Final Report

Title of the Project: Sustainability through the green economy and its impact on skills requirements

Submitted to:

Developed by:

Department of Animal Science, Faculty of Science

Project Team:

Prof K A Nephawe, Dr T J Mpofu, Dr B Mtileni, Dr F Bertram, Prof C Banga

Date: September 2021

ACKNOWLEDGEMENTS

The research team and AgriSETA would like to acknowledge with much appreciation all the respondents who afforded us their time to provide this study with invaluable contribution with information and deep insights on the green economy and skills requirements in their respective organizations/departments. Without their stimulating contributions, this study would not have been possible.

EXECUTIVE SUMMARY

This document presents a final report for the project entitled, “Sustainability through the green economy and its impact on skills requirements”. From global perspectives, the United Nation Sustainable Development Goals (UN SDGs) recommended that each country should consider the implementation of green economy policies in the context of sustainable development and poverty eradication. Through the transition from a brown to a green economy, jobs will be created and destroyed in some sectors; thus identification of skills needs and provision of the right set of skills are paramount to green economy transition in all affected sectors, including agriculture. Locally, the White Paper on Science, Technology, and Innovation (2019) estimate that green innovations in South Africa can lead to the creation of around 400 000 jobs. In relation to the agricultural sector, the Agriculture Sector Education Training Authority (AgriSETA) is mandated to identify sectoral training needs linked to the strategic direction of green economy in the sector.

This study was intended to assess sustainability through the green economy and skills requirements in agriculture and related sectors with special reference to the South African setting. The study further aimed at indicating whether the present workforce of the agriculture and related sectors have the required skills and competencies for their respective jobs in line with the green economy and, if not, which skills need further development. The study was guided by the following objectives:

- To determine the green economy methods, practices and approaches being used in the agriculture and related sectors.
- To determine the challenges for ensuring sustainability through the green economy in the agriculture and related sectors.
- To determine the current and future skills required for ensuring sustainability through the green economy in the agriculture and related sectors.
- To make recommendations on training interventions for ensuring sustainability through the green economy in the agriculture and related sectors.

The study was exploratory in nature and adopted a qualitative research approach to gather in-depth insights. The study population was all relevant public and private

organizations at national and provincial departments, entities and industries working towards the green economy in South Africa. Due to the impact of COVID-19 pandemic and its regulations, an electronic questionnaire survey was emailed to relevant stakeholders who are mainly members of the AgriSETA sector skills committee. The findings show that there are various skills gaps in agriculture and related sectors for sustainability through the green economy. This has shed some light on the possible training and development needs of the current workforce in the sector. Noted below are some of the conclusions and recommendations derived from the research:

- There is a need to move from the brown economy towards the green economic practices in agriculture and related sectors.
- There are various policies and strategies at sectoral, local, national and international arena on the green economy-related to agricultural sectors.
- Demand for green economy skills varies across occupations and the size of the organisation, this study determined that whilst some skills gaps are cutting across the various subsectors, some are unique to a particular subsector depending on the product or service offered by those organizations/companies.
- Since there are no universal sustainability indicators for jobs and businesses at large, every business and type of job must develop its personalized sustainability indicators.
- For the organizations/companies in agricultural and related sectors to decide upon the appropriate approach to closing their skills gaps, they need to establish the wideness of the identified skills gaps per employee and then decide whether to hire new talent or up-skill the existing workforce through learning programmes or on-the-job training.
- Different green agricultural practices and methods can be used, however, there is a need for skills development/reskilling in this sector to ensure a smooth transition.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

BSC	Balanced Scorecard
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
GRI	Global Reporting Initiative
IPM	integrated pest management
ILO	International Labour Office
KZN	KwaZulu-Natal Province
NDP	South Africa National Development Plan
NCPC-SA	National Cleaner Production Centre of South Africa
OECD	Organisation for Economic Co-operation and Development
SONA	State of the Nation Address
SSC's	Sector Skills Committees
SBSC	Sustainability Balanced Scorecard
SDGs	Sustainable Development Goals
TVET	Technical and Vocational Education
UNCSD	The United Nations Conference on Sustainable Development
UNEP	United Nations Environment Programme
UNSDGs	United Nations Sustainable Development Goals
USDA-ARS	United States Department of Agriculture-Agricultural Research Service

CHAPTER 1: GENERAL INTRODUCTION

The study was conducted by Tshwane University of Technology in partnership with the Agriculture Sector Education Training Authority (AgriSETA) to assess sustainability through the green economy and skills requirements in agriculture and related sectors with special reference to the South African setting. The AgriSETA was established in 2005 after the merger between Primary Agriculture Education and Training Authority (PAETA) and the Sector Education Training Authority for Secondary Agriculture (SETASA) by the Minister of Labour. The role of this specific SETA is to ensure skills development within the agriculture industry. AgriSETA is listed as a public entity in Schedule 3 Part A of the Public Finance Management Act (PFMA). The entity is enacted in Chapter 3, Section 9 of the Skills Development Act, 1997. In accordance with the Skills Development Act, AgriSETA is responsible for developing the skills of agricultural workers, both employed and unemployed. AgriSETA is also responsible for the accreditation of sector specific training providers, facilitators and moderators.

In addition, AgriSETA is responsible for developing a Sector Skills Plan, in line with the National Skills Development Plan (2030), which describes the trends within the sector, the skills that are in demand and identify Sectoral Priority Occupations for skills development and then implement them through learning programmes, approving workplace skills plans, allocating grants to employers, education and training providers and workers, and monitoring education and training in the agriculture sector.

This chapter of the report shall present a brief background to the research, purpose, aims and objectives of the study as well as study limitations.

1.1. Background to the study

Food security is a challenge in rural and peri-urban areas of South Africa. The escalation of the high unemployment rate in rural areas further exacerbates the food security challenge (International Labour Office (ILO), 2012, p. 20). The increasing demand for agricultural products is connected to the increasing demand for global

food. The global agriculture sector, including forestry and fisheries, currently offers over 1 billion jobs (ILO, 2012) and 3% of the global gross domestic product (GDP) (World Development Indicators (WDI), 2009). The reality more or less ignored until recently, is that agriculture remains one of the most important backbones of most sub-Saharan African economies, including South Africa (Salahuddin *et al*., 2020). Noteworthy, environmental quality is of importance for sustainable agricultural production, and the most important challenge is climate change. The Green Economy Report, published by the United Nations Environment Programme (UNEP, 2011) argues that the reasons for many global crises associated with climate change, food, energy, and finance are because money was being invested in a "brown economy" (e.g. fossil fuels) instead of green sectors (e.g. renewable energy). This is what UNEP called an era of capital misallocation. The report further indicates that there would be just as much global economic growth and more so in the long term if there is a shift to a green economy. The report further calls for the elimination of fossil fuel subsidies, green taxes, and energy efficiency. Of significance, UNEP argued that it is a myth to think there is a trade-off between economic progress and environmental sustainability.

The United Nations Sustainable Development Goals (UNSDGs) maintained that each country should consider the implementation of green economy policies in the context of sustainable development and poverty eradication, in a manner that endeavours to drive sustained, inclusive, and equitable economic growth and job creation, particularly for women, youth and the poor. In this respect, it is noteworthy the importance of ensuring that workers are equipped with the necessary skills, including through education and capacity-building, and are provided with the necessary social and health protections. Through the transition from a brown to a green economy, it is notable that jobs will be created in some sectors and destroyed in some sectors. This change can be compared to the industrial revolution. Therefore, identification of skills needs, the provision of the right set of skills are paramount to green economy transition in all affected sectors, including agriculture. Intending to assess the skills development measures, this paper conducts a review and assessment of green economy skills in agriculture and related sectors with special reference to the South African setting. This manuscript concludes by evaluating the current state of skills development in agriculture and related sectors.

1.2. Purpose of the study

This study was intended to assess sustainability through the green economy and skills requirements in agriculture and related sectors with special reference to the South African setting. The objectives were:

- To determine the green economy methods, practices and approaches being used in the agriculture and related sectors.
- To determine the challenges for ensuring sustainability through the green economy in the agriculture and related sectors.
- To determine the current and future skills required for ensuring sustainability through the green economy in the agriculture and related sectors.
- To make recommendations on training interventions for ensuring sustainability through the green economy in the agriculture and related sectors.

1.3. Study limitations

The COVID-19 pandemic is affecting the way that the researchers work and also affected the way we go about conducting research. In this research, the researchers suspended the data collection or re-design the data collection activities taking into account social-distancing measures and the ability to work more remotely.

Much qualitative research typically relies on face-to-face interaction for data collection through interviews, focus groups and field work. The qualitative data for this research was collected through online survey questionnaires. Although qualitative surveys generate less rich data than interviews, they do maintain some of the benefits of qualitative research (e.g. the generation of unanticipated findings) and allow for data collection from a larger number of people, relatively quickly. Moreover, qualitative approaches relies on data saturation which can be obtained with a relatively small number of research participants. Moreover, triangulation by comparing data from multiple sources also strengthened the study methodology.

CHAPTER 2: LITERATURE REVIEW

This chapter covers the review of relevant literature on the subject focusing on the following: green agricultural economy, challenges concerning the quality of green jobs in agriculture, policies towards greening the economy in agriculture, skills for the green transition in agriculture and related sector, green agricultural practices and methods, and sustainability indicators for green jobs.

2.1. Green Agricultural economy

According to ENEP (2011), a green economy is defined as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource-efficient, and socially inclusive. In the South African context, the green economy can be regarded as a "system of economic activities related to the production, distribution, and consumption of goods and services that result in improved human well-being over the long term, while not exposing future generations to significant environmental risks or ecological scarcities". It implies the decoupling of resource use and environmental impacts from economic growth. It is characterized by substantially increased investment in green sectors, supported by enabling policy reforms.

From a global perspective, in September 2015, the United Nations' General Assembly adopted the 2030 Agenda for Sustainable Development that includes 17 Sustainable Development Goals (SDGs). The green economy can serve as a vehicle to achieve the SDGs and advance the transition to low-carbon, resource-efficient, and inclusive economies. Continentally, the African Union Agenda 2063 (Goal 7) also calls for "Environmentally sustainable and climate-resilient economies and communities".

From the national perspective, the National Development Plan (NDP) 2030 of South Africa aims to eliminate poverty and reduce inequality by 2030. According to the plan, South Africa can realise these goals by drawing on the energies of its people, growing an inclusive economy, building capabilities, enhancing the capacity of the

state, and promoting leadership and partnerships throughout society. The NDP argues that climate change has the potential to reduce food production and availability of potable water, with a consequence of migration patterns and levels of conflicts. To that end, the NDP calls for intervention to ensure environmental sustainability and resilience, reduction in greenhouse gas emissions and improving energy efficiency, protection of biodiversity and natural resources, investment in greener technologies; to mention but a few.

