Davis, 2009).

Table 27: Views of commercial farmers on using qualified people to advise NGFCFs on sustainable agricultural practices

		Frequency	**Percentage**	**Valid Percentage**
Valid	Neutral	1	11.1	11.1
	Agree	4	44.4	44.4
	Strongly agree	4	44.4	44.4
	Total	**9**	**100.0**	**100.0**

All commercial farmers strongly agreed that NGFCFs should use qualified people to advise them on the correct use of crop protection products and that they should follow the instructions on the label of crop protection products. More than half (55.6%) of the commercial farmers also agreed that it is important for NGFCFs to follow guidelines to store crop protection products safely (Table 28). Additionally, 55.6% of the commercial farmers

strongly agreed that it's important for NGFCFs to follow guidelines to safely discard empty crop protection containers (Table 29). The commercial farmers' view also correlates with the view of CropLife International (2019) that the appropriate use, storage and disposal or recycling of empty crop protection containers is essential to protect the health of farmers, their communities, and the environment.

Table 28: Commercial farmers' views on the importance of NGFCFs to safely store crop protection products

		Frequency	**Percentage**	**Valid Percentage**
Valid	Agree	5	55.6	55.6
	Strongly agree	4	44.4	44.4
	Total	**9**	**100.0**	**100.0**

Table 29: Commercial farmers' views on the importance of NGFCFs to follow guidelines to discard empty crop protection containers safely

		Frequency	**Percentage**	**Valid Percent**
Valid	Agree	4	44.4	44.4
	Strongly agree	5	55.6	55.6
	Total	**9**	**100.0**	**100.0**

5.3.2. Views of commercial farmers on how NGFCFs can achieve environmental sustainability by improving soil health and fertility and preventing soil erosion

Most (88.9%) of the commercial farmers reported crop rotations as the most important factor to be considered by NGFCFs to improve soil health. However, more than half (55.6%) of the commercial farmers said NGFCFs should also consider growing cover crops to improve soil health (Figure 25). Only some (33.3%) commercial farmers said applying organic amendments

should be considered, and only one commercial farmer said no-tillage should be considered to improve soil health.

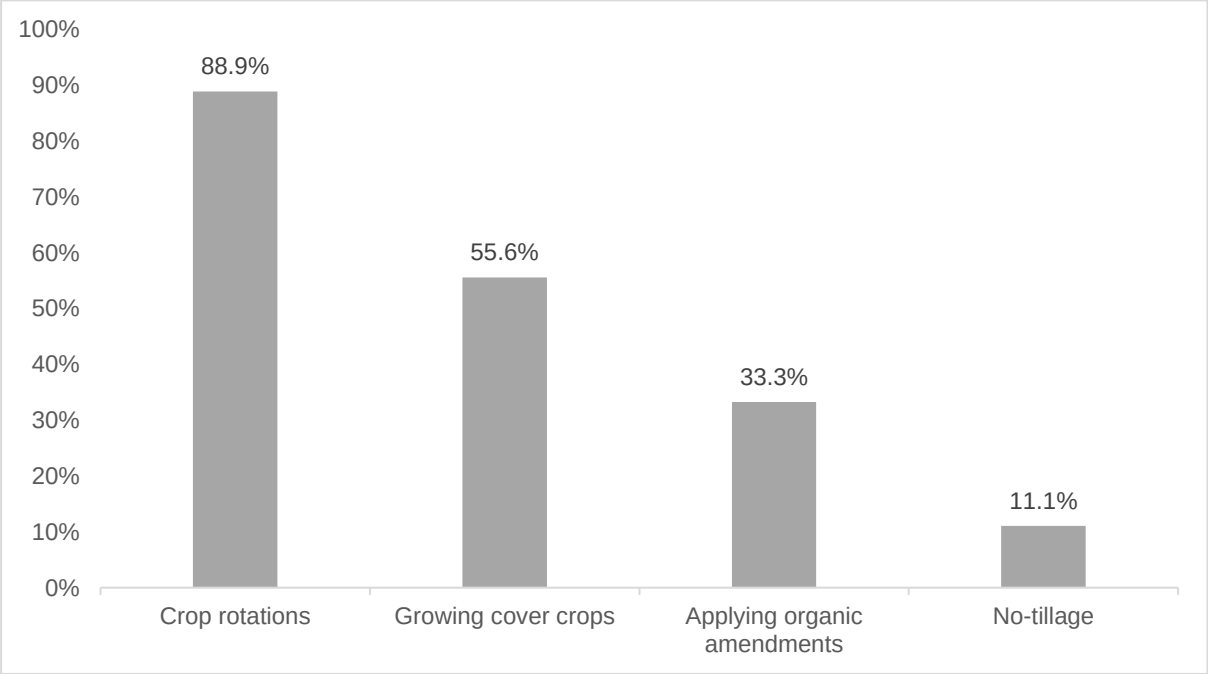


Figure 25: Commercial farmers' views on how NGFCFs can improve soil health

Nearly 90% (88.9%) of the commercial farmers reported that it is important to both use a balanced fertilizer program and correct the soil pH to improve soil fertility. In addition, 77.8% of the commercial farmers said soil testing and balancing soil nutrients according to crop needs should be done to improve soil fertility (Figure 26).

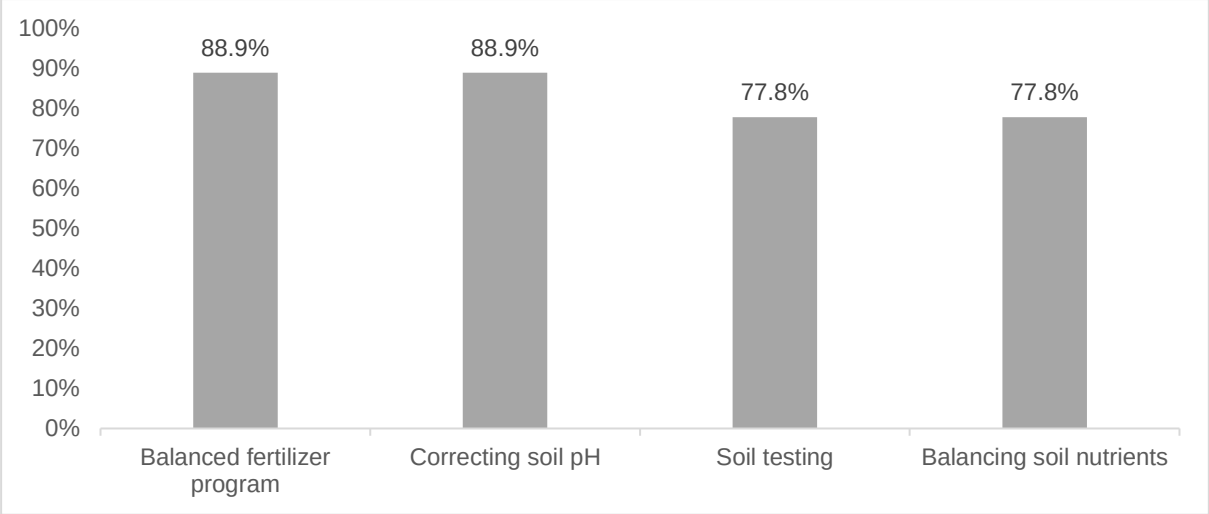


Figure 26: Views of commercial farmers on how NGFCFs can improve soil fertility

Commercial farmers viewed minimum tillage as the most popular means to prevent soil erosion, followed by cover crops (Table 30). Contouring fields and leaving as much as possible stubble were also opinions commercial farmers had on how NGFCFs can prevent soil erosion.

Table 30: Commercial farmers' views of steps NGFCFs could take to prevent soil erosion

		Frequency	Percentage	Valid Percentage
Valid	Not answered	1	11.1	11.1
	Contouring of fields	1	11.1	11.1
	Cover crop	2	22.2	22.2
	Minimum till	4	44.4	44.4
	Try to leave as much (residue-stubble) as possible on the land	1	11.1	11.1
	Total	**9**	**100.0**	**100.0**

The views of commercial farmers on the mitigating factors mentioned mainly fall under the umbrella agricultural practice of integrated crop management. The integrated crop management system is a system that focuses on the whole farm operation. It links best management practices into an integrated plan while broadening integrated pest management from managing pests to incorporating all aspects of crop production, including but not limited to soil fertility, tillage, crop rotation and variety selection. Integrated crop management provides the opportunity for increased economic yield, profitability, and environmental sustainability (Padgitt *et al*., 2001).

5.3.3. Conclusion environmental sustainability

Commercial farmers' views on the environmental sustainability of NGFCFs were gathered under the following headings: using qualified people and correctly using, storing, and discarding crop protection products. In addition, their views on how NGFCFs can achieve environmental sustainability by improving soil health and fertility, and preventing soil erosion, were also provided.

The most important factors specified by commercial farmers which they viewed to be important for the environmental sustainability of NGFCFs were:

- **i.** To use qualified people to advise NGFCFs on sustainable agricultural practices, like tillage, soil fiscal, chemical and biological factors, using environmentally safe crop protection programs, and disposal of empty crop protection containers, etc.
- **ii.** Implementing crop rotations programs
- **iii.** Growing cover crops
- **iv.** Applying a balanced fertilizer program to improve soil fertility
- **v.** Correcting soil pH
- **vi.** Balancing soil nutrients according to soil samples and crop
- **vii.** Making use of minimum tillage practices and leaving as much as possible stubble on the fields
- **viii.** Contouring of fields to prevent soil erosion

5.4. SOCIAL SUSTAINABILITY

Commercial farmers' views on the social sustainability of New Generation Future Commercial Farmers (NGFCFs) were gathered under the headings: the importance of supporting local families and social sustainability factors to consider.

5.4.1. Commercial farmers' views on social sustainability factors to consider by NGFCFs to improve their social sustainability

The most agreed-upon statements (based on the mean) were that it is essential to have a succession plan in place for your farming enterprise and that it is essential to provide a safe environment for your workforce ($\overline{X}$ = 4,44 ± 0,53 respectively). On the contrary, the least agreed-upon statement was that it is essential to support other families in the local community ($\overline{X}$ = 3,78 ± 0,67). Commercial farmers (based on the median) mostly agreed with all statements regarding social sustainability (median = 4,00) (Table 31).

According to the Food and Agriculture Organization of the United Nations (FAO) & International Fund for Agricultural Development (2019), the future of food and agriculture lies in the hands of the next generation of family farmers. Therefore, new generations of young people involved in agriculture need to be supported, and urgent actions are required to promote their contribution to rural development.

The importance of providing a safe environment to your workforce correlates with the findings of the International Labour Office (2011) report that agriculture is one of the most hazardous occupations worldwide and that the accidental fatality rate in agriculture is double that of most other industries. The main reason is the intensive use of machinery and crop protection products, which has raised the risks of poisoning, death, and work-related cancer. Yet, for many farm workers, work remains the principal source of income and one of the main drivers of social stainability (Gosetti, 2017).

Table 31: Commercial farmers' views on social sustainability factors NGFCFs should consider to improve their social sustainability

		a.	b.	c.	d.	e.
N	**Valid**	9	9	9	9	9
	Missing	0	0	0	0	0
Mean		4.00	3.78	4.00	4.44	4.44
Median		4.00	4.00	4.00	4.00	4.00
Mode		4	4	4	4	4
Std. Deviation		0.500	0.667	0.500	0.527	0.527
Minimum		3	3	3	4	4
Maximum		5	5	5	5	5

Coding: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

a. It is important to support other businesses in the local community
b. It is important to support other families in the local community
c. It is important to make use of labour from your local community
d. It is important to have a succession plan in place for your farming enterprise
e. It is important to provide a safe environment for your workforce

The commercial farmers' views were also gathered regarding the importance of NGFCFs supporting local families**.** It is evident from Figure 27 that all (100%) commercial farmers regard training as the most important factor to consider in supporting local families to improve social sustainability, followed by providing full-time and part-time jobs, both receiving 77.8% of the commercial farmers' votes. On the other hand, providing Logistics received 33.5% of commercial farmers' votes. Providing infrastructure and housing to improve social sustainability received the least votes, both with 22.2% of commercial farmers' votes.

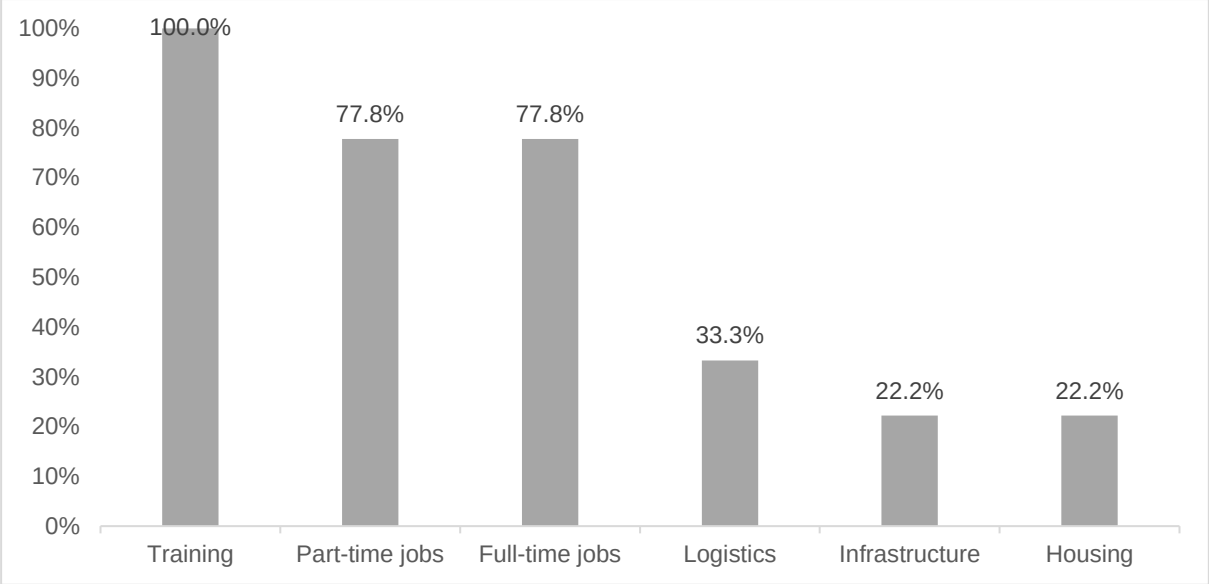


Figure 27: Views of commercial farmers regarding NGFCFs supporting local families

Investing in your employee's authentic training and providing jobs not only help with rural development, food security and employment (Olufemi, 2020) but also increases their knowledge of your farming enterprise. This limits additional costs associated with replacement and capital loss associated with employing inexperienced labour (Meulenberg, 2019).