According to the Department of Environmental Affairs, South Africa views a green economy as a sustainable development path based on addressing the interdependence between economic growth, social protection, and the natural ecosystem. The South African approach is to ensure that green economy programmes are to be supported by a practical and implementable action plan, therefore the importance of building on existing best processes, programmes, initiatives and indigenous knowledge in key sectors “Towards a resource-efficient, low carbon, and pro-employment growth path”.

The country’s sustainable development vision is outlined in the National Framework for Sustainable Development (2008) as “South Africa aspires to be a sustainable, economically prosperous and self-reliant nation-state that safeguards its democracy by meeting the fundamental human needs of its people, by managing its limited ecological resources responsibly for current and future generations, and by advancing efficient and effective integrated planning and governance through national, regional and global collaboration”. Economic transformation and job creation is one of the key 7 national priorities of the country as outlined by President Ramaphosa in his State of the Nation Address, SONA2019.

Greening the agricultural sector is projected to create millions of green and sizeable jobs, benefitting African countries in particular, therefore, addressing socio-economic issues such as poverty, food security and economic development, and environmental challenges (UNEP, 2008; FAO, 2012; Babugura, 2020). The policy brief report by the International Labour Office (ILO) urges that there is a need for policy-makers and social partners in both developed and developing economies for skills development in facilitating the transition from the brown economy to the

greener economy. The report also notes that the skills development in facilitating the transition from the brown economy to the greener economy should be tailored at improving the sustainability for employment opportunities to the working force.

South Africa consider that the Green Economy refers to two inter-linked developmental outcomes for its economy: (i) growing economic activity (which leads to investment, jobs, and competitiveness) in the green industry sector, and (ii) a shift in the economy as a whole towards cleaner industries and sectors. The White Paper on Science, Technology, and Innovation 2019 maintains that the economic opportunities of greening the economy in South Africa will be harnessed to provide jobs. It further estimated that green innovation in South Africa can lead to the creation of around 400 000 jobs. Noteworthy, from agricultural perspectives, there are various Sector Skills Committees (SSC's) that focused attention on Green Economy in their Sub Sector Skills Plan. These include but are not limited to Aquaculture, Fibre, Milling, Pet food and Animal feed, Pest Control, Poultry, Seed and Tobacco.

The policy brief report by the International Labour Office (ILO) also notes that the extensive move in the adoption of greener approaches in agriculture and related sectors, however, changes the nature of work, and consequently the skills required. There is a need for skills development for sustainable agricultural sector production to match the supply and demand for skills, this will consequently assist workers to adjust to a rapidly changing workplace environment.

2.2. Green jobs trends and their skills requirements in agriculture and related sectors

Both the Sustainable Development Goals (SDGs) and the ILO Guidelines for the transition towards sustainable environmental economies and societies for all (ILO, 2015a) are paramount to determining the work and green economy. Noteworthy, skills development is a critical component in addressing environmental degradation and also in promoting reasonable work. Innovation, investment, and competitiveness can be promoted through skills development (ILO, 2010). Skills development in green jobs can is essential for the transition from a brown to a green economy.

Environmental sustainability is an important part of a green economy, notably, the transition to a green economy requires environmental policies that are tailored to reducing carbon and the use of resources efficiently and sustainably. The shift to a green agricultural economy leads to an important shift in skills requirements, policy on skills development for a successful transition (Bowen *et al*., 2016; Bowen and Kuralbayeva, 2015; ILO, 2012; Strietska-Ilina *et al*., 2011).

To best examine the green jobs trend, it's important to understand that it's just another way of looking at the career trend in general. There's an almost endless list of occupations that are readily identified as green jobs (environmental engineer, solar energy technician, recycling engineer, etc). To differentiate between the green jobs and regular jobs in the near future will be challenging due to the shift of greater energy efficiency use, sustainable use of natural resources such as water, land, etc. For example, the need to reduce the activities impacting the environment badly, leading to climate change is evidence, this may, in turn, lead to a significant intensification in the use of public transportation. Noteworthy, driving a bus isn't at present considered a green job, but in the future, it could be one of the most important green jobs globally. Table 2.1 provides a clearer snapshot of the current green jobs, their relevancy, and minimum skills requirement in agriculture and related sectors. The most important trend of the listed green jobs in agriculture and related sectors is that the job growth is undoubtedly expected to be strong into the future.

Table 2. 1: Current green jobs, their relevancy and minimum skills requirements in agriculture and related sectors

Job title	Their relevancy	Skills requirements
Farm Manager	Farm managers run enterprises that produce crops, livestock and dairy products.	Entry into the profession typically requires a minimum of a bachelor's degree in agriculture.
Fish and Game warden	Fish and game wardens are commissioned peace officers employed in the enforcement of wildlife, hunting, fishing and boating laws.	Jobs in the field often require minimal postsecondary education with most experience coming on the job.
Agricultural Inspector	Agricultural inspectors work for national, provincial and local governments to inspect agricultural commodities, equipment, facilities and other locations to ensure compliance with health laws and regulations.	Entry into the profession typically requires a minimum of a bachelor's degree in agriculture or agricultural management.
Renewable Energy Systems Engineer	Renewable Energy Systems Engineer design and develop systems to harness the energy of the sun and wind to generate electricity and heat for buildings and water.	Entry into the profession typically requires a minimum of a bachelor's degree in mechanical or electrical engineering.
Solar Panel Technician	Solar panel technicians are involved in every aspect of the installation and maintenance of solar energy systems.	Jobs in the field often require minimal postsecondary education with most experience coming on the job.
Chemist	Chemists study the structure of substances on the molecular and atomic levels. They are employed in every facet of the construction and manufacturing fields to produce better and safer products and building materials.	Entry into the profession typically requires a minimum of a bachelor's degree in chemistry or chemical engineering.
Industrial Production Manager	Industrial production managers oversee the day-to-day operations of production facilities.	Entry-level positions for this job title typically require a bachelor's degree with advancement coming primarily from on-the-job experience.
Truck driver	Trucks drivers provide the main means of transportation of goods and services in the nation.	Jobs in the field often require minimal postsecondary education, a valid driver’s license is a requirement.

Recycling Coordinator	Recycling coordinators are closely related to refuse materials collectors, they oversee curbside and dropoff recycling services.	Jobs with this title may require minimal postsecondary education, and advancement is more often based on the job experience.
Hazardous Materials Workers	Hazardous materials workers identify and remove all sorts of hazardous materials	Entry into the profession typically requires a minimum of a bachelor's degree in chemistry or chemical engineering.
Compliance officers	Compliance officers investigate and analyze government laws and regulations for private companies and other entities to ensure proper compliance.	Educational requirements vary for this job title, although most prospective compliance managers complete some level of postsecondary work and often obtain certification from industry associations.
Green Marketer	Green marketing managers oversee the advertising, marketing and promotion of goods and services to maximize product exposure and sales.	A bachelor's degree in marketing is the norm for entry-level positions.

2.3. Challenges concerning the quality of green jobs in agriculture

The policy brief report by the International Labour Office (ILO) identified several skills challenges for agricultural green economies (Table 2.2). These challenges are (i) the skill shortages hampering the transition to greener economies; (ii) skills and environmental policies that are not pushing towards a common goal of the green economy; (iii) the need for strong green structural change; (iv) the need for occupations to change at different rates and in different ways; (v) the need to identify critical skills for sustainable agricultural greener economy; and lastly (vi) the need for appropriate training addressing those identified critical skills. New job opportunities will be generated in the agricultural and related sectors that are expected to grow as the economies go green (Table 2.3).

Table 2. 2. Challenges regarding the quality of green jobs in agriculture

Challenges on green jobs in agriculture	Possible policy solutions
(i) The skill shortages hampering the transition to greener economies.	Improve policy coordination at the planning, design, and implementation stages.
(ii) Skills and environmental policies that are not pushing towards a common goal of the green economy.	Focus on retraining and the development of portable skills to encourage occupational mobility.
(iii) The need for strong green structural change.	Prioritize training for disadvantaged groups
(iv) The need for occupations to change at different rates and in different ways.	Enable trainers and teachers to keep skills for green jobs up to date.
(v) The need to identify critical skills for sustainable agricultural greener economy; and lastly.	Improve systems for identifying and anticipating skill needs.
(vi) The need for appropriate training addressing those identified critical skills	Target skill needs through social dialogue.

Table 2. 3. Green Agriculture and related sector industries are likely to grow and associated retraining needs

Agricultural sub-sectors	Employment effect	Type of restructuring	Training needs	Benefits	Reference
Push-Pull Farming	Gaining	20 -30 % higher labour requirements.	Skills upgrading: Integrated and intercropping		Khan *et al*., 2008a; Asiabaka et al., 2008
Skilled Labour Pest Management	Gaining: Increased labour inputs	Increase	Skills upgrading: Pruning, shade adjustments, and phytosanitary harvesting methods	Reduced use of pesticides	STCP/IITA, 2006; Baoua *et al*., 2008
Organic farming	Gaining: Greater employment and business diversification		Skills upgrading: Organic certification and inspection skills	Limit the use of agrichemical inputs, maintain biodiversity	Green *et al.*, 2006; Badgley *et al*., 2007; GHK, 2007; UNEP, 2008; UNEP, 2010
Agroforestry	Gaining: Employment opportunities in the management of seedling farms and increased labour for pruning and harvesting firewood and other tree products.	Inter-farming	Skills upgrading: Intercropping skills		Garrity *et al.*, 2010

2.4. Policies towards greening the economy in agriculture

In South Africa, strategies and plans have been developed for the implementation of the green economy at the level of provincial and local governments. These strategies include Limpopo Green Economy Plan 2013, Western Cape Green economy Strategy Framework 2013, Green Strategic Programme for Gauteng 2011. These strategies differ in terms of both the extent and how they refer to agriculture, but they have identified the most important focus areas (Table 2.4), (i) food security, (ii) local organic agriculture and small urban agriculture, (iii) spatial planning for sustainable land use and protection of land, (iv) regulation of feedlots, (v) food banks, (vi) water efficiency, (vii) incentives to promote sustainable agriculture, (viii)rehabilitation of degraded lands, and (ix) support of programmes ensuring the protection of agricultural lands.