5.4.2. Conclusion social sustainability

The commercial farmers' views on the social sustainability of NGFCFs concluded that it is important for NGFCFs to have a succession plan, to provide a safe environment for their workforce, invest in their employees' authentic training and provide jobs.

5.5. CONCLUSION ON THE VIEWS GATHERED FROM COMMERCIAL FARMERS REGARDING THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS

In this chapter, the commercial farmers' views on the sustainability of New Generation Future Commercial Farmers (NGFCFs) were evaluated under the three principles of sustainable agriculture: economic-, environmental-, and social sustainability.

The single most important factor specified by commercial farmers influencing the economic sustainability of NGFCFs was the lack of financial and farm management skills and insufficient farming knowledge. The view of commercial farmers on the factors NGFCFs need to consider to increase their economic sustainability was doing a soil survey to determine the best soil for the crop, doing soil sampling and fertilizing, and managing direct input costs.

The most important factors specified by commercial farmers that they viewed to be important for the environmental sustainability of NGFCFs were:

i. To use qualified people to advise NGFCFs on sustainable agricultural practices, like tillage, soil fiscal, chemical and biological factors, using environmentally safe crop protection programs, and disposal of empty crop protection containers, etc.
ii. Implementing crop rotations programs
iii. Growing cover crops
iv. Applying a balanced fertilizer program to improve soil fertility
v. Correcting soil pH
vi. Balancing soil nutrients according to soil samples and crop
vii. Making use of minimum tillage practices and leaving as much possible stubble as possible on the fields
viii. Contouring of fields to prevent soil erosion

The commercial farmers' views on the social sustainability of NGFCFs concluded that it is important for NGFCFs to have a succession plan in place, to provide a safe environment to their workforce, to invest in their employees' authentic training, and to provide jobs.

CHAPTER 6

INDUSTRY EXPERTS' VIEWS ON THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS

6.1. INTRODUCTION

In this chapter, industry experts' views on the sustainability of new generation future commercial farmers (NGFCFs) will be evaluated by way of a logframe analysis of the sustainability of NGFCFs under the three principles of sustainable agriculture: economic-, environmental-, and social sustainability. An adapted Logical Framework Analysis (LFA) tool was used to collect qualitative data from 10 industry experts to determine what they believe is needed to improve emerging farmers' economic-, environmental-, and social sustainability. As described by van Niekerk (Van Niekerk *et al*., 2011), LFA principles were used to capture the views and insights of industry experts on the core problems NGFCFs face regarding sustainability (economic, environmental, social). This was done by way of a discussion group including nine industry experts who identified the negative causes of the problems and the negative effects they associated with these causes.

6.2. ECONOMIC SUSTAINABILITY

6.2.1. Logframe analysis – Problems and objectives as viewed by industry experts New Generation Future Commercial Farmers face regarding their economic sustainability

6.2.1.1. Problem Analysis

Emerging farmers are encouraged to participate in the commercial farming sector and become economically sustainable NGFCFs. Industry experts included academic, agricultural, and social sustainability experts participating in the research. Their views on the economic sustainability of NGFCFs from the Zamukele project growing dry beans for Schoeman Boerdery under contract in the North-West Province were captured by a logframe analysis.

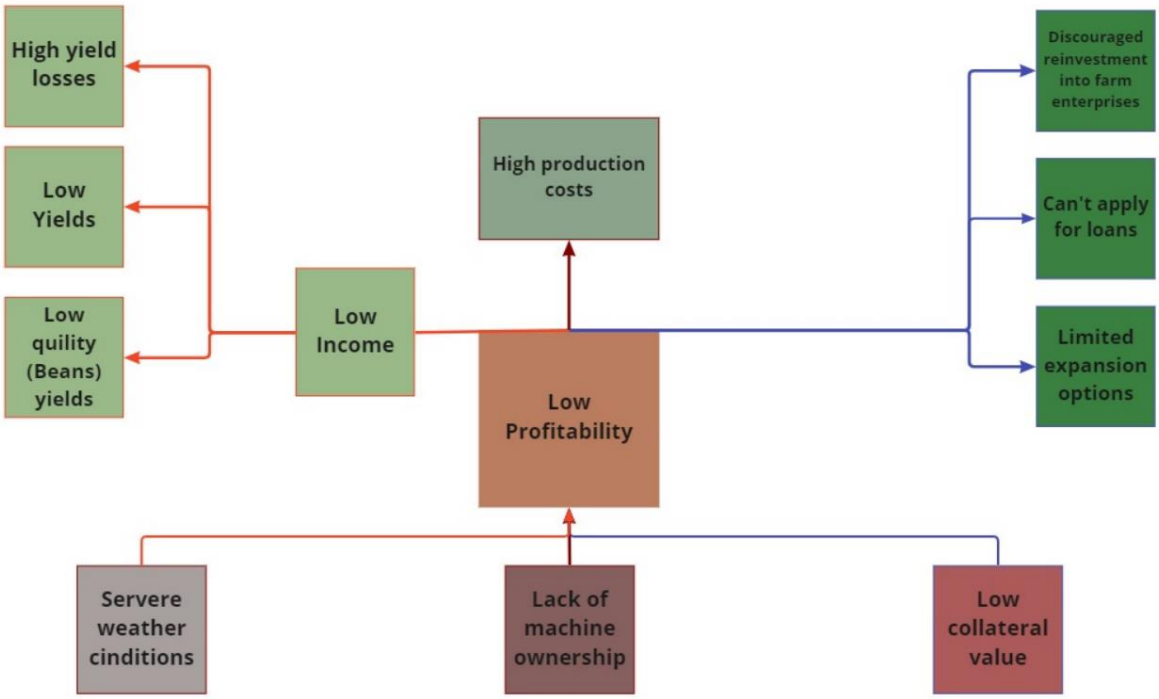


Figure 28: Problem tree (as proposed by industry experts NGFCFs face regarding their economic sustainability)

The core problem focus was low profitability, which forms the tree trunk in the middle of Figure 28. Profitability is the most important factor in determining economic sustainability, where profitability is measured with an income statement with income and expenses. Income is money generated by the farm; in this case, the beans are produced and sold to generate income. The expenses are the cost of resources used by the farming enterprise, to produce the beans, it include factors like seeds, fertilizers, fuel, crop protection, etc. Therefore where farmers have low profitability, the farming enterprise cannot reward the farmer with large returns on his investment, resulting in the farm not being economically sustainable (Hofstrand, 2009). The industry experts identified various problems regarding participants' economic sustainability, which were divided into causes and effects. The causes become the roots of the Problem Tree, and the effects are the branches.

The first causes identified were severe weather conditions (hail, frost, drought, floods, etc.). Due to global climate change, the climatic variability and occurrence of extreme weather events are likely to increase agricultural risk and eventually destabilize farm

income substantially. This is in line with the literature on global climate change leading to extreme weather events, in turn leading to increased agricultural risk and destabilized farm income (Gobin *et al*., 2013). The effect of severe weather conditions identified by the industry experts on profitability is damaged crops leading to lower yields and income, low return on investment, and cash flow restrictions.

The second cause was the lack of owning machinery. Where the participant did not own harvesting machinery, it led to late harvesting. The effect of late harvesting is that the beans become too dry for canners to use, and these beans also tend to shatter and split during the harvesting proses and at the processing plants, leading to income losses for the NGFCFs (Du Plessis *et al*., 2002). Additionally, not owning the necessary machinery means emerging farmers use more labour, increasing production costs, and making it difficult to do farming activities at the ideal time, leading to potential yield losses and lowering profitability (Dane, 2020).

The third cause identified by experts was low collateral value. According to De Klerk *et al*. (2013), the lack of collateral contributes to restricted access to finance. Access to a comprehensive range of financial services is a significant challenge for emerging farmers unable to use the land they farm as collateral, hindering the development of the economies of scale. Industry experts identified the effects of low collateral value on NGFCFs as being unable to expand their farming enterprise, having difficulties accessing finances, and discouraging them from reinvesting in their farming enterprise. Access to financial services is critical to provide funds for farm investments to improve productivity and post-harvest practices, improve household cash flow, and enable farmers to have better access to markets and better manage risks associated with farming (International Finance Corporation (IFC), 2014).

6.2.1.2. Objective Analysis

The next phase in the LFA process is to turn the Problem Tree into an Objective Tree.The Objective Tree describes the future situation once the identified problems have been solved. This involves reformulating the negative statements of Figure 28 into positive statements to be achieved in the future. This reformulation needs to be realistic. The logical cause-and-effect relationship is now converted into a logical activity-ends relationship

forming the objective (Van Niekerk, 2012). The Objective Tree is displayed in Figure 29.

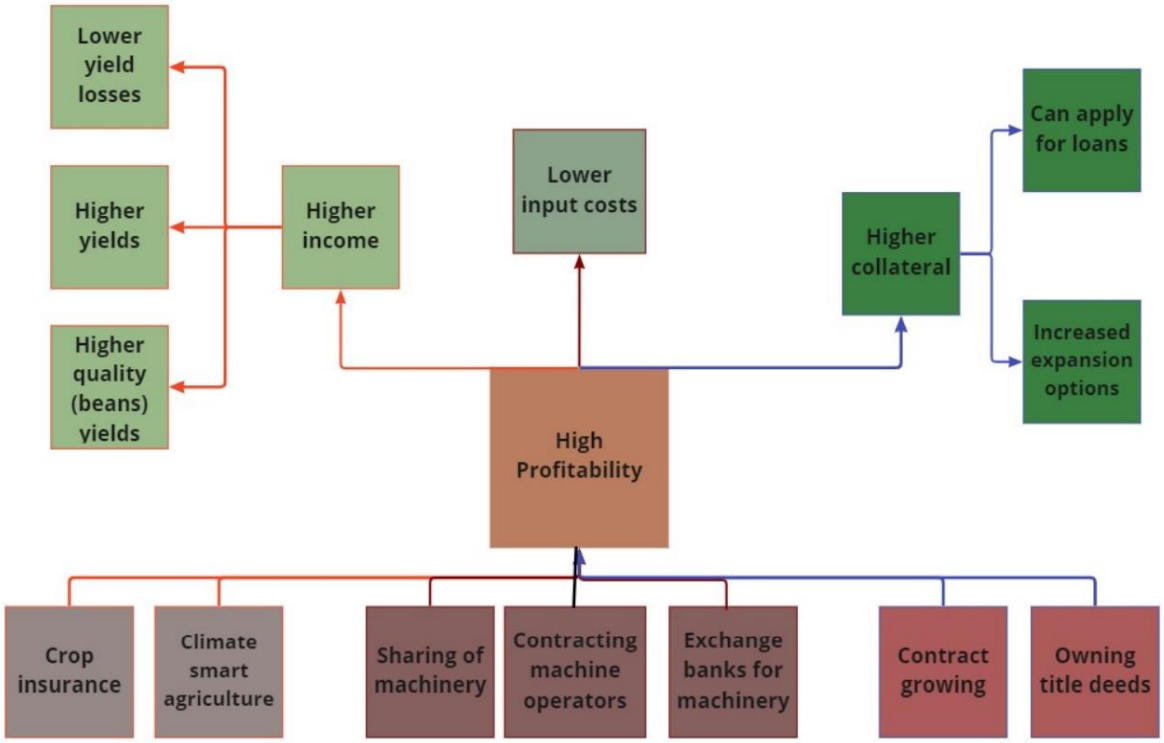


Figure 29: Objective tree (proposed by industry experts for NGFCFs regarding economic sustainability)

In the Objective Tree, the trunk serves as the core objective statement for the NGFCFs to achieve economic sustainability. The roots represent the activities to reach the objectives, and the branches are the end goals that must be achieved. The industry experts identified several desirable ends for NGFCFs to achieve economic sustainability. These desirable ends included higher income due to higher yields, higher quality beans, lower yield losses, lower input cost, and higher collateral, enhancing the NGFCF's ability to apply for loans and expanding potential.

The industry experts identified seven main activities that they believed would enable NGFCFs to become economically sustainable, profitable commercial farmers. These seven main activities are:

i. Crop insurance

ii. Climate-smart agriculture

iii. Sharing of machinery

iv. Contracting machine operators

v. Exchange banks for machinery

vi. Contract growing

vii. Owning title deeds

By having crop insurance and implementing climate-smart agriculture (CSA) methods, industry experts argued that NGFCFs could achieve higher incomes due to higher expected yields, higher quality of their crops, and lower yield losses associated with severe weather conditions. In addition, implementing CSA methods will improve input cost efficiency and productivity and limit economic costs (Mnkeni *et al*., 2019).

Activities recommended by the industry experts to address the lack of owning essential machinery included sharing machinery, setting up exchange banks for machinery between the NGFCFs in the Zamukele project, and contracting machinery operators. According to Pressman (2011), sustainable agriculture can be a labour-intensive business. Therefore, by selecting the appropriate equipment, farmers can increase crop yields and profits, improve crop quality, and reduce production costs. Furthermore, the industry experts believed that access to essential machinery would enable NGFCFs to be proactive in their approach to farming activities like harvesting, soil preparation, and crop protection. This would improve their yields, improve the quality of their yields (crops), and lower their labour cost, contributing to NGFCFs being more profitable.

The industry experts felt that by taking part in projects like the Zamukele project, NGFCFs could establish themselves as sustainable and profitable agricultural enterprises under the guidance and mentorship of commercial farmers like Schoeman Boerdery, where they farm under an off-take agreement (that provides production, support & market access). This would improve their chances of showing financial institutes, government, and private sector investors, their ability to be economically sustainable and profitable NGFCFs. Contract farming under an off-take agreement contends to be one of the most important documents in financial transactions and provides the revenue stream to support project financing (Hogan, 2016).

Industry experts also suggested that NGFCFs use a cession agreement where commodity-based financing is predominantly characterized by Agri-financiers taking a cession agreement on the to-be-produced crop income as primary security for repayment of their loan. The right of future crop income as primary collateral for repayment of an input cost loan (Linde, 2014).

Owning title deeds, industry experts argued, would provide NGFCFs with higher collateral, improving their ability to apply for loans, expand their farming enterprises, and help them become more profitable. The benefits of owning title deeds include better access to formal credit, higher land values and investment in land, and higher output leading to higher income (Feder and Nishio, 1999). In addition, industry experts argued that NGFCFs who successfully implement the central activities identified by them and show their economic sustainability and profitability would improve their chances of owning title deeds. Ownership of title deeds became a reality for farmers at Tafelkop, in the Groblersdal district of Limpopo, on Saturday, 22 May 2021, when President Cyril Ramaphosa handed over their title deeds. This enabled them to use title deeds to secure loans and long-term supply contracts and form partnerships with bigger commercial farmers (The Government of the Republic of South Africa, 2021). Furthermore, it confirmed the government's intention to increase the sustainability of emerging farmers on their way to becoming NGFCFs.

6.2.1.3. Conclusion economic sustainability

The study delved deeper into the factors hindering emerging farmers' economic sustainability by capturing industry experts' views via a logframe analysis. In line with the views of emerging farmers that lack of finance is one of their biggest problems, the analysis revealed low profitability as the core problem identified by industry experts. After identifying the core problem, the industry experts pinpointed possible causes of low profitability. Severe weather conditions, lack of owning machinery, and low collateral value were identified as factors causing low profitability. These findings are again in line with emerging farmers' views that not owning their own machinery and not being able to access finance are some of their biggest concerns.

After identifying the problems, the industry experts put forth seven actionable solutions to enable emerging farmers to become economically sustainable, profitable commercial farmers. The solutions identified were for the emerging farmers to acquire crop insurance,

engage in climate-smart agriculture, share machinery, make use of contract machine operators, exchange banks for machinery, make use of contract growing, and own title deeds

6.3. ENVIRONMENTAL SUSTAINABILITY

6.3.1. Logframe analysis – Problems and objectives, as viewed by industry experts, New Generation Future Commercial Farmers (NGFCFs) face regarding their environmental sustainability

6.3.1.1. Problem Analysis

Emerging farmers are encouraged to participate in the commercial farming sector and become environmentally sustainable NGFCFs. The views of industry experts participating in the study on the environmental sustainability of NGFCFs from the Zamukele project growing dry beans for Schoeman Boerdery under contract in the North-West Province were captured by a logframe analysis.

The core problem focus was the lack of the implementation of sustainable agricultural practices, forming the tree trunk in the middle of Figure 30. The industry experts identified various problems that were divided into causes and effects. The causes become the roots of the Problem Tree, and the effects are the branches.

The first cause identified was the lack of utilizing advice, which directly impacts how NGFCFs go about sustainable environmental practices. “The effect of not making use of the advice on agricultural production will negatively influence their ability to solve problems and obtain information, skills, and technologies to improve their sustainability” (Davis, 2009). However, given the earlier findings, it is probably a lack of extension support, instead of farmers not heeding advice, that is problematic. Therefore, it is essential to make use of the advice on environmental sustainability actions like tillage, soil fiscal, chemical en biological factors, use of environmentally safe crop protection programs, and disposal of empty crop protection containers.

The second cause identified was a lack of education on soil erosion which will hurt the management and prevention of soil degradation and erosion. Wang *et al*. (2000) found that a simple perception of, for instance, a wind erosion problem by farmers, was insufficient to

motivate farmers to adopt wind erosion control practices. However, educational campaigns focus on the farmers' sense of social responsibility and profit motive, which positively affects farmers adopting new environmentally sound technologies (Wang *et al*., 2000).

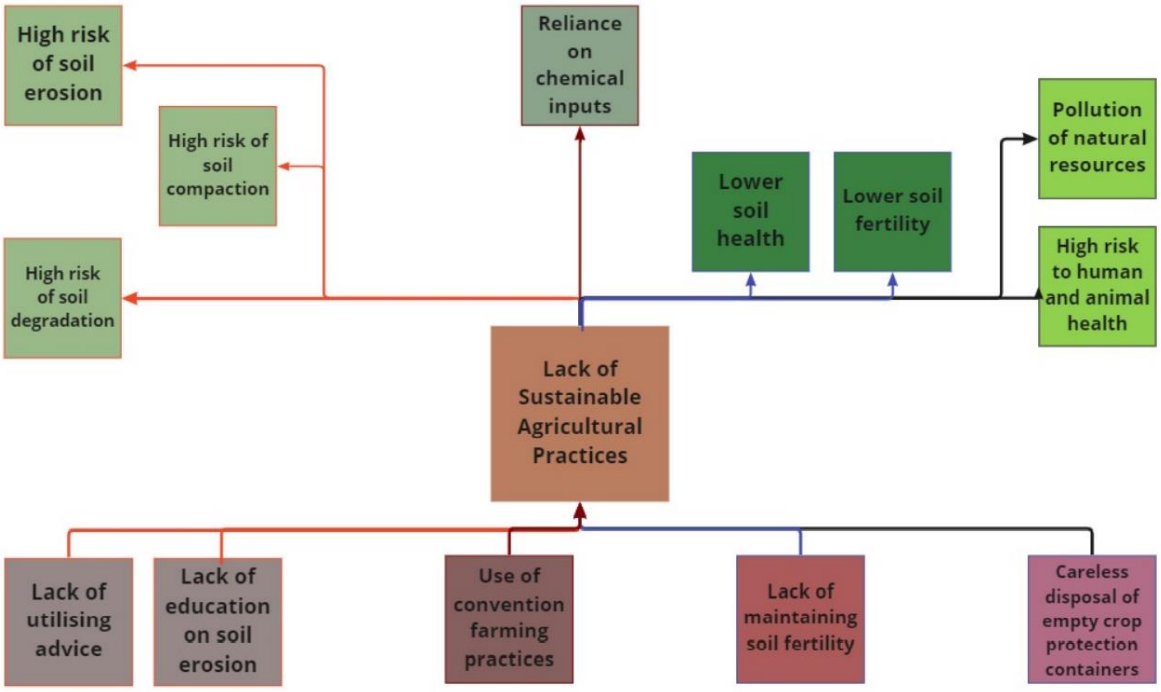


Figure 30: Problem tree (as proposed by industry experts for NGFCFs regarding their environmental sustainability)

The third cause identified was using conventional farming (CF) practices. CF-based agriculture increases erosion rates enough to prove unsustainable (Montgomery, 2007). CF also contributes to numerous forms of environmental degradation, including air and water pollution, soil depletion, erosion, and diminishing biodiversity (Bradley, 2002; Horrigan *et al*., 2002; Lal *et al*., 2007; Gauker, 2010; Palm *et al*., 2014). Additionally, CF tends to induce long-term disturbance of soil properties and soil fertility (Dayou *et al*., 2017).

The fourth cause identified was a lack of maintaining soil fertility, negatively affecting soil health and fertility. Providing plants with balanced essential nutrients through applying organic matter and minerals is the basis of healthy soils that is the foundation of the food system producing healthy crops that, in turn, nourish people (Ghorbani *et al*., 2008). Both soil health and – fertility is important factors to consider for improving environmental sustainability (Idowu *et al*., 2019). As noted, the integrated soil fertility management

approaches combine organic fertilizer resources with optimal chemical fertilizers to maintain and restore soil fertility.

The fifth cause identified was the careless disposal of empty crop protection containers with negative effects on the health of humans and animals and a high risk of pollution of natural resources. To maintain a healthy ecosystem, farmers must follow a responsible and ethical approach to disposing of crop protection containers. Therefore, the appropriate disposal or recycling of empty crop protection containers is essential to protect the health of farmers, their communities, and the environment (CropLife International, 2019).

6.3.1.2. Objective Analysis

The next phase in the LFA process is to turn the Problem Tree into an Objective Tree.The Objective Tree describes the future situation once the identified problems have been solved. This involves reformulating the negative statements of Figure 30 into positive statements to be achieved in the future. This reformulation needs to be realistic. The logical cause-and-effect relationship is now converted into a logical activity-ends relationship that forms the objective (Van Niekerk, 2012). The Objective Tree is displayed in Figure 31.

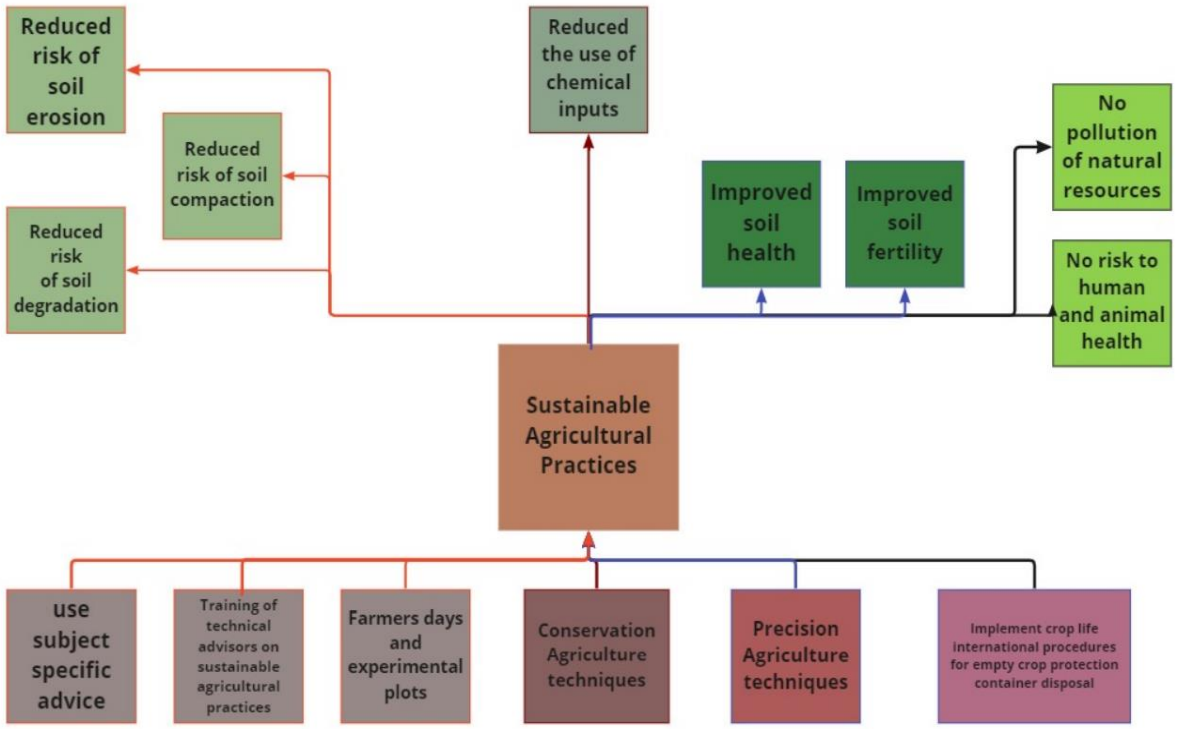


Figure 31: Objective tree (proposed by industry experts for NGFCFs regarding environmental sustainability)

In the Objective Tree, the trunk serves as the core objective statement for the NGFCFs to achieve economic sustainability. The roots represent the activities to reach the objectives, and the branches are the end goals that must be achieved.

The industry experts identified several desirable ends for NGFCFs to achieve environmental sustainability. These desirable ends included reducing the risk of soil erosion, - soil degradation, - soil compaction, and – reliance on chemical inputs, improved soil health and fertility, no risk of pollution of natural resources, and no risk to the health of animals and humans.

The industry experts identified six main activities that they believed would enable NGFCFs to become environmentally sustainable commercial farmers. These six main activities are:

i. Use subject-specific advice

ii. Training of technical advisors on sustainable agricultural practices

iii. Farmers days and experimental plots

iv. Conservation agriculture (CA) techniques

v. Precision agriculture (PA) techniques

vi. Implement crop life international procedures for empty container disposal

Industry experts suggested that NGFCFs and technical advisors use subject-specific advice and training provided by sustainable agricultural research institutes like the Sustainable Food Systems and Development Faculty at the University of the Free State. This will assist them in addressing their lack of education on subject-specific matters (sustainable agricultural practices) to improve their environmental sustainability practices and to ensure sound technical advice. The technical experts also felt that NGFCFs should attend farmers days and experimental plots that explain and showcase the benefits of conservation farming practices and the impact of sound sustainable farming practices on the environment.

Industry experts also suggested using conservational agricultural (CA) practices to reduce the risk of soil erosion, degradation, and compaction and improve soil health and fertility. CA tillage involves tillage practices ranging from zero tillage (No-till), reduced (minimum) tillage, mulch tillage, and ridge tillage to contour tillage. The aim is to reduce soil disturbance for a better soil environment and minimal environmental impact (Bradley, 2002**;** Palm *et al*., 2014**;** Busari *et al*., 2015)**.** CA tillage methods offer various environmental benefits like lower soil erosion, higher agricultural productivity, reduced soil compaction and crust formation, fewer carbon emissions and air pollution, and better surface water quality (Karayel and Šarauskis, 2019).