Table 2. 4 Provincial and local government green economy policies and strategies in South Africa

Policy or Strategy	Vision	Aim	Special reference
Green Economy Strategy for KwaZulu-Natal Province (2011) (Department of Economic Development and Tourism, KwaZulu-Natal Provincial Government)	For the province to have an economy that provides opportunities for all its residents to prosper, and where natural resources are enhanced and used sustainably in supporting basic needs as well as 'green' economic growth.	The existing brown economy must be wholly substituted by a green economy.	Rural development, green jobs, and no special reference to agriculture
Green Strategic Programme for Gauteng (2011) (Department of Economic Development, Gauteng Provincial Government)	To inform the objectives and activities of departments and municipalities in the province, so that all parts of government working on green issues within Gauteng are focused on the same targets		
Green is Smart: Western Cape Green Economy Strategy Framework (2013) (Western Cape Provincial Government)	To position the Western Cape as the lowermost carbon province in South Africa and the leading green economic hub of the African continent.	The framework indicates three priorities about renewable energy, a financial establishment for green growth and green jobs	Sustainable farming practices, energy and water efficiency, waste beneficiation, food security, and support for growing value chains and markets.
Limpopo Green Economy Plan (2013) (Department of Economic Development, Environment, and Tourism)	To build a new economic and environmental paradigm for the Province	To create jobs and improve on environmental quality, enabling conditions for green growth and to change behavioural and production patterns.	Agriculture, food production and forestry are one of the focus areas in the plan.
Green Economy Strategic Framework for the City of Tshwane (2012)	By 2055, growth and development in Tshwane is driven by an economy that supports a sustainable, vibrant, liveable, and prosperous city, through integrated ecological, social, economic and spatial agendas that promote human and environmental well-being		Sustainable agriculture and food security are one of the themes of the strategy.

2.5. Coherence between environmental sustainability and skills development

Many environmental policies are not coherent with the skills development strategies or do not make special reference to skills development. However, South Africa is one of the few countries including Denmark, France, and Germany, to have comprehensive environmental policies, which make special reference to skills development extensively. Noteworthy, the Technical and Vocational Education (TVET), skills development strategies policies are recognizing the growing demand for skills essential for greening the economy.

The central government of South Africa, some national government departments (Department of Environmental Affairs, Department of Agriculture, Forestry and Fisheries, Department of Mineral Resources), and provincial government departments (Western Cape Provincial Government, Department of Economic Development, Environment and Tourism, Limpopo; Department of Economic Development, Gauteng, etc) have implemented various policies and strategies tailored towards the environmentally sustainable development (Table 2.4). The 2011 National Climate Change Response White Paper recognizes the role of the labour market in the green transition and pays special attention to youth (DEA, 2011).

2.6. Skills development programmes and initiatives for greening economy

World Employment Social Outlook, 2018 noted the role of public and private institutions, local government initiatives, employer-led initiatives, and workers organizations that they should increasingly be involved in skills development for greening the economy. For example, public institutions involved in skills development in South Africa, there a six-month internship programme to support the employability of young engineers by providing them with training and experience in greener production in various sectors, including those in agriculture and related sectors (agro-processing, textiles, chemicals) by the National Cleaner Production Centre of South Africa (NCPC-SA). The report by OneWorld Sustainable Investments indicated that it should be noted that the combination of training,

mentoring and work experience is operative in enhancing the employability of trainees.

As for the involvement of private institutions in skills development, the report indicated the importance of private training institutions, a number of these institutions are public-funded while others are privately funded. Furthermore, there is also a concern about the quality of the skills development or training offered by the public institutions in comparison to those offered in a private sphere.

As for the involvement of local government initiatives, the report indicated that the local government should be in place wherein they are familiar with the local economies and labour markets to design and skills training. For example, the City of Tshwane developed the Green Economy Strategy Framework 2012 as a local municipality, this framework covered areas such as intensifying sustainable agriculture and agro-ecology, rehabilitation of the degraded common-lands and promotion of their sustainable use by the communities and small-scale farmers, promotion of organic farming, etc (City of Tshwane, 2013). These ascertain had been developed with the knowledge of the City of Tshwane local economy and labour market needs.

World Employment Social Outlook, 2018 also noted that employers play an important role not only in identifying skills needs but also in designing and providing training, especially short training programmes. Such initiatives are critical as they may also enhance public-private partnerships in providing skills development in areas of interest as a response to changing labour market needs in greening the economy. The report also noted that the workers' organizations should also be at the forefront of skills development in a green economy. These organizations can either partner with the public or private enterprises in training their members for the green transition.

2.7. Green agricultural practices and methods

Skills programmes in the agricultural and related sectors are commonly concerned with the efficiency of food production rather than adopting sustainable and environmentally friendly production systems. Weak coordination, the failure to

identify skills needs, the inactive involvement of the social partners and poor working conditions are all key challenges to overcome if agriculture is to go green. There is a set of green agricultural methods and practices to be implemented for the country to be fully green agriculture (UNEP, 2011). Among them, no-till cultivation, push-pull farming, skilled labour pest management, organic farming, certification and branding of organic and sustainable produce, agroforestry, farm-to-market food systems, livestock management, capture fisheries, biofuel production, and farm mechanization. The skills development facilitation to greener sustainable agricultural sector should be tailored in enhancement and addressing several greener agricultural practices and methods. The literature points out that green agricultural methods and practices can improve soil productivity (Mrabet *et al.*, 2005; Organisation for Economic Cooperation and Development (OECD), 2013).

The environmental and economic benefits of no-till operations are well-documented (Hobbs *et al*., 2008). Noteworthy, no-till operations conserve soil resources by reducing wind and water erosion, nutrient cycling, soil water holding capacity, water infiltration, and water use efficiency (Hobbs *et al*., 2008, Verhulst *et al*., 2010, FAO, 2011). The effect of no-till cultivation on the return, disease and pest infections, and the employment status reported that the farms applied no-till cropping practices, their cumulative yields were significantly higher (20 – 45 %) than conventionally tilled farms (Pieri *et al*., 2002; Mrabet *et al*., 2005; Carr *et al*., 2012; Pittelkow *et al*., 2015). These reports further reported that the returns were also higher in these farms high during low rainfall drought conditions. Furthermore, most no-till farm operations required lower labour requirements per productive unit of output and per unit of land in comparison to the conventionally tilled farms. Noteworthy, non-till operating farms were consistently greater than conventional farms (Erenstein *et al*., 2012). On contrary, several reviews have postulated that no-till practices can decrease crop productivity (Alvarez & Steinbach, 2009, Ogle *et al*., 2012, Van den Putte *et al*., 2010). This was ascribed to the fact that there is potential for soil waterlogging, lower soil temperatures, soil compaction which is not favourable for crop vegetative growth.

The push-pull farming system or stimulodeterrent diversionary strategy for pest control is a low-input system (Pickett *et al*., 2010) and have become an important target for sustainable food production and environmental protection (Pickett *et al*., 2014). Use of companion cropping strategies to reduce the losses caused by

stemborers and striga weed significantly increases cereal production and results in better nutrition and purchasing power for many cereal producers (Khan *et al*., 2014). This system allows the use of the companion cropping involved as an intercrop and can be used where chemical inputs are not affordable (Pickett *et al.,* 2010) or green agriculture. The push-pull farming system has been explored for many decades in some central and eastern parts of Africa and has yielded positive results (Hassanali *et al.,* 2008; Tamiru *et al*., 2012). This system requires comprehensive knowledge and skills of the associated chemical ecology of plant-insect and plant-plant interactions on the different crops (Khan *et al.,* 2016). Noteworthy, the skills and technology transfer for this system requires new approaches, and skills development training is required for both the extension services and farmers. The potential of this system to contribute positively to green agriculture is unavoidable.

The concept of integrated pest management (IPM) has been in practice for a long time, previous models primarily focused on the ecological, and to some extent on the evolutionary, aspects of pest management (Peterson *et al.,* 2018). The IPM a sustainable strategy for managing pests. The IPM is a sustainable, science-based, decision-making process that entails both biological, cultural, physical, and chemical tools to identify, manage, and pest management tools and strategies in a way that reduces economic, health, and environmental risks associated with pest control and management (United States Department of Agriculture-Agricultural Research Service (USDA-ARS), 2018).

There is evidence that organic farming is expanding across the world. Several studies have been done in comparing organic and conventional agriculture in terms of yield, environmental, and economic impacts. These studies have indicated that organic farming production performs very well and there is room for improvement. Noteworthy, these studies have repeatedly been compiled in different meta-analyses studies (De Ponti *et al*., 2012; Tuomisto *et al.,* 2012; Seufert *et al.,* 2012; Ponisio *et al.*, 2015). In these meta-analyses, both positive and negative impacts of organic farming system in nutrient management and reduction negative environmental impacts and increasing yields have been noted. Noteworthy, organic growers are more concerned with protecting the environment whilst conventional growers are more concerned with food security (Kings & Ilbery 2011).

Agroforestry or the management of trees on the farm is deemed a cheaper system for sustainable intensification of agriculture and this system has been encouraged and promoted for decades (Garrity *et al.,* 2010; Mbow *et al.,* 2014; Waldron *et al.,* 2017). This system of providing a tree canopy above shade-tolerant crops have many positive benefits; soil carbon enrichment, nitrogen fixation, nutrient and water cycle, pest outbreak prevention, the yield of valuable tree products, habitat for biodiversity, higher resilience to climate variability and ultimately carbon sequestration (Pumarino *et al.,* 2015; Souza *et al.,* 2012; Tscharntke *et al.,* 2011). The effect of wealth or income on the adoption of agroforestry was assessed in 12 studies that Pattanayak *et al.* (2003) analyzed, there was a positive relationship between half of the study and the insignificant in the other six was observed. It should be noted that consumers of agricultural products have become more and more concerned about the health status of the products they consume. In turn, most of these consumers support organically produced food (Mbow *et al*., 2014; Waldron *et al*., 2017). The certification and branding of organic and sustainable produce in agriculture are also encouraged as this will assist the customers in terms of supporting the products that are produced more organically. Kiyani, *et al.*, 2017 reported that the majority of farmers identified that capacity building (skills and development) through training and field demonstrations are important to increase the adoption rate of agroforestry technology and the overall profitability of the farming operations.

2.8. Sustainability indicators for green jobs

More and more businesses are aligning their activities with the principles of sustainable development. Therefore, they need to adapt their ways of measuring performance. The concept of sustainability or sustainable development is a complex one, with many definitions of what is and what is not sustainable. Sustainability can be defined as a participatory process that creates and pursues a vision of the community that respects and makes prudent use of all its resources - natural, human, human-created, social, cultural, scientific, etc (Viederman, 1994). Fundamental to this task is the creation and deployment of sustainable development indicators.