The industry experts suggested using precision agriculture (PA) technology to monitor and evaluate the impact of their agricultural practices on the environment and to reduce the use of chemical inputs. According to Stafford and Deboer (2019), “Precision farming is a management strategy that gathers, processes, and analyses temporal, spatial, and individual data and combines it with other information to support management decisions according to estimated variability for improved resource use efficiency, productivity, quality, profitability and sustainability of agricultural production”.

The final suggestion from industry experts was that NGFCFs should implement the crop life international procedures for the disposal of empty containers. This will limit the risk of crop chemical active ingredients polluting the natural resources or risking the health of humans or animals. The crop protection industry is taking the lead to ensure the development, use, and appropriate disposal or recycling of empty crop protection containers is managed sustainably to protect the health of farmers, their communities and the environment (CropLife International, 2019).

6.3.1.3. Conclusion environmental sustainability

In the logframe analysis, industry experts identified a lack of emerging farmers implementing sustainable agricultural practices as the core problem affecting environmental sustainability. The causes of emerging farmers not implementing sustainable agricultural practices were identified by industry experts as a lack of utilizing advice, a lack of education on soil erosion, the use of conventional farming practices, a lack of maintaining soil fertility, and careless disposal of empty crop protection containers. However, given the lack of extension support, a lack of advice rather than a lack of utilizing advice is probably more accurate. In addition, all these causal factors highlighted by the industry experts can be mitigated by proper support from extension officers.

In line with the findings around the importance of extension support, the actionable solutions proposed by the industry experts centred around educational interventions. The solutions included using subject-specific advice, training technical advisors on sustainable agricultural practices, farmers days and experimental plots, using conservation- and precision agricultural techniques, and implementing crop life international procedures for empty container disposal.

6.4. SOCIAL SUSTAINABILITY

6.4.1. Logframe analysis – Problems and objectives, as viewed by industry experts, New Generation Future Commercial Farmers (NGFCFs) face regarding their social sustainability

6.4.1.1. Problem Analysis

Emerging farmers are encouraged to participate in the commercial farming sector and become socially sustainable NGFCFs. The views of industry experts participating in the study on the social sustainability of NGFCFs from the Zamukele project growing dry beans for Schoeman Boerdery under contract in the North-West Province were captured by a logframe analysis.

The core problem focus was the lack of social entrepreneurship initiatives, forming the tree trunk in the middle of Figure 32. The industry experts identified various problems that were divided into causes and effects. The causes are the roots of the Problem Tree, and the effects are the branches.

The first cause identified was a lack of succession planning. The effects of not having succession planning in place, identified by industry experts, were a high risk of food insecurity (Ntshangase *et al*., 2016), unemployment (Olufemi, 2020), and low rural development. “One of the main preconditions for keeping agriculture viable and sustainable is the generational renewal of family farming, i.e., the retaining of young people on the farms and in rural communities. The future of food and agriculture lies in the hands of the next generation of family farmers. Urgent actions are therefore needed to support young people’s engagement in agriculture and promote their active contribution to rural development” (Food and Agriculture Organization of the United Nations (FAO) & International Fund for Agricultural Development, 2019).

The second identified cause was a lack of local community business investment. The effects are the increased risk of job losses and poverty for local communities. According to Shuman (2000), investment in locally owned businesses leads to sustainably using local resources, employing local workers at decent wages and serving primarily local consumers. In the long run, investment in local communities can improve the quality of life for local communities (International Finance Corporation, 2010).

The third cause identified was a lack of specialized sustainable farming education. The effect is that NGFCFs have a high risk of being socially unsustainable. Social sustainability is such an elusive concept making it difficult to understand and implement. However, it is an important criterion for being a sustainable farmer. Social sustainability is a process of creating sustainable, successful places that promote well-being by understanding what people need from the place they work and live. “The 2030 Agenda for Sustainable Development holds that education is essential to achieving a sustainable future”(Skrefsrud, 2022).

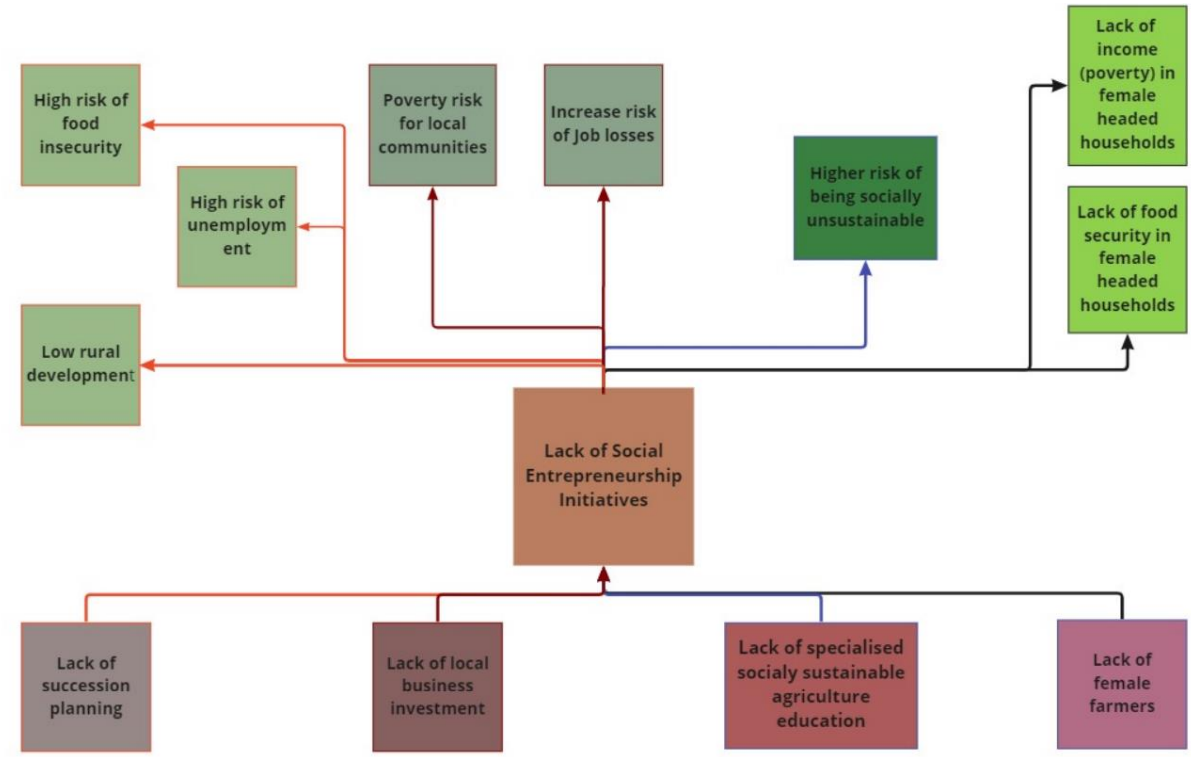


Figure 32: Problem tree (proposed by industry experts for NGFCFs regarding their social sustainability)

The fourth cause identified is the lack of female farmers. The effects expected of the lack of female farmers are a lack of female-driven value-adding initiatives and food insecurity in female-headed households. The reasons for the lack of female farmers include, but are not limited to, unequal access to land and capital, lack of representation within institutions that affect policy, the global financial crisis, the food and fuel crises, and privatization of large portions of customary land through land grabs (Acord *et al*., 2011; Massy, 2018). A study by Ahmed and Elneel (2018) showed that having women involved in farming activities significantly increased household food security and wealth. This is because women have

important roles as food producers, managers of natural resources, caretakers of household food and nutrition security, and contributors to household income (Olumakaiye and Ajayi, 2006). It's also important to note that if women were given equal access to resources and human capital, women farmers could achieve yields equal to or even significantly higher yields than men (Quisumbing *et al*., 1996).

6.4.1.2. Objective Analysis

The next phase in the LFA process is to turn the Problem Tree into an Objective Tree. The Objective Tree describes the future situation once the identified problems have been solved. This involves reformulating the negative statements of Figure 32 into positive statements to be achieved in the future. This reformulation needs to be realistic. The logical cause-and-effect relationship is now converted into a logical activity-ends relationship that forms the objective (Van Niekerk, 2012). The Objective Tree is displayed in Figure 33.

In the Objective Tree, the trunk serves as the core objective statement for the NGFCFs to achieve improved social entrepreneurship initiatives. The roots represent the activities to reach the objectives, and the branches are the end goals that must be achieved.

The industry experts identified several desirable ends for NGFCFs to achieve social sustainability. These desirable ends included lowering the risk of food insecurity, unemployment, poverty in the local community, job losses, and being socially unstainable. The desirable ends also included reducing food insecurities, increased income and wealth in female-headed households, and higher rural development.

The industry experts identified six main activities that they believed would enable NGFCFs to become socially sustainable commercial farmers. These six main activities are:

i. Mentoring on succession planning
ii. Private and public partnership
iii. Mentorships by agribusiness enterprises, extension officers, and academic institutions on social sustainability
iv. Internships for females by the government and agribusiness enterprises
v. Incentives by the government and agribusiness enterprises for female farmers
vi. The government to provide policies to enhance female farmer participation in agriculture

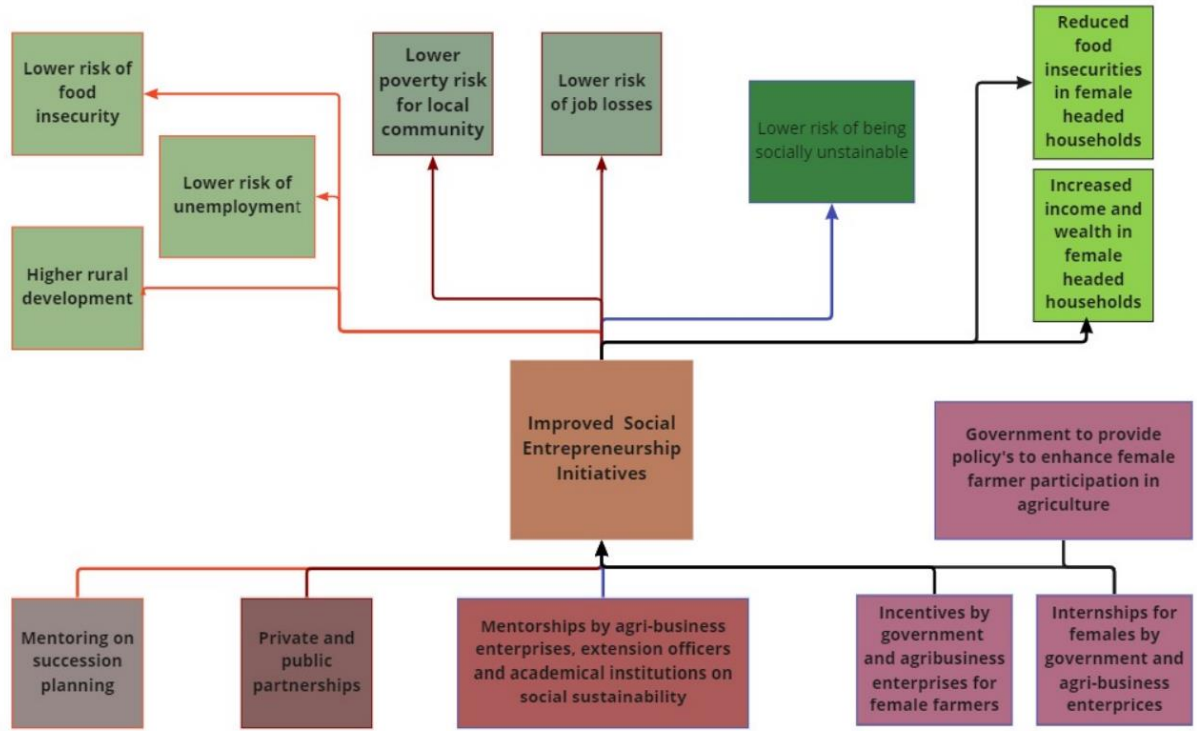


Figure 33: Objective tree (proposed by industry experts for NGFCFs regarding social sustainability)

Industry experts suggested that technical advisors from agribusiness enterprises mentor NGFCFs on the importance of succession planning. “This means an institutional unit in its capacity as a producer of agricultural goods and services with autonomy in respect of financial and investment decision making, as well as authority and responsibility for allocating resources to produce agricultural goods and services” (Law Insider, 2022). The first cause identified was a lack of succession planning. They highlight the fact that not having succession planning in place increases their risk of food insecurity (Hicks *et al*., 2012) and becoming unemployed (Olufemi, 2021; Ntshangase *et al.*, 2016). By having proper succession planning in place, NGFCFs can also contribute to the development of their local community.

The industry experts also suggested that NGFCFs enter into private and public partnerships to lower poverty risks for their local community and lower the risk of job losses. Some of the potential partnerships include AgricultSURE, Schoeman Boerdery, (Zamukele project), PepsiCo, Total SA, Sasol, Rhodes Food Group, Cofco International, Bunge, Cargill, Glencore, The Coca-Cola Company, Nestle, Danone, Heineken, Kellogg Company, SABMiller, Clover, Tongaat-Hulett, Parmalat, Pioneer Foods, Illovo Sugar, Rainbow Chicken, FarmSol, Farm2Fork

and Saffricon. With partnerships, it's important to consider these factors, namely whether it plays a role in capacity building, technical support, financial assistance, learning and research (Ngaka and Zwane, 2018).

Industry experts suggested that NGFCFs are mentored by agribusiness enterprises, extension officers, and academic institutions to achieve social sustainability. The aim is that the necessary knowledge and skills are transferred to the NGFCFs, enabling them to understand: the need for change to a sustainable way of doing things, individually and collectively, to have sufficient knowledge and skills to decide and act in a way that favours sustainable development, and finally be able to recognize and reward other people's actions and decisions that enhance social sustainability (Parkin *et al*., 2004). NGFCFs, being equipped with the necessary knowledge and skills, should help lower the poverty risk for local communities, lower the risk of food insecurity, lower the risk of job losses, and achieve social sustainability.

The industry experts' suggestions to address the lack of female farmers were mentorships and internships for females, incentives by agribusiness enterprises for female farmers, and improved marketing of opportunities for women. The end goal is to reduce food insecurities and increase income and wealth in female-headed households. In South Africa, the female entrepreneur award by the Department of Agriculture, Forestry and Fisheries (DAFF) sponsored by Total South Africa is one of the incentives (financial reward) to acknowledge, encourage and increase the participation of women in agriculture and to integrate emerging women entrepreneurs or farmers to commercial level with the vision of them being able to export farm produce. It highlights the important fact that women play a significant role in food security, job creation, economic growth and poverty alleviation (Ljatuyi and Oladele, 2017). Other types of incentivising for female farmers to improve social sustainability includes: growers' contracts specific for female farmers, rewarding successful female growers by enlarging their growers' contracts based on their success, providing longer repayment terms and lower interest rates on financed agricultural inputs and machinery, providing off-take agreements where inputs like; seed, fertilizer, crop protection, seed treatment, fuel and crop insurance are financed, and technical advice are provided for successful female farmers to enhance their social sustainability. Incentives like these can improve living standards, useful for household and rural development, enabling them to improve their productivity (Wagan *et al*., 2016). It is essential for food security and job creation (G20 Global Partnership for Financial

Inclusion (GPFI), 2015). It enables rural households to meet unexpected expenses and social demands, such as food, school fees, health care, and funeral expenses, without diverting financing from investment opportunities (Agar, 2011).

The FAO's women and population division's sustainable development department recommended that policymakers measure, review and re-orient government policies to ensure that the problems that constrain the role of women in food security are addressed. The suggestion to governments included: ensuring that women have equal opportunities with men to own land; tailoring agricultural services to women's needs; the use of incentives to encourage the production of crops, and promoting the adoption of appropriate inputs and technology to free up women's time for income-producing activities; improve the nutritional status of women and children; provide better employment and income earning opportunities; and promote women's organizations (FAO, 2011).

Internships for females by governments and agribusiness enterprises in the agricultural sector will improve woman's success as NGFCFs. It will help them gain valuable work experience, give the women time to explore the opportunities farming could provide them, provide opportunities to develop and refine essential skills, they will gain confidence, network with professionals in the field, and it will serve as a stepping stone to transition into a job (Fremont University, 2022).

6.4.1.3. Conclusion social sustainability

In the logframe analysis, industry experts identified a lack of social entrepreneurship initiatives as the core problem hindering social sustainability. The industry experts identified the causes of a lack of social entrepreneurship initiatives as a lack of succession planning, a lack of local business investment, a lack of specialized socially sustainable agriculture education, and a lack of female farmers.

After identifying the problems, the industry experts identified six activities that they believed would enable emerging farmers to become socially sustainable commercial farmers. The six main activities include: mentoring and succession planning; private and public partnerships; mentorship provided by agribusiness enterprises, extension officers and academic institutions on social sustainability; internships for females by government and agribusiness enterprises;

incentives by government and agribusiness enterprises for female farmers; and policies designed by the government to enhance female farmer participation in agriculture.

6.5. CONCLUSION ON THE VIEWS OF INDUSTRY EXPERTS ON THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS

In this chapter, the researcher aimed to get views from industry experts on how to improve the sustainability of NGFCFs so that they can help themselves to become sustainable commercial farmers. Industry experts' views on NGFCFs were discussed under the three principles of sustainable agriculture: economic-, environmental-, and social sustainability.

The industry experts identified seven main activities that they believed would enable NGFCFs to become economically sustainable and profitable commercial farmers. These seven main activities include: taking out crop insurance, implementing climate-smart agriculture methods, sharing machinery, setting up exchange banks for machinery between the NGFCFs in the Zamukele project, contracting machinery operators, making use of contract farming options like off-take agreements and implementing the main activities identified by the industry experts successfully would improve their chances of owning title deeds.

The industry experts identified six main activities that they believed would enable NGFCFs to become environmentally sustainable commercial farmers. These six main activities are: making use of subject-specific advice; the training of technical advisors on sustainable agricultural practices; attending farmers days and experimental plots on sustainable agricultural practices and technology; making use of conservation agricultural and precision agricultural techniques; implementing crop life international procedures for the disposal of empty crop protection containers.

The industry experts identified six main activities that they believed would enable NGFCFs to become socially sustainable commercial farmers. These six main activities are: mentoring on succession planning; private and public partnerships; mentorship by agribusiness enterprises, extension officers and academic institutions on social sustainability; incentives by government and agribusiness enterprises for females; internships for females by government and

agribusiness enterprises in the agricultural sector; and finally government to provide policies to enhance female farmers participation in agriculture.

CHAPTER 7

CONCLUSION & RECOMMENDATIONS

7.1. CONCLUSION AND SUMMARY

The author accepted the hypothesis that “New Generation Future Commercial Farmers (NGFCFs) will be profitable, environmentally-, and socially sustainable by applying sustainable agricultural principles”.

This study aimed to explore further problems emerging farmers face in the South African context from the perspective of NGFCFs, commercial farmers, and industry experts. Furthermore, the study aimed to give actionable recommendations to NGFCFs to improve their sustainability. A Model (NGFCFs Model) was developed to guide all role players, including the role agribusiness partners and the government plays in this process, on how to help emerging farmers progress to become sustainable New Generation Future Commercial Farmers.

From the NGFCF’s perspective, economic sustainability was hindered by difficulty accessing finance and the lack of extension officer support. Because of a lack of finance, emerging farmers also found it problematic not to own their own machinery. Not owning their machinery resulted in them needing to wait for contractors, which led to them not harvesting at the ideal time. Cost factors viewed as problematic by NGFCFs included the cost of labour, contractor fees, and the cost of leasing agricultural farmland. Commercial farmers agreed that contractor fees and leases of agricultural farmland are problematic for emerging farmers. In addition, the commercial farmers highlighted direct input costs and farm instalments as problematic for emerging farmers from their perspective.

The study delved deeper into the factors hindering the economic sustainability of NGFCFs by capturing the views of industry experts via a logframe analysis. In line with the views of NGFCFs that lack of finance is one of their biggest problems, the analysis revealed low profitability as the core problem identified by the industry experts. After identifying the core problem, the industry experts pinpointed possible causes of low profitability. Severe weather conditions, lack of owning machinery, and low collateral value were identified as factors causing low profitability. These findings are again in line with the view of NGFCFs that not

owning their own machinery and not being able to access finance are some of their biggest concerns.

After identifying the problems, the industry experts put forth seven actionable solutions to enable NGFCFs to become economically sustainable and profitable. The solutions identified were for the NGFCFs to acquire crop insurance, engage in climate-smart agriculture, share machinery, use contract machine operators, exchange banks for machinery, use contract growing, and own title deeds.

The main problem related to environmental sustainability identified from the perspective of NGFCFs is the lack of guidance from extension officers to help the farmers implement sustainable agricultural practices. Few farmers received proper guidance from qualified extension officers on best management practices to prevent soil erosion, improve soil health and fertility, use correct crop protection products, and guidelines to store these products safely and discard empty containers. There was also a lack of advice on using crop rotation, cover crop options available, taking soil samples, and using correct tillage options, crop protection chemicals, and cultivars. Implementing sustainable agricultural practices such as rotating crops, testing soils, balancing soil nutrients, using a balanced fertilizer program, and correcting soil pH, were identified by commercial farmers as important for environmental sustainability.

NGFCFs lacking in implementing sustainable agricultural practices were identified as the core problem affecting environmental sustainability by the industry experts in the logframe analysis. The causes of NGFCFs not implementing sustainable agricultural practices were identified by industry experts as a lack of utilizing advice, a lack of education on soil erosion, the use of conventional farming practices, a lack of maintaining soil fertility, and careless disposal of empty crop protection containers. Given the lack of extension support, a lack of advice rather than a lack of utilizing advice is probably more accurate. In addition, all these causal factors highlighted by the industry experts can be mitigated by proper support from extension officers.

In line with the findings around the importance of extension support, the actionable solutions proposed by the industry experts centred around educational interventions. The solutions

included using subject-specific advice, training technical advisors on sustainable agricultural practices, farmers days and experimental plots, using conservation- and precision agricultural techniques, and implementing crop life international procedures for the disposal of empty containers.

Finally, rural development has been recognized as a key factor in promoting social sustainability. Farmers can influence rural development by supporting and becoming involved with the local communities. The results made it apparent that local families lack support from the emerging farmers participating in the study. Although all the NGFCFs indicated that they provide part-time jobs to local families, less than half provided full-time jobs, and even fewer helped with logistics or provided training to these families. Commercial farmers viewed providing training as particularly important for promoting social sustainability.

In the logframe analysis, industry experts identified a lack of social entrepreneurship initiatives as the core problem hindering social sustainability. The industry experts identified the causes of a lack of social entrepreneurship initiatives as a lack of succession planning, a lack of local business investment, a lack of specialized socially sustainable agriculture education, and a lack of female farmers.

After identifying the problems, the industry experts identified six activities that would enable emerging farmers to become socially sustainable NGFCFs. The six main activities include: mentoring and succession planning; private and public partnerships; mentorship provided by agribusiness enterprises; extension officers and academic institutions on social sustainability; internships for females by government and agribusiness enterprises; incentives by government and agribusiness enterprises for female farmers; and policies designed by the government to enhance female farmer participation in agriculture.

The NGFCFs Model proposed (under recommendations) will help create sustainable commercial farmers, which is essential to achieve sustainable food production, as set out by the United Nations (2015) Sustainable Development Goals (SDGs). Therefore, sustainable food production by NGFCFs will be critical in supporting the needs of the present and future generations. Additionally, sustainable NGFCFs will help the South African government achieve its National Development Plan (National Planning Commission of South Africa, 2017) for

agriculture to play an important role in rural economic development and natural resources management and significantly contribute to household food security and improved nutrition.

7.2. RECOMMENDATIONS

7.2.1. Introduction

A Model (NGFCFs Model) was developed to guide all role players, including the role agribusiness partners and government plays in this process, on how to help emerging farmers progress to become sustainable commercial farmers.

The NGFCFs Model will focus on emerging farmers (producers), growing row crops (produce) under an off-take agreement (agribusiness partner), and will also consider the government (policy maker and service provider). The off-taker drives the model.

7.2.2. Requirements for producers (emerging farmers) to be part of the model

7.2.2.1. The profile of the producer

The producer must already be a sustainable emerging farmer with a background in farming and preferably grew up on a farm. In addition, the producer must have a passion for farming, be enthusiastic about farming, have people skills, and be able to build long-lasting relationships.

7.2.2.2. Market Access

The producer must already have access to formal or informal markets for his current product portfolio. Market access is essential to become NGFCFs as it provides cash flow, employment, and food security for the farmer and the local community. Additionally, it shows the producer's marketing skills, understanding of price fluctuation, and market trends for produce.

7.2.2.3. Natural resources

It's essential to have a title deed for the farm or a long-term lease contract, forming part of the farmer's risk profile for investors and partners. Additional information regarding the farm's natural resources includes soil classification (potential) information, soil chemical en biological analysis, water quality analyses and quantity allocations/access, climatological

information, and GPS farm maps. The additional information can form part of the agribusiness partner's service to be provided.

7.2.2.4. Infrastructure

Basic infrastructure is important for logistics, market access, communications, production, and processing. This includes access to roads to the farm, markets and agribusiness partners, power supply to the farm (Eskom/generators), and access to communication (telecommunication, cell phone, Wi-Fi, and internet). Infrastructure development forms part of the government's role and initiatives to help sustainable development. Agribusiness partners can also form part of a solution to infrastructure development.

7.2.2.5. Farming equipment

Basic farming equipment is required for the effective and timely production and harvesting of farming produce. Essential farming equipment can also be contracted, shared, exchanged, or provided by agribusiness partners as part of the off-take agreement costs. Basic farming equipment will differ from farm to farm, the type of soil and crop produced. The basic farming equipment will include tractors, planters, harvesters, crop sprayers, tillage equipment, and trailers.

7.2.2.6. Insurance

The farmer should have crop insurance to lower his risk and that of his agribusiness partners. Crop insurance could also be part of the government's role, providing a loan to emerging farmers to help finance operational costs. The emerging farmer will be required to pay back the loan on fulfilment of his off-take agreement.

7.2.2.7. The key factors for producers to become NGFCFs

The key factor will have the most significant impact in helping speed up the process and improve the success of establishing NGFCFs in the agribusiness sector. The key factors when it comes to the producers are that they must already be sustainable emerging farmers with a background in farming and preferably grew up on a farm. In addition, the producer must have a passion for farming, be enthusiastic about farming, have people skills and be able to build long-lasting relationships.

7.2.3. Requirements for agribusiness partners to be part of the model

7.2.3.1. The requirements and actions that the off-taker (OT) should take and put in place before putting an off-take agreement (OTA) in place

i. Only provide an OTA to successful emerging farmers, according to the requirements for producers (emerging farmers) to be part of the model.
ii. Make sure that the projects are economically viable by considering the distribution of growers, the scale of production and funding requirements.
iii. Have contracts with agribusiness partners, providers of agricultural inputs, services, and technical support required for the producers under the OTA, which the off-taker can't provide. Agricultural input supplies are required for direct inputs like seed, seed treatment, fertilizers, fuel, etc. Service providers are required to provide: logistics; funding; crop insurance; precision farming services; contractors to assist with farming activities like planting, tillage, and harvesting; and a list of already successful emerging farmers that can potentially be part of the project and evaluate the potential successful emerging farmers to be part of the project. Technical support providers are required throughout the agribusiness value chains, including government extension officers supporting producers under the off-take agreement with sustainable technical support and advice.
iv. Have a project manager and a service agreement with a service provider for the project if the off-taker does not fill this function.