Increasingly, stakeholders are becoming more vocal in their demands for information on business activities aside from financial performance (Brown, 2000), even the customers are asking about the origins of products, who made them, and what they contain. Secondly, the employees are also keen to work for industry companies that are accountable for their duties to both environment and society at large (Keeble et al., 2003). Thirdly, also the governments and civil society are steaming pressure on these businesses to report on social and environmental performance. Noteworthy, these demands are highly associated with the alignment of the business activities with the principles of sustainable development. These issues present some interesting questions for the development of performance indicators within any business, (i) How can one identify the right set of performance indicators for specific jobs in the organization? (ii) How effectively different jobs within the company are delivering on sustainability commitments can be determined? (iii) How can one measure performance at the operational levels, such as within projects and jobs, where there are direct environmental, socio-economic impacts?

Following the “Earth Summit” in 1992, there is a global consensus that sustainable development involves economic growth, social progress, and management of the environment (Tanzil & Beloff, 2006). The sustainability performance of green economy jobs in a company can be clouded by generalized statements of performance. Noteworthy, it is challenging to identify the sustainability indicators of green jobs in agriculture and related sectors. The OECD (1993) provides an indicator as a parameter or a value derived from parameters, which provides information about a phenomenon.

According to Veleva & Ellenbecker (2001), before presenting the indicators of sustainable production concept, it is vital to give brief importance of indicators and what their role is in business or job success. Companies primarily have financial and output goals and managers measure in some way performance toward these goals, wherein the general measurement practices are usually used. As part of the feedback system, measures help managers decide whether they are on course or whether corrections are needed. Their purpose is to inform the business environment about sustainable production, inform decision-making, and assist in measuring and managing productivity in alignment with sustainable development principles. Medel-González *et al*. (2013) suggested that the sustainable indicators

are important because they can be used (i) to evaluate and control the performance of resources, (ii) to communicate performance to external as well as internal stakeholders, and (iii) to suggest improvement by identifying gaps that require intervention and improvement.

There are two important aspects of indicators. Foremost, the indicators are grounded on substantial data and they are as good as the supporting data (Lawrence, 1997; Veleva & Ellenbecker, 2001). Secondly, the indicators provide more information than the primary data set. More importantly, they can show trends or cause-and-effect relationships and they encompass data interpretation and value assessment. The selection of a particular indicator is guided by two contemplations: what knowledge is desired and how will the information be used (Farrell & Hart, 1998; Veleva & Ellenbecker, 2001). Noteworthy, many indicators can be used to assess the sustainability of the jobs (Table 2.5), however, these indicators differ with the type of job. These indicators entail materials, energy, water emissions, effluents and waste, products, and services (Veleva & Ellenbecker, 2001). There are no internationally agreed sustainable development indicators that would help monitor progress (UNCSD, 2012).

The Balanced Scorecard (BSC) can also be used to assess the sustainability of a business and its jobs. This method is one of the most influential management ideas of the past 20 years, proposed for the first time in 1992 in the article published in the Harvard Business Review (Kaplan & Norton 2000; Medel-González *et al*., 2013). Several authors adapted the SSC to include sustainable development, defining the Sustainability Balanced Scorecard (SBSC) it is developed for the ‘‘Business Case’’, where the environmental and social topics are used to generate economic value, without committing future generations. An SBSC is a type of BSC specifically designed to reflect the issues and objectives of corporate sustainability (Figge *et al*., 2002).

Table 2. 5 Type of indicator for sustainability of green jobs in agriculture and related sectors (Adapted from Warhurst 2002; Keeble *et al*. 2003; GRI, 2006)

Type of indicator	**Description of the indicator**
Descriptive	Descriptive indicators can relate to drivers, pressure, state, impact, or response across the three dimensions of sustainable development. Quantitative and qualitative descriptive indicators describe the factual situation, but do not assess whether this is good or bad - they are in practical terms a statement of fact. These indicators are applied to assess the social, environmental, and economic sustainability of a job.
Performance indicators	Performance indicators compare the actual situation with targets, allowing progress towards such targets to be measured. Relevant targets include those set at national and international levels and voluntary targets that relate more explicitly to sustainable development. These indicators are applied to assess the social, environmental, and economic sustainability of a job.
Efficiency indicators	Efficiency indicators provide insights into the efficiency of processes and product use. They are, therefore, largely limited to environmental applications at present
Efficiency indicators	These relate to target levels of environmental quality set from the specific perspective of sustainable development. At present, only environmental SRVs are available, and these relate to acid deposition and air quality. These types of indicators are applied to assess the environmental sustainability of a job.
Production-related indicators	Production-related indicators are drawn from standard engineering approaches to process management and relate to both environmental and economic aspects of the production process. These indicators are limited in the scope of their application, representing as they do a narrow focus, largely internal to the company.
Regulatory indicators	Regulatory indicators are drawn from a consideration of legal compliance and typically are limited to the environmental dimension (e.g. release of pollutants to air, land, and water). The use of regulatory indicators fails to capture the significance of moving 'beyond compliance' and are static relative to the kinetic sustainable development process.
Accounting indicators	Accounting indicators may be used for internal or external reporting with a focus on liability management, and efficient and transparent tracking of costs associated with waste production, management, and disposal
Economic indicators	Economic indicators can be used to value external environmental and social costs and allow their internalization. These are potentially powerful tools and are an essential input to any lifecycle-based assessment of environmental performance.

Environmental indicators	These indicators concern sustainability in terms of job's impact on the living and non-living natural systems, including ecosystems, land, water, and air. They cover performance related to inputs and outputs
quality-based indicators	Similar to production-related indicators, quality-based indicators have as their focal point waste minimization during the production process
Ecological indicators	Ecological indicators relate to the local, regional, national, and international impacts on ecosystem health resulting from all aspects of human activity.

2.9. Conclusion

It is evident, from the issues discussed in this chapter or elsewhere that there is a need to move from the brown economy towards the green economic practices in agriculture and related sectors. Various green agricultural practices and methods are available, however, there is a need for skills development in this sector to ensure a smooth transition. Noteworthy, there are no universal sustainability indicators for jobs and business at large, therefore, every business and type of job might have its personalized sustainability indicators.

CHAPTER 3: RESEARCH METHODOLOGY

This section of the report presents the research methodology focusing on the ethical approval process, research design, study population and sampling strategies, data collection and analysis, as well as stakeholder engagement strategies.

3.1. Ethical Approval

The study was approved by the TUT Research Ethics Committee (Annexure 1) for ethical clearance (Ref: FCRE 2020/06/008 (02) (SCI). The following ethical considerations were being adhered to:

(i) Ensuring participants have given informed consent
(ii) Ensuring no harm comes to participants
(iii) Ensuring confidentiality and anonymity
(iv) Ensuring that permission is obtained
(v) Ensuring access to results by all participants

Consent was sought and obtained, and participants were allowed to withdraw at any stage, as well as being offered a copy of the results. Anonymity has been protected for the participants and pseudonyms are used throughout this report.

3.2. Research Design

There is basically three types of research design, viz. qualitative, quantitative, and mixed-methods approach. Quantitative research explains and examines social phenomena by testing theories on variables by means of numerical measurement and statistical analysis to determine if the theory predicts the phenomena of interest. On the contrary, qualitative research intends to generate knowledge grounded on human experiences and aims to provide illumination and understanding of complex psychosocial issues, answering “why?” and “how?” questions. The mixed-method approach considers the strengths and weaknesses of quantitative and qualitative research, taking advantage of the vigour of both paradigms to increase the reliability and validity of the findings (Creswell, 2014; Saunders *et al*., 2019).

The current study was exploratory in nature (Saunders *et al*., 2019) and therefore it adopted a qualitative research approach to gather data. In order to understand sustainability through the green economy and its impact on the skills requirement, it was necessary to gather in-depth insights in line with phenomenological research philosophy (Saunders *et al*., 2019). Unlike the positivist philosophy which is an objective philosophy associated with the quantitative methods of research and uses numbers, figures and statistical expressions to measure and examine the social issue at hand, the phenomenological philosophy is a subjective approach that is associated with qualitative methods of data collection and uses narratives, expression of feeling through discussions (Creswell, 2014). In phenomenology the world, a socially constructed and driven by social interests and behaviour leading to subjectivity. A schematic representation of the methodology used is depicted in Figure 3.1 below:

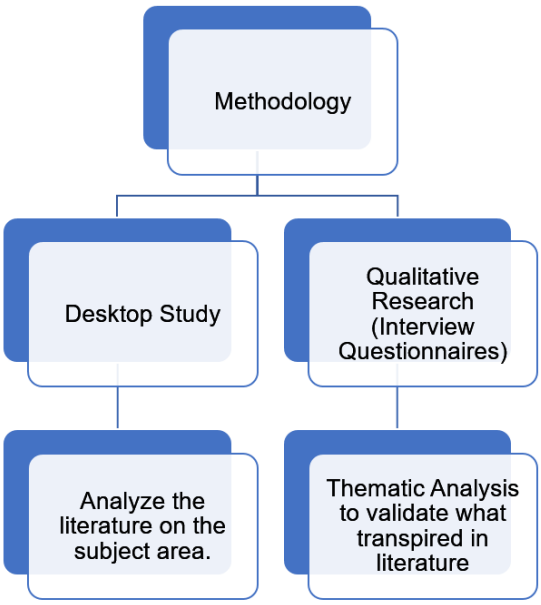


Figure 3. 1. A schematic representation of the methodology

3.3. Study Population and Sample

The study population was all relevant organizations at national and provincial departments, entities and industries working towards the green economy in South

Africa. Members of the AgriSETA sector skills committee were selected based on purposive (non-probability) sampling techniques to participate in the study since only subject matter experts could be selected for a particular purpose. Moreover, the questionnaire was sent to other relevant organizations within the agriculture and related sectors. The literature reveals that qualitative analyses typically require a smaller sample size (8 to 12) than quantitative analyses (Creswell, 2014; Saunders *et al*., 2019). The goal of qualitative researchers should be the attainment of saturation. Saturation occurs when adding more participants to the study does not result in additional perspectives or information.

3.4. Data Collection and Stakeholder Engagements

The study was divided into two phases. First, a desktop study was conducted to review relevant literature sources on the subject. Then a qualitative study was conducted via an electronic questionnaire survey.

Phase 1: Desktop study

At the beginning of this phase, a comparative desktop research review was undertaken to assess the skills development measures, a review and assessment of green economy skills in agriculture and related sectors with special reference to the South African setting. Additionally, the climate-smart agriculture literature was reviewed in order to understand how this study could build on the outputs of the agricultural green economy study. Furthermore, the current state of skills development in agriculture and related sectors in South Africa was evaluated. The purpose of this exercise was to identify skills requirements for a green economy in agriculture that – if better understood – could unlock green jobs for the sector. The outcome of this process can be viewed in the previous Chapter 2 on Literature Review.