7.2.3.2. What the off-take (OT) should provide

i. An OTA to the successful emerging farmers
ii. Project manager for the project
iii. Technical support (crop production, fertilizer recommendation, crop protection and irrigation)
iv. Services (soil classification, soil sampling, leaf analyses, GPS mapping, etc.)
v. Logistical support to deliver inputs provided and deliver crops grown under OTA to the delivery point
vi. Direct inputs (seed, seed treatment, fertilizer, crop protection, etc.)
vii. Crop insurance or faciliatory with the government to arrange for crop insurance loans or security to successful emerging farmers in the project

viii. Training in sustainable agricultural practices or arranging with partners to provide this training/education

ix. Negotiate with agribusiness partners in the value change and government for incentives (Internships, excursions to Agri-input suppliers, study burses, lower interest rates, etc.)

7.2.3.3. The off-taker (OT) to provide an off-take agreement (OTA) that specifies:

i. The agricultural produce (crop) required

ii. Delivery address

iii. The effective date of the contract

iv. Quality contracted/estimated

v. Grading requirements

vi. Quantity specifications

vii. Deviation allowance

viii. Agricultural crop protection chemical declaration (Use and limitations of crop protection actives within the agricultural act (Act 36 of 1947)

ix. Deductions

x. Price per ton

xi. Payment terms

xii. Inputs provided: seed, seed treatment, fertilizers, crop protection

xiii. Logistics provided: transport of inputs to the farm and produce delivered to the delivery point

xiv. The interest rate charged on inputs provided

7.2.3.4. Key factor for agribusiness partners to help establish successful emerging farmers

A project manager with extensive knowledge, insights, skills, and experience in the agricultural value chain will play an essential part in successful projects. Such a project manager can help coordinate resources and tasks that will result in a defined objective within a set timeframe and budget and ensure that the scope is reached. In addition, the project manager will be able to identify potential risks and make recommendations to address them and will also be able to put strategies in place to improve the current project protocol. The project manager also

plays an essential role for all parties involved in the value chain (producers, agribusiness partners and government) to inform them of the project's challenges and expected outcomes.

7.2.4. Government's role

7.2.4.1. The role government plays in effectively establishing New Generation Future Commercial Farmers

i. **Title deeds:** Often, emerging farmers do not have the title deeds to the land they cultivate, making accessing financial services difficult and slowing their progress to evolve to commercial farmer status. Owning title deeds would provide NGFCFs with higher collateral that would improve their ability to apply for loans, expand their farming enterprises, and help them become more profitable. The benefits of owning title deeds include better access to formal credit, higher land values and investment in land, and higher output leading to higher income.
ii. **Provide infrastructure:** Telecommunication, Wi-Fi and internet access, power (electricity), roads, railroad, and ports.
iii. **Impose import tariffs** to protect domestic producers and industries.
iv. **Providing loans or security** to successful emerging farmers to finance their operational costs (crop insurance, labour cost and power (electricity)). The loan is to be paid back on fulfilment of OTA.
v. **Providing Extension officers**: Providing sufficiently qualified extension officers, educated and mentored on sustainable agriculture. Unfortunately, the ratio of extension officers is too low (1,147 farmers: 1 extension agent), resulting in farmers experiencing difficulties accessing imperative information for farm management. It is required that the government's extension officers advise on economic sustainability, environmental sustainability, social sustainability, crop rotation, cover crop options, soil samples, correct tillage options, correct crop protection chemicals and – cultivars.
vi. **Internships in the agricultural sector:** It would improve emerging farmers' success, help them gain valuable agricultural-related work experience, provide opportunities to develop and refine essential skills, gain confidence, and network with professionals in the agricultural field.

vii. **Review and re-orient government policies** to ensure that the problems that constrain the role of women in food security are addressed. The suggestion to governments included: the implementation of incentives to encourage crop production, the adoption of suitable inputs and technology to free up women's time for income-producing activities, improving the nutritional status of women and children, providing better employment and income earning opportunities, and promoting women's organizations.

7.2.4.2. Key factor for government to help establish New Generation Future Commercial Farmers

Providing sufficiently qualified extension officers, educated and mentored on sustainable agriculture and providing loans to cover the operational costs like crop insurance, labour cost and the cost of power (electricity).

7.3. NGFCFs MODEL

The researcher proposes a model which is called the NGFFCF. This model serve as a contribution for the study because it is original. The purpose of the model, is to get agricultural input suppliers who are mainly focused on commercial farmers, involved in the development of emerging farmers. The purpose of the model will be achieved by using Laeveld Agrochem (Pty) Ltd, where I currently work, to motivate other agricultural input suppliers to be part of this movement to help develop emerging farmers to become sustainable commercial farmers. The NGFCFs model is driven by the off-taker (OT) providing an off-take agreement (OTA) to a group of already successful emerging farmers growing row crops under the OTA. The NGFCFs model will help establish emerging farmers as NGFCFs (Figure 34).

Action 1: The off-taker (OT) will provide the requirements for producers (emerging farmers), agribusiness partners (input suppliers, technical support, services, etc.), and the government will be part of the off-take agreement. The OT determines the risk of the project and sets a financial budget for the project.

Action 2: The OT provides the project manager (PM) to manage and coordinate total supply chain activities and manage the project's risk and budget.

Action 3: The OT will get contracts with essential service providers (evaluation) that can provide a list of already successful emerging farmers that can potentially comply with the requirements for producers set out by OT. The service providers, in conjunction with the project manager, will determine the successful group of emerging farmers that will be part of the project. The OT also negotiates with essential services and provides incentives for performing growers. Government form part of essential service providers.

Action 4: The OT and essential service providers (evaluation) determine the services and the technical and production needs of successful emerging farmers to be addressed by the OT.

Action 5: The OT will get contracts with essential service providers (services, technical and production) that are required to address the logistics, funding, crop insurance, precision farming services, planting, tillage and harvesting needs of emerging farmers in the project. The OT also negotiates with essential services and provides incentives for performing growers. Government form part of the essential service providers.

Action 6: The OT will get contracts with essential inputs suppliers, supplying seed, seed treatment, fertilizer, crop protection, fuel, etc., required for the project. The OT to also negotiate incentives for performing growers with essential input suppliers.

Action 7: The OT will get contracts with essential technical support providers. It can be government extension officers, technical support provided by input suppliers, academic institutions, research institutions or technical support provided by the OT. The contractor should also provide technical support, including training on sustainable agricultural practices. The OT should also negotiate incentives for performing growers with essential technical support suppliers.

Action 8: The OT will provide OTAs to successful emerging farmers.

Action 9: Successful emerging farmers will fulfil their financial obligation towards the OT, government or any other party that provided financial support.

Action 10: The OT will give incentives to performing growers.

Action 11: The OT will provide new OTAs to successful emerging farmers that were able to fulfil their OFA and transition to commercial farmer status. The OT will start the process again to allow the project to grow.

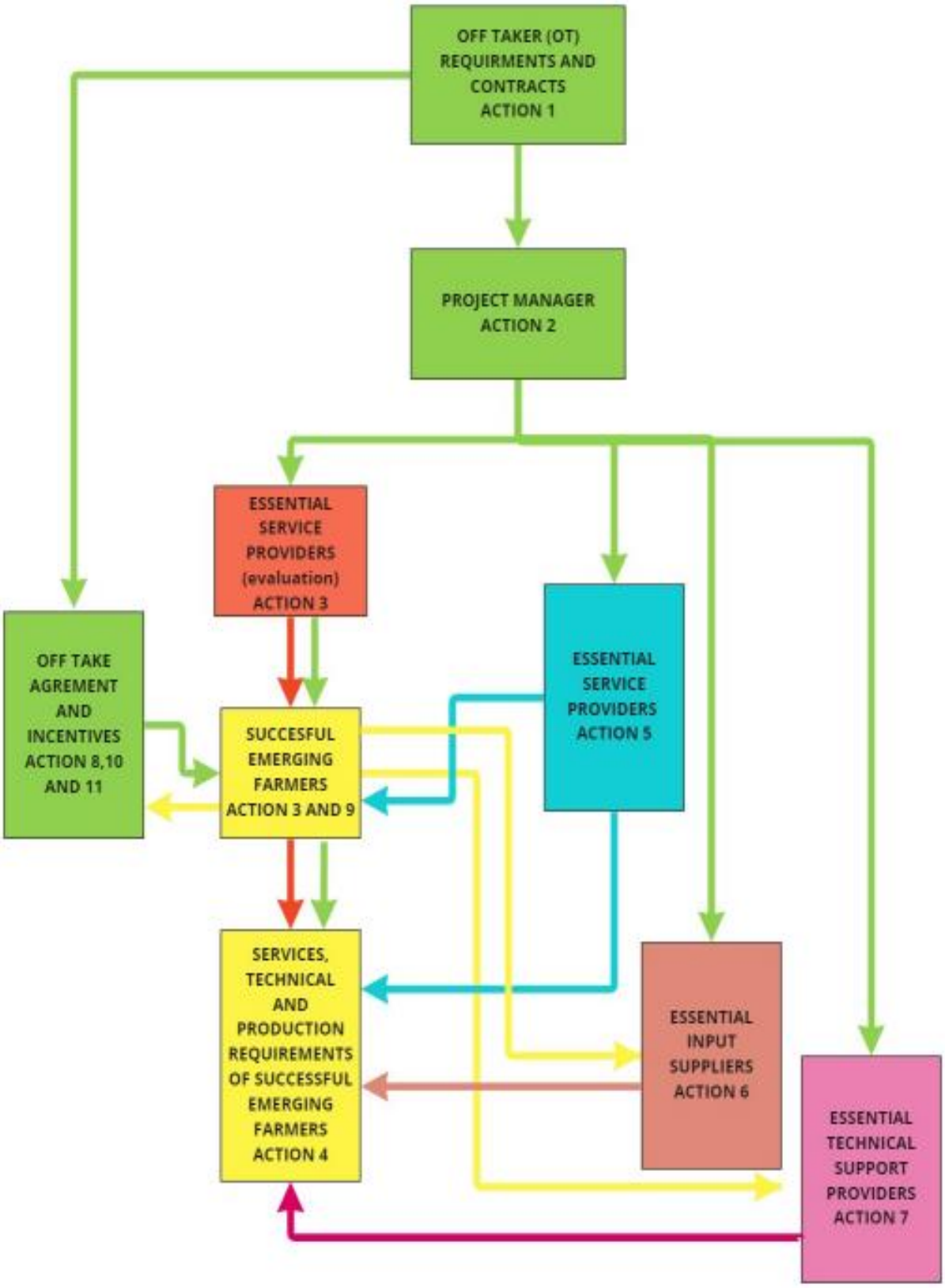


Figure 34: NGFCFs Model

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APPENDIX 1

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES (UFS)

FAKULTEIT NATUUR- EN LANDBOUWETENSKAPPE (UV)

CENTER FOR SUSTAINABLE AGRICULTURE

SENTRUM VIR VOLHOUBARE LANDBOU

PHD

QUESTIONNAIRE

THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS IN SOUTH AFRICA, A CASE STUDY DONE IN THE NORTH-WEST PROVINCE OF SOUTH AFRICA.

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Questionnaire	**A**
No:	

THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS IN SOUTH AFRICA, A CASE STUDY DONE IN THE NORTH-WEST PROVINCE OF SOUTH AFRICA.

INFORMATION LEAFLET:

Mainstreaming sustainable agriculture systems in South Africa has become imperative. However, for South African farmers to be sustainable and economically viable, the agricultural production and management paradigms must be changed (Smith *et al*., 2017).

For New Generation Future Commercial Farmers in South Africa to be part of the SDG and NDP, they need to be economically viable and profitable. Additionally, they must implement effective farming practices that are environmentally sound and socially acceptable for the consumers (Abubakar *et al.*, 2013; STATS SA, 2017a; STATS SA, 2017b). However, the sustainability of New Generation Future Commercial Farmers (NGFCFs) is being hindered by climate changes (Reganold *et al.*, 2016), lack of education and extension education (Mukwevho *et al.*, 2014), lack of capital assets (Kamara *et al.*, 2019) and infrastructure (Patel, 2016), cost of mechanisation, access to financing (Ajah, 2014), and poor governance and policy (Brown and Crawford, 2009). The South African government reported that land reform policies had been implemented with little or no coordinated support to small- and predominantly black farmers. The report highlighted that many small farmers lack the collateral required to secure bank loans and basic financial and business management skills to develop the land into a viable and successful business (The Government of the Republic of South Africa, 2019).

HYPOTHESIS

"New Generation Future Commercial Farmers (NGFCFs) will be profitable, environmentally sound, and socially acceptable by applying sustainable agricultural principles."

OBJECTIVES

(a) To test the study's hypothesis of whether (NGFCFs) applying sustainable agriculture principles will be sustainable.

(b) The study will evaluate NGFCFs and commercial farmers under the three principles of sustainable agriculture. Inputs from industry experts on the sustainability of New Generation Future Commercial Farmers will also be included.

(c) New Generation Future Commercial Farmers (NGFCFs) will be evaluated on their sustainability.

(d) Commercial farmers' views on the sustainability of New Generation Future Commercial Farmers will be evaluated.

(e) Industry experts' views on the sustainability of New Generation Future Commercial Farmers will be evaluated.

WHAT IS THE NATURE OF PARTICIPATION IN THIS STUDY?

Your participation will be divided into two. Firstly, a questionnaire that will take 30-45 minutes to complete with questions about your feedback on your farming enterprise's economical-, environmental – and social sustainability. Secondly, a Logframe analysis will be done in group form; the duration is roughly 1-2 hours.

INSTRUCTIONS:

Please answer all the questions. If you are unsure of what is expected of you from any question, please ask the researcher for help.

Mark the appropriate block with an X, or write your answer in the provided space where applicable.

NB some questions will have the phrase “select all that apply” you can thus mark multiple options.

Where the option is “other, specify”, please provide your own opinion/answer.

Please note that the information provided will be treated with the highest degree of confidentiality.

INTERVIEWER DECLARATION:

I, ……., declare that I have asked this questionnaire as it has been laid out. I declare that all responses which have been recorded are the true responses of the respondent and that I have fully checked the questionnaire.

Signature: …….

Date: ……

PARTICIPANT CONSENT:

I, ……., agree to take part in the survey. I understand that my responses to this survey will be treated with the strictest confidence. Furthermore, I understand that I will not receive any compensation for participating in this study.

Signature: …….

Date: ……

SECTION A: DEMOGRAPHIC - AND BACKGROUND INFORMATION

To be completed by New Generation Future Commercial Farmers.

Contact number: _____

Date: _____

Name of farm/project: _____

Area/location of farm/project: _____

Instructions: Mark the appropriate block with an X or write your answer in the provided space where applicable.

1. Gender:

Male	1
Female	2

2. Age:

18-20	1
21-25	2
26-30	3
31-35	4

36-40	5
41-50	6
51-60	7
61 or older	8

3. What is your highest qualification?

Never been to school	1
Grade R to grade 8	2
Grade 9 to grade 12	3
Matriculated	4
National certificate	5
Tertiary qualification	6

4. How long have you been farming in this area?

Less than 5 years	1
More than 5 years, but less than 10 years	2
More than 10 years, but less than 20 years	3
More than 20 years	4

5. Do you have any dependents?

Yes	1
No	2

6. If yes to question 5, how many dependents do you have?

SECTION B: ECONOMICAL SUSTAINABILITY

7. How many hectares in total do you plant?

---Ha

8. What crop do you farm other than dry deans (select all that apply)?

Maize	1
Sunflower	2
Soybeans	3
Groundnuts	4
Other, describe. ---	5

9. How many hectares are planted under dryland small white dry beans?

---Ha

10. Is farming your primary source of income?

Yes	1
No	2

11. What other source of income do you have outside of farming?

---

12. What % does farming make up of your annual income?

Less than 30%	1
31-50%	2
51-70%	3
71-90%	4
More than 90%	5

13. If you want to grow your farming enterprise, is there enough land available on the market that you can access to do so?

Yes	1
No	2

14. What is your average long-term dryland small white dry bean yield kg/ha?

Less than 500kg/ha	1
501-1000kg/ha	2
1001-1500kg/ha	3
1501-2000kg/ha	4
>2000kg/ha	5

15. According to you, how many hectares under dry land crops in your area would form an economic unit?

    ----------ha

16. According to you, what would be the most important factors to consider for increasing your productivity? Please indicate how much you agree with the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Making use of qualified advice could increase productivity					
Making use of crop protection products could increase productivity					
Planting at the optimal date could increase productivity					
Harvesting at the optimal time could increase productivity					
Planting with quality and adapted seeds for your area could increase productivity					
Doing soil surveys to determine the best soil for crops could increase productivity					
Doing soil sampling and fertilizing accordingly could increase productivity					
Correct soil tillage practices could increase productivity					

17. What factors are hampering your ability to farm sustainably? Please indicate how much you agree with the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Availability of land on the market hampers the ability to farm sustainably					
Difficulty accessing finance hampers the ability to farm sustainably					
Their lack of farming experience hampers their ability to farm sustainably					
Lack of extension officer support hampers the ability to farm sustainably					
Other, specify. _____					

18. What value does the Schoeman Boerdery bring to your farming enterprise? Please indicate how much you agree with the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
HSB brings a dedicated team of technical and operational support					
HSB brings access to the market					
HSB brings relevant research and best-practice advice					
HSB brings logistical assistance					
HSB brings assistance with the financing and procurement of seed					
HSB brings assistance with the procurement and fertilizer inputs and the set-up					
HSB brings knowledge of the price you earn (Price/Ton) for your crop at the onset of the season					
Other, specify. _____					

19. Regarding the use of seeds, do you hold some of the harvest seeds back to use next season?

Yes	1

No	2

20. Regarding the use of seeds, do you plant with seeds provided by HSB?

Yes	1
No	2

21. How long do you store the seeds if you use your held-back harvest seeds to plant?

---------- months.

22. If you use your own held-back harvest seeds to plant, are your yields?

Lower	1
Higher	2
The same as seeds provided by HSB	3

23. What is the advantage of using seeds provided by HSB (select all that apply)?

Better yields	1
Lower cost for crop protection	2
Better germination	3
Even plant density	4
Other, specify. ----------	5

24. Do you make use of financing?

Yes	1
No	2

25. What is your biggest cost? Please indicate how much you agree with the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Interest payable on loans is a big cost					
Lease of agricultural farmland is a big cost					
Farm instalments are a big cost					
Direct input cost (seed, fertilizer etc.) is a big cost					
Labour cost is a big cost					
Contractor fees are a big cost					
Other, specify. _____					

26. Do you make use of financing?

Yes	1
No	2

27. If yes to question 26, what do you finance (select all that apply)?

Farmland	1
Machinery	2

Direct farm inputs seed, fertilizers, diesel etc.	3
Other, specify. ----------	4

28. What type of financing do you use (select all that apply)?

Landbank	1
Commercial Bank	2
Co-Op	3
Off-take agreement	4
Other, specify. ----------	5

29. Would you rather make use of finance to?

Buy a farm	1
Lease farmland	2

30. According to you, what is the single most important factor that influences your economic viability?

---

31. Do you make use of contractors?

Yes	1
No	2

32. If yes to question 31, what do you use the contractors for (select all that apply)?

Primary tillage	1
Seedbed preparation	2
Planting	3
Spraying crop protection inputs	4
Applying of fertilizers	5
Harvesting	6
Logistics to deliver the harvest to market	7
Other, specify. ----------	8

33. Do you plant during the optimal planting window for dry beans?

Yes	1
No	2

34. If the answer is no to question 33, what is the reason for harvesting outside the optimal harvesting window (select all that apply)?

Seedbed preparations were not completed in time	1
Waiting on contractor	2
Lack of finances	3

Do not have seed	4
Other, specify. ----------	5

35. Do you tend to be proactive or reactive in your response to crop protection?

Proactive	1
Reactive	2

36. If you are reactive, what is the reason for your answer (select all that apply)?

Lack of finances	1
Lack of equipment to apply products	2
Lack of understanding the crop-protecting products	3
Other, specify. ----------	4

37. Do you harvest at the optimal time?

Yes	1
No	2

38. If your answer is no to question 37, what is the reason for not harvesting during optimal dates (select all that apply)?

Do not own harvesting equipment	1
Waiting on contractor	2
Lack of finances	3
Hectares are too small to harvest with a mechanical harvester	4
Other, specify. ----------	5

39. Do you have the necessary facilities to store seeds under cool, dry conditions?

Yes	1
No	2

SECTION C: ENVIRONMENTAL SUSTAINABILITY

40. Do you use qualified people to advise you on sustainable agricultural practices?

Yes	1
No	2

41. Do you do crop rotation?

Yes	1
No	2

42. What type of crop protection products do you make use of?

Chemical	1
Biological	2
Combination of chemical and biological products	3
No crop protection is being done	4

43. What type of fertilizers do you use?

Chemical	1
Organic	2

Combination of chemical and organic fertilizers	3
No Fertilizers	4

44. What type of tillage do you make use of?

Conventional	1
No-Till	2
Minimum Till	3
Other Specify ----------	4

45. What steps do you take to prevent soil erosion?

---

46. What steps do you take to improve soil health (select all that apply)?

Apply organic amendments	1
No-tillage	2
Growing cover crops	3
Crop rotations	
Other, specify. ----------	4

47. What steps do you take to improve soil fertility (select all that apply)?

Soil testing	1
Correcting soil pH (liming)	2
Balancing soil nutrients according to crop needs	3
Applying a balanced fertilizer program according to crop specialists' recommendation	4
Other, specify. ----------	5

48. Do you use a qualified person for advice on crop protection products?

Yes	1
No	2

49. Do you follow the instructions on the label for the use and application of crop protection products?

Yes	1
No	2

51. According to you, what would be the most important factor in looking after the environment? Please indicate how much you agree with the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Making use of qualified people to advise you on sustainable agricultural practices is an important factor					
Taking the necessary steps to prevent soil erosion is an important factor					
Taking steps to improve soil health is an important factor					
Using soil analysis to base fertilizer programs on is an important factor					
Following guidelines to store crop protection products safely is an important factor					
Following guidelines to discard empty crop protection containers safely is an important factor					
Other, specify. _____					

SECTION D: SOCIAL SUSTAINABILITY

52. Do you support other businesses in the local community?

Yes	1	
No	2	

53. Do you support other families in the local community?

Yes	1	
No	2	

54. If yes to question 52, how do you support other families in the local community (select all that apply)?

Do not support them	1
Provide housing	2
Provide part-time jobs	3
Provide full-time jobs	4
Provide infrastructure like schools	5
Provide logistics (transport to and from work)	6
Provide training to improve skills to improve work efficiency	7

Other, specify. ----------	8

55. Do you have succession planning in place?

Yes	1
No	2

56. How important do you think the following statements are to your sustainability? Please indicate how much you agree with the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
It is important to support other businesses in the local community					
It is important to support other families in the local community.					
It is important to make use of labour from your local community.					
It is important to have a succession agreement plan in place for your farming enterprise					
It is important to provide a safe environment for your workforce					
Other, specify. _____					

57. Do you think it is important to get regular visits from government extension officers to guide you on sustainable farming practices?

Yes	1
No	2

58. Do you get regular visits from your government extension officers to guide you?

Yes	1
No	2

59. Does your government extension officer provide sound advice that you can use to be more sustainable?

Yes	1
No	2

60. If yes to question 58, what advice do they provide (specify)?

APPENDIX 2

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES (UFS)

FAKULTEIT NATUUR- EN LANDBOUWETENSKAPPE (UV)

CENTER FOR SUSTAINABLE AGRICULTURE

SENTRUM VIR VOLHOUBARE LANDBOU

PHD

QUESTIONNAIRE

THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS IN SOUTH AFRICA, A CASE STUDY DONE IN THE NORTH-WEST PROVINCE OF SOUTH AFRICA.

Researcher: PHILLIP VENTER

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Mobile: 076 430 4847

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Questionnaire	**B**
No:	

THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS IN SOUTH AFRICA, A CASE STUDY DONE IN THE NORTH-WEST PROVINCE OF SOUTH AFRICA.

INFORMATION LEAFLET:

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HYPOTHESIS

“New Generation Future Commercial Farmers (NGFCFs) will be profitable, environmentally sound, and socially acceptable by applying sustainable agricultural principles.”

OBJECTIVES

(a) To test the study's hypothesis of whether (NGFCFs) applying sustainable agriculture principles will be sustainable.

(b) The study will evaluate NGFCFs and commercial farmers under the three principles of sustainable agriculture. Inputs from industry experts on the sustainability of New Generation Future Commercial Farmers will also be included.

(c) New Generation Future Commercial Farmers (NGFCFs) will be evaluated on their sustainability.

(d) Commercial farmers' views on the sustainability of New Generation Future Commercial Farmers will be evaluated.

(e) Industry experts’ views on the sustainability of New Generation Future Commercial Farmers will be evaluated.

WHAT IS THE NATURE OF PARTICIPATION IN THIS STUDY?

Your participation will be divided into two. Firstly, a questionnaire that will take 30-45 minutes to complete with questions about your feedback on your farming enterprise's economical-, environmental – and social sustainability. Secondly, a Logframe analysis will be done in group form; the duration is roughly 1-2 hours.

INSTRUCTIONS:

Please answer all the questions. If you are unsure of what is expected of you from any question, please ask the researcher for help.

Mark the appropriate block with an X, or write your answer in the provided space where applicable.

NB some questions will have the phrase “select all that apply” you can thus mark multiple options.

Where the option is “other, specify”, please provide your own opinion/answer.

Please note that the information provided will be treated with the highest degree of confidentiality.

INTERVIEWER DECLARATION:

I, ……., declare that I have asked this questionnaire as it has been laid out. I declare that all responses which have been recorded are the true responses of the respondent and that I have fully checked the questionnaire.

Signature: …….

Date: ……

PARTICIPANT CONSENT:

I, ……., agree to take part in the survey. I understand that my responses to this survey will be treated with the strictest confidence. Furthermore, I understand that I will not receive any compensation for participating in this study.

Signature: …….

Date: ……

SECTION A: DEMOGRAPHIC - AND BACKGROUND INFORMATION

To be completed by commercial farmers.

Contact number: _____

Date: _____

Name of farm/project: _____

Area/location of farm/project: _____

Instructions: Mark the appropriate block with an X or write your answer in the provided space where applicable.