Phase 2: Qualitative study through semi-structured questionnaires

The selected organizations were identified during Phase 1 of the study (literature or desktop study). Greater attention was on various Sector Skills Committees (SSC's) that focused attention on Green Economy in their Sub Sector Skills Plan. These

include; but are not limited to; Aquaculture, Fibre, Milling, Pet food and Animal feed, Pest Control, Poultry, Seed, and Tobacco. Other relevant organizations that participated in the study include government departments and research councils. Due to the impact of the COVID-19 pandemic and its regulations during the study duration, an electronic link to a self-administered questionnaire survey and a letter requesting participant's participation in the study questionnaire was emailed to all participants. This also assisted in assuring confidentiality of the information and protecting the participant's identity. A total of 13 participants responded to questionnaires administered (Annexure 2).

3.5. Data Analysis

The open-ended questionnaire's responses and the interview data was analysed inductively using thematic analysis of the responses. Data was coded and codes were developed and a thematic framework for the respondents was created. Additionally, when analyzing the emerging themes, the focus was predominantly on a group as a whole, rather than on individuals within them (Krueger, 1994). It was acknowledged that the data emerging was to a great extent a joint product of these groups, rather than being merely a reflection of individual perspectives (Smithson, 2000). Moreover, simple frequencies of occurrence of each themes that emanated were presented to indicate the most frequent themes.

3.6. Stakeholder engagements

As stated above, stakeholders within the AgriSETA sector skills committees were approached to participate in the study. Additionally, other relevant stakeholders in agriculture and related sectors were approached and consulted at various stages of the research process.

3.7. Study limitations and delimitations

The study was limited to relevant organizations at national and provincial departments, entities and industries working towards the green economy in South Africa. These included members of the AgriSETA sector skills committee were as well as other relevant organizations within the agriculture and related sectors. Study limitations include the small sample size for respondents. However, given a

qualitative approach used, the sample size was considered sufficient enough to gain saturation (Saunders *et al*., 2019). Further limitations include the fact that the study was only conducted through online survey due to the impact of COVID-19 pandemic. However it is believed that the findings will be robust enough to provide sufficient detail to allow another researcher to 'share in the researcher's understandings and find interpretations of them in their own professional experience' (Richards, 2003: 266). Noteworthy, triangulation by using multiple sources of information is expected to minimize these limitations.

CHAPTER 4: PRESENTATION OF THE RESULTS

This section of the report presents the results obtained from the study through the qualitative method as discussed in the previous chapter (Chapter 3). This section covers the characteristics of the responses of the questionnaire, the demographic details of respondents, findings from the study in relation to the research objectives and conclusions listed to the sustainability through the green economy and its impact on the skills requirements with particular reference to the Agricultural and related sectors. The pie charts and the summary tables are used to present the results of the survey.

The research was based on the following research questions:

- What are the green economy methods, practices and approaches being used in the agriculture and related sectors?
- What are the challenges for ensuring sustainability through the green economy in the agriculture and related sectors?
- What are the current and future skills required for ensuring sustainability through the green economy in agriculture and related sectors?
- What recommendations on training interventions can be made for ensuring sustainability through the green economy in agriculture and related sectors?

4.2. Study participants

Self-administered survey questionnaires were sent to participants by email, and 13 were completed and returned to the researcher. As stated previously, qualitative research typically requires a smaller sample size (8 to 12) than quantitative analyses since the goal of qualitative researchers should be the attainment of saturation (Creswell, 2014; Saunders et al., 2019). Saturation occurs when adding more participants to the study does not result in additional perspectives or information.

4.3. Section A: Demographic details of respondents

This section presents the results in terms of the demographics of participants as discussed in the Methodology section. The purpose of requesting this information was to ensure that the study covers a range of views from the targeted respondents. The demographics section included the sub-sectors within the Company/organization involved Green Economy in Agriculture and related sectors, the core business of the company/organization, respondent's designations, company/organization areas of residence, work experience, age, gender, and respondent's educational background.

4.3.1. Agricultural Sector

The research participants were asked to specify their demographics in terms of the Sector for their respective companies. Most (11) of the sample consisted of respondents from the private entities whilst the remaining 2 were respondents from the government entities. The researcher intended to ensure a total inclusion of respondents in the process of extracting valid information from the organization.

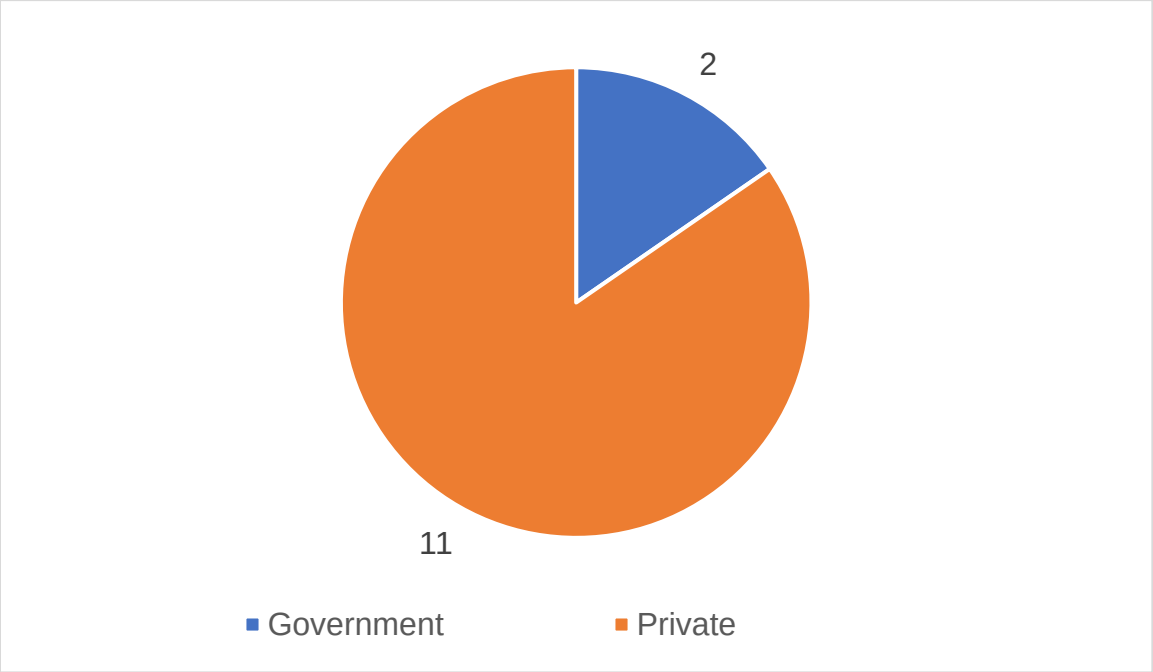


Figure 4. 1. The respondents from the private *vs* government agricultural sector

Furthermore, those who are involved in livestock and its products sub-sector constituted a great frequency (6), whilst those involved in crop and its products, aquaculture and, manufacturing and sale of agricultural equipment constituted a small frequency of 3, 1 and 1, respectively (Figure 4.2). Noteworthy, those involved in both livestock and crop production were only 2.

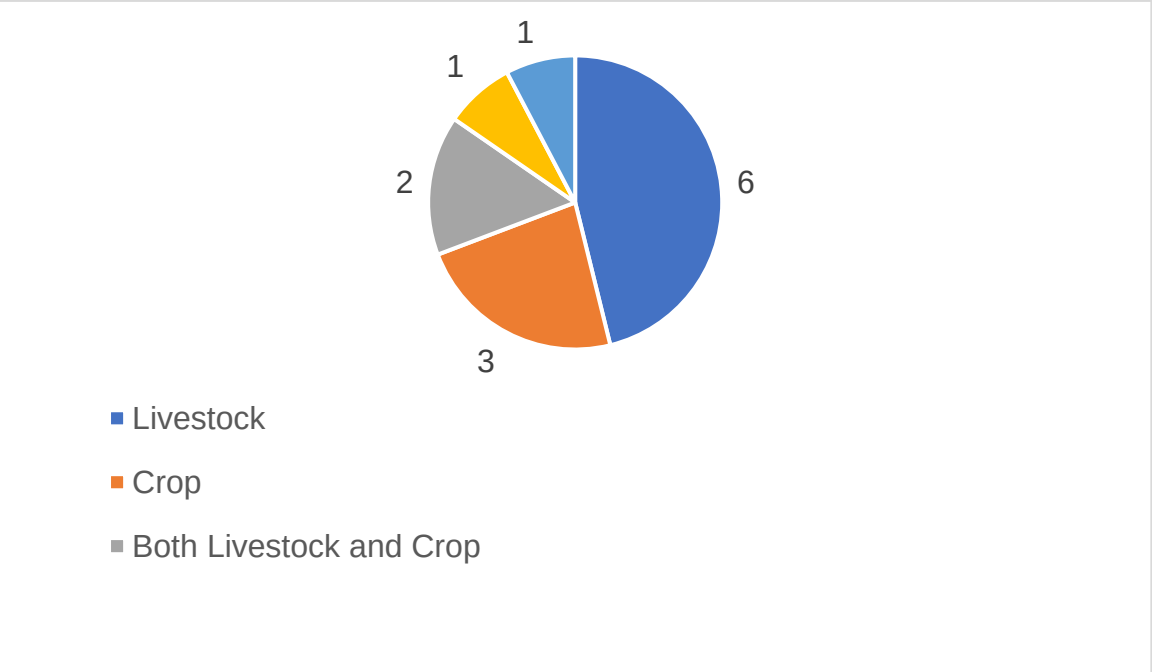


Figure 4. 2. Involvement of the respondents in different agricultural sub-sectors

4.3.2. Provincial demographical area

Figure 4.3 presents the demographical area of the respondent's company/organization. It can be observed that the majority of the respondents (6) companies/organizations were located and operated in the Gauteng province, followed by the respondent's company/organization which are located and operated in multiple provinces in South Africa (4). The remaining frequency of 3 respondents was made up of the respondent companies/organizations which are located and operate in the Mpumalanga province.

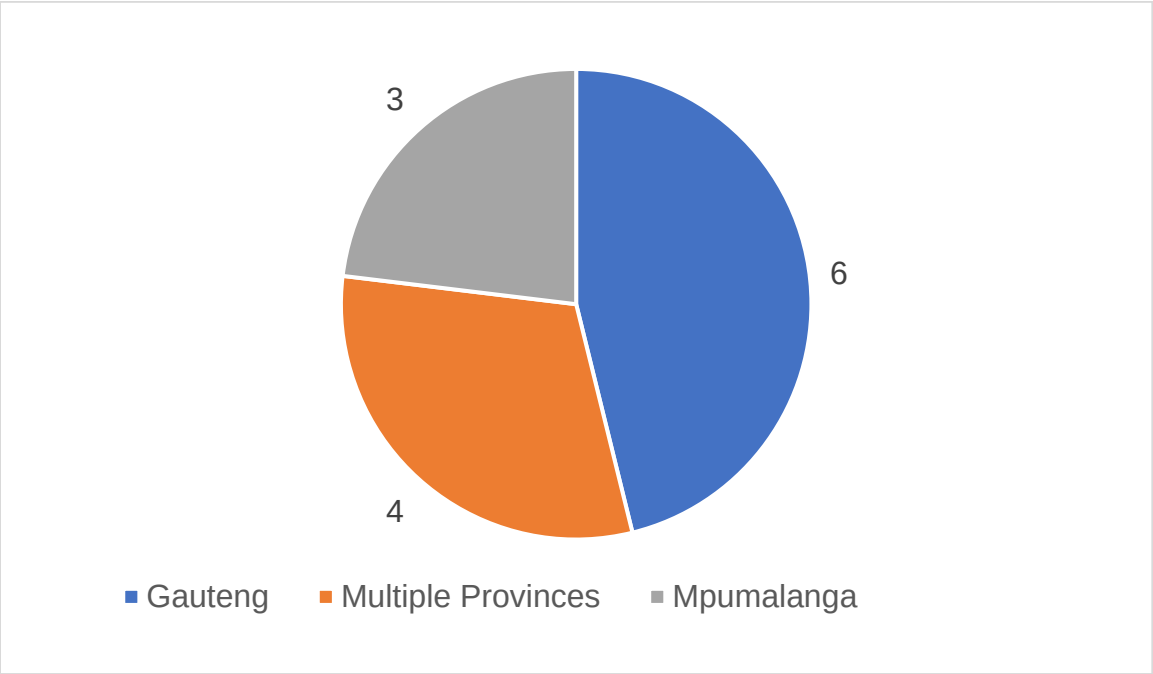


Figure 4. 3. Provincial demographical area

4.3.3. Role in the company/organization

Figure 4.4 indicates that most (7) of the sample respondents are made of senior management, followed by human resource personnel and Engineers, each contributing an equal frequency of 2, respectively. The remaining frequency (2) was shared equally by the respondents who are Environmental Compliance Officers and Specialist Researchers.

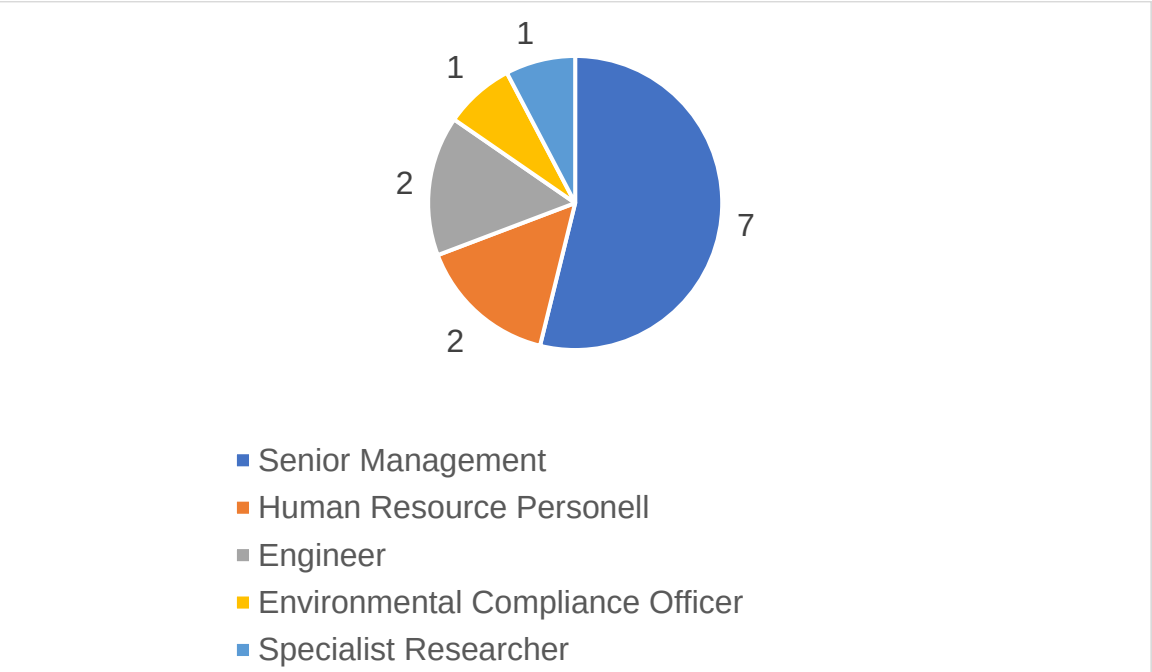


Figure 4. 4. Role in the organization

4.3.4. Gender distribution

Figure 4.5 represents the gender distribution of the respondents. It can be observed from the chart below that the majority of the sample consisted of male respondents (9) whilst were female (4).

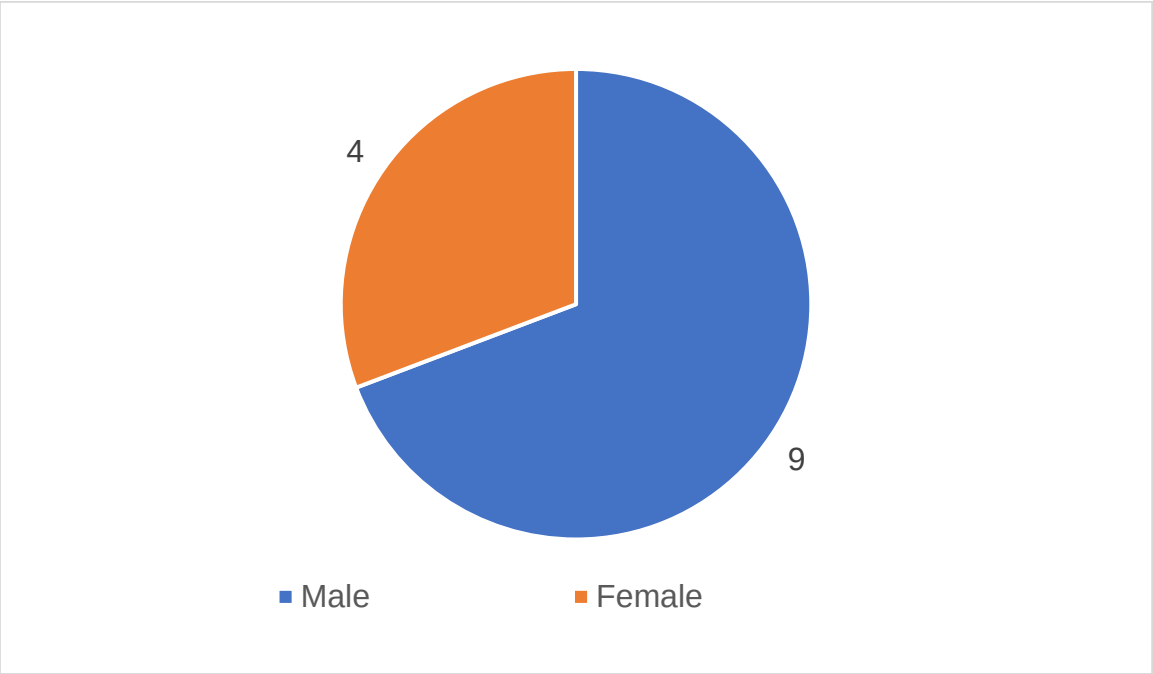


Figure 4. 5. Gender distribution

4.3.5. Race

Figure 4.6 represents the race distribution of the respondents. It can be observed from the chart below that there was an equal distribution of respondents (6) of African and White races. However, 1 of the respondent preferred not to disclose their race for this research study. Furthermore, in this research, there was no respondent of Asian or any other known race in South Africa.

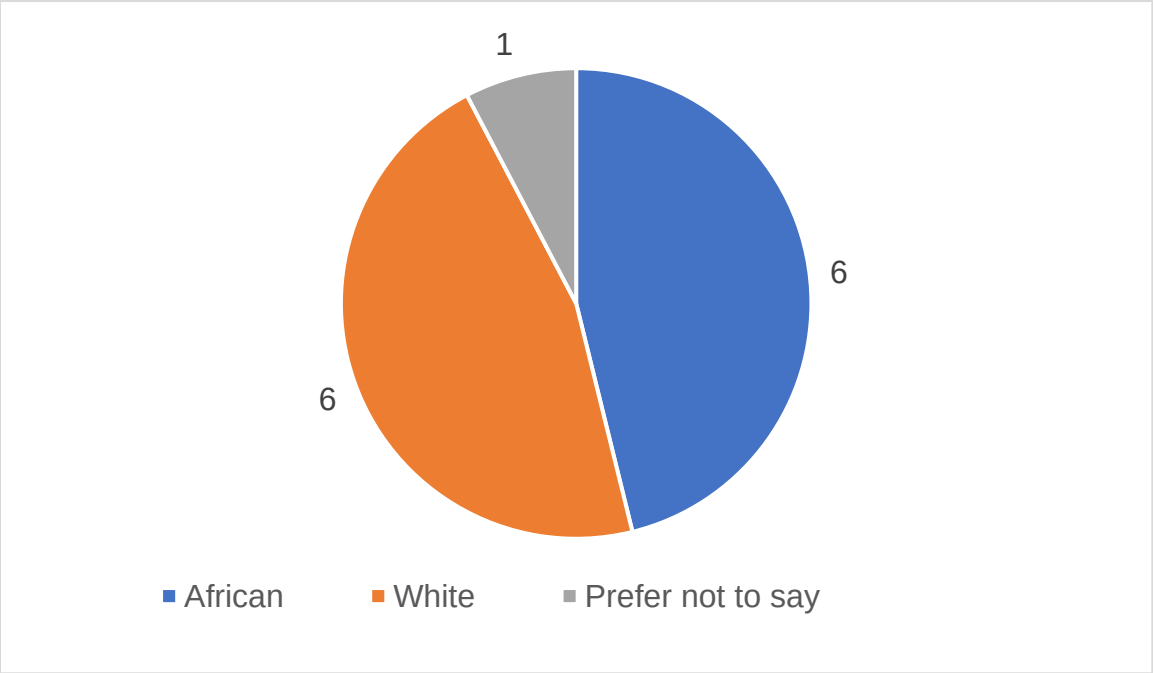


Figure 4. 6. Race of the respondents

4.3.6. Years of experience within the Agriculture and related sectors

Figure 4.7 highlights the results of the respondent's years of experience within the agriculture and related sectors. The majority (9) of the sample consists of participants with 20 and above years of experience, 2 of the respondents were having between 15-19 years of experience, whist those with 5-9 and 10-14 years of experience group were made up of 1 respondent each. Noteworthy, there were no respondents with less than 5 years of experience in agriculture and related sectors that participated in this research.