1. Gender:

Male	1
Female	2

2. Age:

18-20	1
21-25	2
26-30	3
31-35	4
36-40	5

41-50	6
51-60	7
61 or older	8

3. What is your highest qualification?

Never been to school	1
Grade R to grade 8	2
Grade 9 to grade 12	3
Matriculated	4
National certificate	5
Tertiary qualification	6

4. How long have you been farming in this area?

Less than 5 years	1
More than 5 years, but less than 10 years	2
More than 10 years, but less than 20 years	3
More than 20 years	4

5. Do you have any dependents?

Yes	1

No	2

6. If yes to question 5, how many dependents do you have?

   ----

7. How many hectares in total do you plant?

   ----------Ha

8. What crop do you farm other than dry deans (select all that apply)?

Maize	1
Sunflower	2
Soybeans	3
Groundnuts	4
Other, describe. ----------	5

9. How many hectares are planted under dryland small white dry beans?

   ----------Ha

10. Is farming your primary source of income?

Yes	1
No	2

11. What other source of income do you have outside of farming?

---

12. What % does farming make up of your annual income?

Less than 30%	1
31-50%	2
51-70%	3
71-90%	4
More than 90%	5

13. If you want to grow your farming enterprise, is there enough land available on the market you can access to do so?

Yes	1
No	2

14. What is your average long-term dryland small white dry bean yield kg/ha?

Less than 500kg/ha	1
501-1000kg/ha	2
1001-1500kg/ha	3
1501-2000kg/ha	4
>2000kg/ha	5

15. According to you, how many hectares under dry land crops in your area would form an economic unit?

    ----------Ha

SECTION B: ECONOMICAL SUSTAINABILITY

NB. YOUR INPUTS IN SECTION B ARE YOUR OPINION ON THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS (NGFCFs)

16. According to you, what would be the most important factor to consider for NGFCFs to increase their productivity? Please indicate how much you agree with the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Making use of qualified advice could increase productivity					
Making use of crop protection products could increase productivity					
Planting at the optimal date could increase productivity					
Harvesting at the optimal time could increase productivity					
Planting with quality and adapted seeds for your area could increase productivity					
Doing soil surveys to determine the best soil for crops could increase productivity					
Doing soil sampling and fertilizing accordingly could increase productivity					
Correct soil tillage practices could increase productivity					

17. What factor/s, according to you, is hampering NGFCF's ability to farm sustainably? Please indicate how much you agree with the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Availability of land on the market hampers the ability to farm sustainably					
Difficulty accessing finance hampers the ability to farm sustainably					
Your lack of farming experience hampers your ability to farm sustainably					
Lack of extension officer support hampers the ability to farm sustainably					
Other, specify. _____					

18. Arrange the value that Schoeman Boerdery, according to you, brings to NGFCFs. Please indicate how much you agree with the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
HSB brings a dedicated team of technical and operational support					
HSB brings access to the market					
HSB brings relevant research and best-practice advice					
HSB brings logistical assistance					
HSB brings assistance with the financing and procurement of seed					
HSB brings assistance with the procurement and fertilizer inputs and the set-up					
HSB brings knowledge of the price you earn (Price/Ton) for your crop at the onset of the season					
Other, specify. _____					

19. Regarding the use of seeds, do you think NGFCFs should hold back some of their harvest seeds to use next season?

Yes	1
No	2

20. Would it be better for NGFCFs to rather make use of seeds provided by HSB than seeds held back from their own harvest seeds?

Yes	1
No	2

21. What do you think the yields would be for NGFCFs if they use their own held-back harvest seeds to plant?

Lower	1
Higher	2
The same as seeds provided by HSB	3

22. What would be the advantage for NGFCFs to use seeds provided by HSB (select all that apply)?

Better yields	1
Lower cost for crop protection	2
Better germination	3
Even plant density	4
Other, specify. ----------	5

23. According to you, what would be NGFCF's biggest cost? Please indicate how much you agree with the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Interest payable on loans is a big cost					
Lease of agricultural farmland is a big cost					
Farm instalments are a big cost					
Direct input cost (seed, fertilizer etc.) is a big cost					
Labour cost is a big cost					
Contractor fees are a big cost					
Other, specify. _____					

24. According to you, what should NGFCFs use financing for (select all that apply)?

Leasing farmland	1
Buying farmland	2
Leasing Machinery	3
Buying farmland	4
Direct farm inputs seed, fertilizers, diesel etc.	5
Other, specify.	6

----------	

25. According to you, what financing should NGFCFs use (select all that apply)?

Landbank	1
Commercial Bank	2
Co-Op	3
Off-take agreement	4
Other, specify. ----------	5

26. According to you, should NGFCFs rather make use of finance to:

Buy a farm	1
Lease farmland	2

27. According to you, what would be NGFCF's single most important factor that would influence their economic viability?

---

28. According to you, what should NGFCFs use contractors for? Please indicate how much you agree with the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Primary tillage should be contracted					
Seedbed preparation should be contracted					
Planting should be contracted					
Spraying crop protection inputs should be contracted					
Applying fertilizers should be contracted					
Harvesting should be contracted					
Logistics to deliver the harvest to market should be contracted					
Other, specify. _____					

29. According to you, should NGFCFs be proactive or reactive regarding crop protection?

Proactive	1
Reactive	2

30. How important is it for NGFCFs to harvest during optimal harvesting time?

Very important	1
Important	2
Not important	3

31. How important is it for NGFCFs to plant during optimal planting time?

Very important	1
Important	2
Not important	3

32. Do you think it is important for NGFCFs to store seeds under cool, dry conditions?

Yes	1
No	2

SECTION C: ENVIRONMENTAL SUSTAINABILITY

NB. YOUR INPUTS IN SECTION C ARE YOUR OPINION ON THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS (NGFCFs)

33. Do you think NGFCFs should use qualified people to advise them on sustainable agricultural practices?

Yes	1
No	2

34. Do you think NGFCFs should do crop rotation?

Yes	1
No	2

35. According to you, what type of crop protection products would be best for NGFCFs?

Chemical	1
Biological	2
Combination of chemical and biological products	3
No crop protection is being done	4

36. According to you, what type of fertilizers would work best for NGFCFs?

Chemical	1
Organic	2
Combination of chemical and organic fertilizers	3
No Fertilizers	4

37. According to you, what type of tillage would be best for NGFCFs to use?

Conventional	1
No-Till	2
Minimum Till	3
Other Specify ----------	4

38. According to you, what steps could NGFCFs take to prevent soil erosion?

---

39. According to you, what steps would be best for NGFCFs to take to improve soil health (select all that apply)?

Apply organic amendments	1
No-tillage	2
Growing cover crops	3
Crop rotations	
Other, specify. ----------	4

40. According to you, what steps would be the most effective for NGFCFs to improve their soil fertility (select all that apply)?

Soil testing	1
Correcting soil pH (liming)	2
Balancing soil nutrients according to crop needs	3
Applying a balanced fertilizer program according to crop specialist recommendation	4
Other, specify. ----------	5

41. Should NGFCFs use a qualified person for advice on crop protection products?

Yes	1
No	2

42. Should NGFCFs follow the instructions on the label for the use and application of crop protection products?

Yes	1
No	2

43. According to you, what should be the most important factor for NGFCFs to consider looking after the environment? Please indicate how much you agree with the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Making use of qualified people to advise you on sustainable agricultural practices is a factor					
Taking the necessary steps to prevent soil erosion is a factor					
Taking steps to improve soil health is a factor					
Using soil analysis to base fertilizer programs on is a factor					
Following guidelines to store crop protection products safely is a factor					
Following guidelines to discard empty crop protection containers safely is a factor					
Other, specify. _____					

SECTION D: SOCIAL SUSTAINABILITY

NB. YOUR INPUTS IN SECTION D ARE YOUR OPINION ON THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS (NGFCFs)

44. Do you think it is important for NGFCFs to support other businesses in their local community?

Yes	1
No	2

45. Do you think it is important for NGFCFs to support other families in their local community?

Yes	1
No	2

46. According to you, what would be the most important factors for NGFCFs to consider, to support other families in their local community (select all that apply)?

Do not support them	1
Provide housing	2
Provide part-time jobs	3
Provide full-time jobs	4
Provide infrastructure like schools	5
Provide logistics (transport to and from work)	6

Provide training to improve skills to improve work efficiency	7
Other, specify. ----------	8

47. According to you, should NGFCFs have succession planning in place?

Yes	1
No	2

48. How important do you think it is for NGFCF's sustainability to:

Please indicate how much you agree with the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
It is important to support other businesses in the local community.					
It is important to support other families in the local community.					
It is important to make use of labour from your local community.					
It is important to have a succession agreement plan in place for your farming enterprise					
It is important to provide a safe environment for your workforce					
Other, specify. _____					

49. Do you think it is important for NGFCFs to get regular visits from government extension officers to guide them on sustainable farming practices?

Yes	1
No	2

50. According to you, what advice should government extension officers give NGFCFs (specify)?

APPENDIX 3

RESEARCH STUDY INFORMATION LEAFLET AND CONSENT FORM

DATE

Date of the research project

TITLE OF THE RESEARCH PROJECT

The sustainability of New Generation Future Commercial Farmers in South Africa**,** a case study done in the North-West province of South Africa**.**

RESEARCHER NAME, STUDENT- AND CONTACT NUMBER:

Phillip Venter 199330992 076 430 4847

FACULTY AND DEPARTMENT:

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES (UFS)

CENTER FOR SUSTAINABLE AGRICULTURE

STUDY LEADER(S) NAME AND CONTACT NUMBER:

Prof Johan van Niekerk

vNiekerkJA@ufs.ac.za

ETHICAL CLEARANCE NUMBER:

UFS-HSD2020/1722/293

WHAT IS THE AIM / PURPOSE OF THE STUDY?

I want to be part of the solution to providing farmers with sound advice on how to maintain or become sustainable farmers. Farmers can help South Africa achieve food security and provide sustainable jobs and income streams by being more sustainable. By being part of the agriculture inputs sector provided me with opportunities to guide input supplies on developing technology and products that are offered to farmers in a holistic manner. With a holistic approach to farming, farmers can make informed and sound management decisions to lower their farming risk. Growing my knowledge over 25 years also gave me opportunities to provide valuable input to decision-makers in South Africa on improving our country's sustainable agriculture.

WHO IS DOING THE RESEARCH?

My name is Phillip Venter, and I am an executive market development manager for a leading crop protection company. I have developed my skills and knowledge of fertilizers, precision farming technology and crop protection over the past 25 years. I have also been involved in training farmers from different categories to become more sustainable.

WHY ARE YOU INVITED TO TAKE PART IN THIS RESEARCH PROJECT?

You have been chosen to be part of this research because you form part of the Zamukele project at Schoeman Boerdery in the North-West Province. Your information was obtained from Jacques Roos, the project manager for the project.

WHAT IS THE NATURE OF PARTICIPATION IN THIS STUDY?

Your participation will be divided into two. Firstly a questionnaire, taking 30-45 minutes to complete, with questions about your feedback on your farming enterprise's economical-, environmental- and social sustainability. Secondly, a Logframe analysis will be done in group form, involving seven New Generation Future Commercial Farmers from the Zamukele project. The duration will be roughly 5-6 hours.

CAN THE PARTICIPANT WITHDRAW FROM THE STUDY?

Participation is voluntary, and there is no penalty or loss of benefit for non-participation. Being in this study is voluntary, and you are under no obligation to consent to participation. If you decide to participate, you will be given this information sheet to keep and asked to sign a written consent form. You are free to withdraw at any time without giving a reason. However, once you have submitted the questionnaire, withdrawing will not be possible. The research involves submitting non-identifiable material such as questionnaires and Logframe analysis.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

Your participation in the study will possibly benefit a larger group of farmers in becoming more sustainable farmers in the future. You will also gain insights from your co-participants on the risks involved in farming and possible solutions for overcoming these risks.

WILL WHAT I SAY BE KEPT CONFIDENTIAL?

Records that identify you will only be available to people working on the study unless you permit others to see the records. Your anonymous data may be used for other purposes, e.g., research reports, journal articles, conference presentations, etc. A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report. Please keep in mind that it is sometimes impossible to make an absolute guarantee of confidentiality/anonymity, e.g., when focus groups are used as a data collection method. In this study, the focus group is the Zumukele focus group. While every effort will be made by the researcher to ensure that you will not be connected to the information that you share during the focus group, I cannot guarantee that other participants in the focus group will treat the information confidentially. I shall, however, encourage all participants to do so. For this reason, I advise you not to disclose sensitive personal information in the focus group.

HOW WILL THE PARTICIPANT BE INFORMED OF THE FINDINGS / RESULTS OF THE STUDY?

If you require further information or want to contact the researcher about any aspect of this study, please contact Phillip Venter at 012 940 4398 or phillipv@laeveld.co.za. Should you have concerns about the way in which the research has been conducted, you may contact Prof Johan van Niekerk at 051 401 9147 or vNiekerkJA@ufs.ac.za.

Thank you for taking the time to read this information sheet and for participating in this study.

APPENDIX 4

CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet. I have had sufficient opportunities to ask questions and am prepared to participate in the study. I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable). I am aware that the findings of this study will be anonymously processed into a research report, journal publications and or conference proceedings.

I agree to the recording of the *insert-specific data collection method*.

I have received a signed copy of the informed consent agreement.

Full Name of Participant:

_____

Signature of Participant: _____

Date: _____

Full Name(s) of Researcher(s):

_____

Signature of Researcher: ____________________________________

Date: ____________________

APPENDIX 5

ETHICAL CLEARANCE CERTIFICATE

GENERAL/HUMAN RESEARCH ETHICS COMMITTEE (GHREC)

29-Mar-2021

Dear Mr Phillip Venter

Application Approved

Research Project Title:

THE SUSTAINABILITY OF NEW GENERATION FUTURE COMMERCIAL FARMERS IN SOUTH AFRICA A NORTH WEST PROVINCE IN SOUTH AFRICA CASE STUDY

Ethical Clearance number:

UFS-HSD2020/1722/293

We are pleased to inform you that your application for ethical clearance has been approved. Your ethical clearance is valid for twelve (12) months from the date of issue. We request that any changes that may take place during the course of your study/research project be ubmitted to the ethics office to ensure ethical transparency. furthermore, you are requested to submit the final report of your study/research project to the ethics office. Should you require more time to complete this research, please apply for an extension. Thank you for submitting your proposal for ethical clearance; we wish you the best of luck and success with your research.

Outcome: Approved

This study is approved. However, we strongly recommend that the following action be taken before engaging with participants: Fair balance of risks/benefits: Completing the uestionnaire and participating in group discussions are time intensive. How will PI mitigate for loss of work time? Insert the data collection techniques applied for this study on the consent forms - it

must be clear what participants are letting themselves in for. For example, the 5-6 hour group discussion. That is quite a commitment from a participant and loss of work time a considerable sacrifice. Selection of potential research participants: Might the PI already know the 17 potential participants? If yes, conflict of interest needs to be explained and measures to be taken to mitigate/guard against this, need to be transparent.

Yours sincerely

Dr Adri Du Plessis

Chairperson: General/Human Research Ethics Committee

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