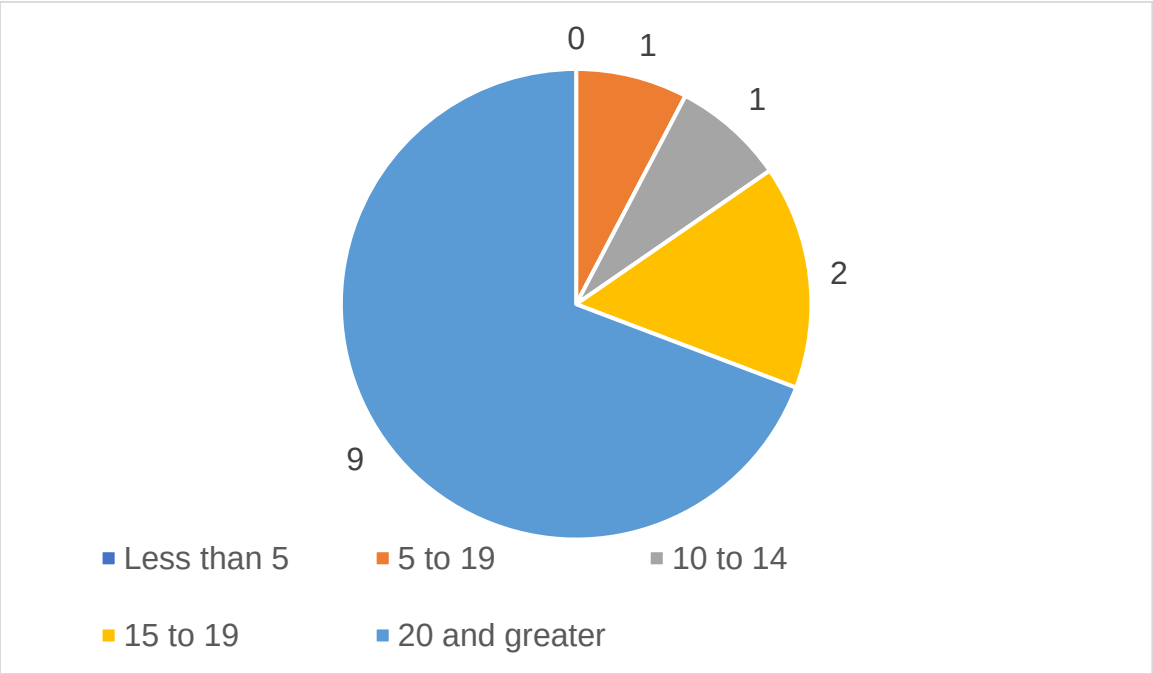


Figure 4. 7. Years of experience in the agricultural sector

4.3.7. Highest educational qualifications

Figure 4.8 represents the sample respondent's education qualifications. The chart below indicates that the majority of respondents have an honours degree as the highest qualification (4), those who have Bachelors and National Diploma as the highest qualification 3 in each category. Noteworthy, those who have Matric, Masters and Doctoral degree constituted equal frequency of 1 respondent per category.

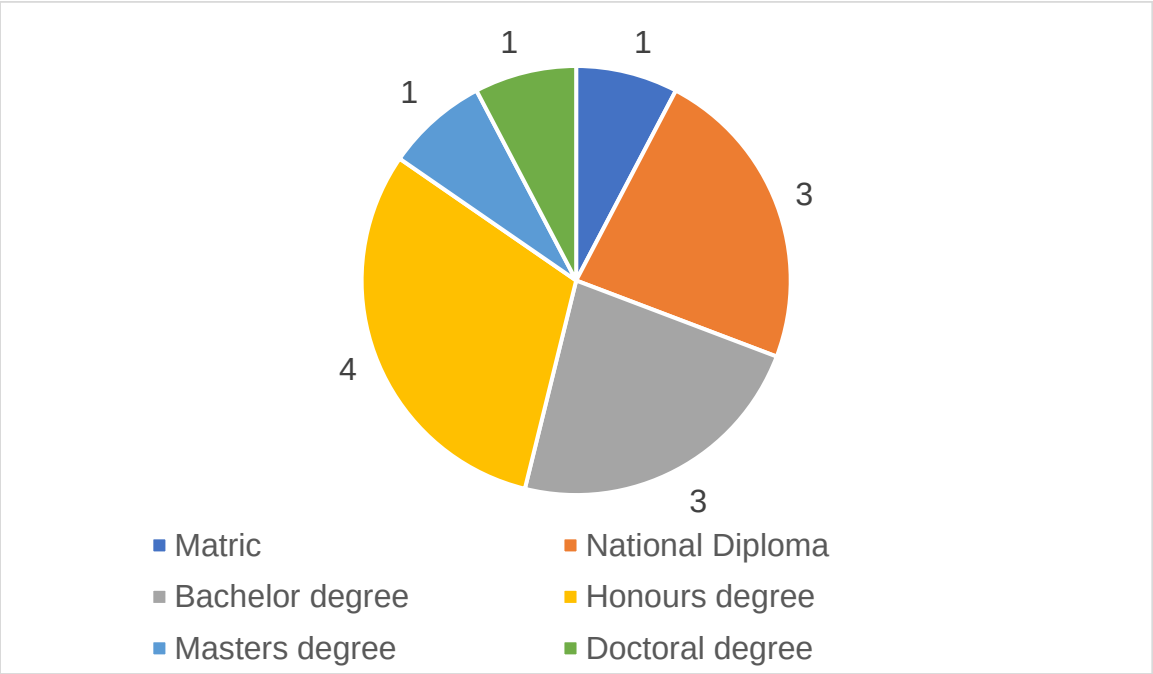


Figure 4. 8. Highest educational qualifications of the respondents

4.4. Section B: Primary Data Analysis

This section presents the survey results in terms of questionnaire responses of participants as well as the discussion in relation to the literature review. The results were analyzed using thematic analysis as indicated in the previous chapter. Furthermore, simple frequencies of occurrence were tallied for each of the themes to indicate the most frequent views of respondents.

4.4.1. Extent of the respondents' understanding of the green economy with particular reference to agriculture and related sectors

Regarding the understanding of the green economy in agriculture and related sectors, the data seemed to differ mainly in terms of the respondent's understanding of the green economy in agriculture and related sectors. Three themes were developed in the analysis (Table 4.1), i.e. (i) Green economy in agriculture involves

environmental sustainability, (ii) The use of renewable energy and energy management in farming, and (iii) Green economy involves social responsibility.

Table 4. 1. Understanding of the green economy in agriculture and related sectors

Themes	Frequency
Green economy in agriculture involves environmental sustainability	8
The use of renewable energy and energy management in farming	7
A green economy involves social responsibility	6

Some of the selected opinions from the respondents on their understanding of the green economy in agriculture and related sectors are quoted below:

“Green economy is improving the quality and quantity of a product but with less resources and harm to the environment”.

“The use of Renewable energy in farming”.

“Sustainable production methodologies that leave a light human footprint on natural resources”.

“Re-use of Waste for energy and others including (water, blood, feather). Energy mix, energy management policy, guidelines, and procedures”

"This to me means working together and respecting the land and the environment, without polluting it and destroying it”.

"A Green Economy promotes a triple bottom line: sustaining and advancing economic which implies profitable business, environmental - implies without affecting the environment negatively, Renewable energy, zero waste, and recycling, social well-being - through CSI initiatives.”

Notably, the most common theme revealed from the data was that the green economy in agriculture and related sectors focuses mainly on environmental sustainability, wherein there is a focus on lightening the human footprint on natural resources such as zero wastes production, less greenhouse gas production and sustainability use of resources such as water, soil, and animals. Furthermore, all the themes revealed on the understanding of the green economy resonates well with literature globally and locally as ENEP (2011), a green economy is defined as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource-efficient, and socially inclusive. In the South African context, the green economy can be regarded as a "system of economic activities related to the production, distribution, and consumption of goods and services that result in improved human well-being over the long term, while not exposing future generations to significant environmental risks or ecological scarcities". It implies the decoupling of resource use and environmental impacts from economic growth. It is characterized by substantially increased investment in green sectors, supported by enabling policy reforms.

4.4.2. The extent to which the company/organizations in agriculture and related sectors aligned themselves towards the green economy within the sector

The underlying strategies that respondent's companies/organizations aligned themselves towards the green economy varied greatly (Table 4.2), some companies aligned themselves by (i) following the sustainable standards set by their sub-sectors/industries, (ii) the use of products and services that have little impact on the environment at the same time giving higher profitability, (iii) the use of organic methods of farming, (iv) diversifying productions, recycling and re-use of valued resources such as water, (v) energy management, and (vi) development of the climate-smart center of excellence.

Table 4. 2. How the companies/organizations aligned themselves towards the green economy

Themes	Frequency
Following the sustainable standards	2
Use of environmental impact-free products and services	9
Organic farming	3
Diversifying production	2
Recycling and re-use of valued resources	5
Development of the climate-smart center	1

Below are selected responses from participants on, "How does your company/organization align itself towards the green economy within the sector?"

"Through sustainable standards set by the industry, i.e. the Sustainable Cape Wool Standard (SCWS)."

"We are in the process to develop a virial centre of excellence that will focus on climate-smart livestock production and my implication the green economy."

"We grow seeds that are pest resistant, delivers a higher yield, more tolerant to heat and dry conditions."

"Providing alternative renewable energy to farmers. (Biogas and solar panel projects)"

"Freshwater aquaculture allows maximum utilization of water resources. Water can in effect be used twice - for instance once for the rearing of fish and on the second occasion the same water can be used for the irrigation of crops."

Our philosophy is working together with the earth and using organic methods of farming, with minimal use of chemicals.

"The organization tries to align itself towards the green economy by attempting to create a circular economy where the diversion of waste to landfill is one of the biggest focuses. Renewables are another way the organization tries to align itself towards the green economy."

Furthermore, although the qualitative analysis revealed that the respondents noted some positive results, several challenges emerged (Table 4.3). In the process of aligning the companies/organizations, all the respondents mentioned (i) Financial-related, (ii) Human capital-related challenges, (iii) Regulatory-related challenges, (iv) Technological-related challenges, (v) Operational-related challenges.

Table 4. 3. Participants' perceptions of challenges in aligning their companies/organizations towards the green economy

Themes/sub-themes	Frequency
Financial-related	
• Capital expansion-related	2
• Cost-related	7
Human capital-related challenges	5
Regulatory-related challenges	
• Barriers-related	1
• Lack consistent standard-related	2
Technological-related challenges	
• Lack of technology-related	2
• Use of technology-related	2
Operational-related challenges	8

Below are selected responses from participants:

"Education and training of all producers (Commercial, emerging and communal) as well as farm workers and sheep shearers and wool handlers. Another challenge is the fact that there is more than one standard in SA, i.e. Responsible Wool Standard, Abelusi and ZQ. These are standards run by

Wool Brokers, creating some challenges in the field. Ideally, there should only be one standard!"

"The problem is the term "green economy" has become a buzzword, while the true challenges are ignored. I see a green economy as "a resource-efficient, low carbon and pro-employment growth path". From the point of livestock (1) it is important that resources are used efficiently, (2) has a considerable carbon footprint that can be reduced and (3) is directly supporting more than 20% of South Africa's population.
This important role of livestock seems to be ignored at all levels."

"Time as it takes time to develop a need variety of seed"

"Environmental consideration in the expense of profit"

"Implementation costs, misunderstanding around green economy status amongst both farmers and consumers, regulatory barriers."

"Understanding from people. Cost related to green projects. Low availability of Green Technology equipment in the country."

"The adoption of green practices remains a challenge as more priority is usually placed on production versus the enforcement of green practices that are voluntary requirements."

The policy brief report by the International Labour Office (ILO) 2012 identified several skills challenges for agricultural green economies, which are in concord with the challenges the respondents have indicated in this study. Musvoto *et al*., (2015) also reported some of the challenges that the agricultural companies/businesses face when moving from a brown to a green economy. Several works of literature (International Energy Agency (IEA), 2009; OECD, 2010; UNEP, 2011; UNEP 2014; Heshmati, 2018) have documented some of the financial challenges that alignment to green economy pose in business/organizations and governments.

4.4.3. Green approaches, methods, and practices applied/used in the company/organization

All the respondents seemed to be aware of certain green approaches, methods and practices applied/used in their respective companies/organizations, but these were mentioned briefly (Table 4.4). Six themes were evident, including the (i) use of Renewable energy (Biogas & solar panel projects), (ii) Using organic methods of farming, with minimal use of chemicals and pesticides, (iii) Environment - Rain harvesting, Solar power and Biofuel for energy, (iv) Emission level monitoring and control, (v) Water re-use projects, and (vi) Waste recycling.

Table 4. 4. Green approaches, methods and practices used

Themes/sub-themes	Frequency
Renewable energy	
• Biogas	2
• Solar panel projects	2
Organic farming	3
Rain harvesting	3
Emission level monitoring and control	4
Water re-use projects	4
Waste recycling	5

A selected extract of opinions from participants on the green approaches, methods and practices used is listed below:

> *"Formal, independent assessments of wool-producing farms based on international standards. Certificate of compliance is issued and the farm is registered on a central database at Cape Wools SA. Qualifying clips are also identified on a catalogue for wool buyers to see and bid on these wools at the weekly wool auction in Port Elizabeth."*

> *"Cover cropping"*

“Recycling, using rain water to water garden, we monitor water usage and working on a solar project currently.”

“Biogas as an alternative energy due to load shedding on farms and high bill of electricity.”

“Cultivating rain and sun light”

“Currently using Poultry waste as manure for our vegetables”

“Using cleaner coal i.e. improved quality with less dust and smoke being created.”

“Introducing low energy use equipment. Re-use water. Re-use waste”

“Company policies (Environmental Policy). Enforcing the waste management hierarchy in everyday processes where disposal of waste to landfill is considered as the last resort after the 3Rs have been explored.”

There is a set of green agricultural methods and practices to be implemented for the country to be fully green agriculture (UNEP, 2011). Among them, no-till cultivation, push-pull farming, skilled labour pest management, organic farming, certification and branding of organic and sustainable produce, agroforestry, farm-to-market food systems, livestock management, capture fisheries, biofuel production, and farm mechanization. The green approaches, methods and practices that are used by the company/organzations of the respondents of this research are in concord with those mentioned by various literature (Khan *et al*., 2014; Ponisio *et al*., 2015; USDA-ARS, 2018). The literature points out that green agricultural methods and practices can improve soil productivity (Mrabet *et al*., 2005; OECD, 2013).

4.4.4. How the adoption of green economy approaches, methods and practices affected the company/organization

The respondents indicated that the adoption of the green economy approaches, methods and practices affected their entities both positively and negatively (Table 4.5), even though some couldn't mention if the transition from brown to green approaches has affected their entities either positively or negatively.

Table 4. 5. Frequency of the respondent's data covered by accounts of benefits and drawback impacts of the adoption of the green approaches, methods and practices

Themes/sub-themes	Frequency
Benefits	
• Lowers operational costs	4
• Increased revenue	3
• Allowed additional business venture	2
Drawback	
• Increased input costs	2
• Slowed production	2

Below is some of the selected direct responses from participants on how the adoption of the green economy approaches, methods and practices affected their entities both positively and negatively.

"It didn`t really affect us as our fellow companies in other country's has been doing it for a while now, we are learning from them and this is the new norm It is still early"

"It costs money because funders for research does not see livestock as a priority."

"It is early days yet. It is important though because we are in a fight against cheap imports from Asia and we need to show the market that we are taking animal welfare and environmental concerns seriously if we want them to pay a premium for our products."

“Allowed additional business areas”

“We have reduced cost of Fertilisation

“Increases cost.

“Cut operational cut. Increased revenue”

It is evident from the literature that the adoption of green economy practices and methods will affect the entities' operational, finances, etc (Aquis Group, 2009; Smith & Perks, 2010, Uygur *et al*., 2015; Olademeji *et al*., 2021).

4.4.5. How government policies and legislations influence the nature of business towards the green economy in agriculture and related sector

In this study, participants indicated how government policies and legislations affect the nature of their business towards a green economy (Table 4.6). Furthermore, they indicated that these legislations and policies influenced their business both negatively and positively. The most common norm mentioned was that, (i) South Africa has strict laws and regulations, (ii) the inability to supply electricity consistently, (iii) the environmental approval requirements are very expensive, and, (iv) lack of incentives.

Table 4. 6. The main themes that the respondents indicating how government policies and legislations influence the nature of the business towards a green economy

Themes/sub-themes	Frequency
South Africa has strict laws and regulations	
• Labour laws and regulations	5
• Import and export regulations	2
Inability to supply electricity consistently	2
Expensive environmental approval requirements	1
Lack of incentives	3
None	1

Below are selected opinions from participants on how government policies and legislations influence the nature of the business towards a green economy.

"South Africa has strict labour laws, resulting in compliance to social standards to be achieved in general. Land issues and legislation on the subdivision of land may result in over-utilization of natural resources."

"They do not, government has no policy."

"This has a crucial effect on the livestock industry."

"Strict regulations on import and export of seed."

"The policies are in place and encourage farmers to adopt. There are also incentives for those who are interested."

"Government is introducing certification programmes that will see farmers who want to remain competitive adopting some level of green farming requirements."

“I feel the government should be louder at encouraging the use of green methods for farmers, and reward and incentives farmers that are doing so, but they are not.”

“Inability to provide sufficient electricity has forced customers to look for alternatives.”

“The Environmental Approval Requirements are very expensive for an emerging farmer. This becomes a barrier to entry with certain institutions of government not being as efficient and cost-effective as they can e.g. supply of electricity, we are required to continue using the Boilers to ensure enough power to be able to manufacture at the best costs.”

“It encourages and promotes green economy with assistance from e.g. NEMA and OSH act.”

The United Nations SDGs maintained that each country should consider the implementation of green economy policies in the context of sustainable development and poverty eradication, in a manner that endeavours to drive sustained, inclusive, and equitable economic growth and job creation, particularly for women, youth and the poor. The UNEP (2011) report argues that there is a set of green agricultural methods and practices to be implemented for the country to be fully green agriculture. For example, in South Africa, strategies and plans have been developed for the implementation of the green economy at the level of provincial and local governments. These strategies include Limpopo Green Economy Plan 2013, Western Cape Green economy Strategy Framework 2013, Green Strategic Programme for Gauteng 2011, to mention a few. The literature also indicates that many governments around the world have formally embraced the green economy practices, and therefore, those companies who are able to offer green economy products and services are supported, either through incentives or are credited for the free-market (Brandt, 2007; Yang *et al*., 2010). This notion is therefore also outlined by some of the respondents, in this research.

4.4.6. The extent of sustainability to which the green economy approaches, methods and practices sustainable

It is evident that the respondents have different views in terms of sustainability through the green economy, some were positive whilst some were negative (Table 4.7). Some were more critical in terms of affordability of the agricultural products produced using the green economy, as South African customers buy their food based on affordability.

Table 4. 7. Extent of sustainability to which the green economy approaches, methods and practices sustainable

Themes/sub-themes	Frequency
Sustainable	11
Not sustainable	2

The extent of sustainability to which the green economy approaches, methods and practices sustainable, according to the selected respondent's own opinions are indicated below:

"Yes it is, reduces the use of chemicals and fertilizers

"It is, there would be a reduction of electricity demand pressure from the Eskom.

"Yes, it can be because as indicated earlier you can use water twice sometimes even three times. There are also other emerging technologies that play a role in this regard."

"Definitely will be sustainable in the long term. Take care of the soil and environment and it will, in turn, take care of you."

"Not really. Production of food is a primary requirement and the majority of South African customers would always buy their food based on affordability,

and methods of production would not play a major role in their decision. The majority of South African customers would not pay a premium, based on production methods."

"The green economy approaches are sustainable for the organization as waste water treatment and recycling allows the business to use water more efficiently and ensure that the resource is not depleted very fast as the nature of the organization requires large volumes of water in the process."

"The adoption of environmental and energy management systems create a more sustainable business in terms of attracting investment and boosting stakeholder confidence as the world is becoming more green-conscious/ environmentally responsible."

The literature indicates that South Africa, like many other low- and middle-income countries, is undergoing a nutrition transition that is characterized by dietary intakes that are low in fruits and vegetables but high in salt, fats, added sugars and highly processed food (Steyn *et al*., 2012; Nnyepi *et al*., 2015). Over half of all households in South Africa experience or are at risk of hunger (Shisana *et al*., 2014), therefore their buying behaviour is based on affordability rather than the type of methods used to produce that certain food. On the other hand, respondents indicated that green economy approaches, methods and practices are sustainable as they reduce environmental degradation, such as low use of chemicals and recycling and re-use of natural resources. This, therefore, is in concord with ENEP (2011), who defined a green economy is defined as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. Of significance, UNEP 2011 argued that it is a myth to think there is a trade-off between economic progress and environmental sustainability. This was confirmed by some respondents who indicated that the agricultural green economy approaches, methods and practices are sustainable because they have improved their economic returns whilst preserving the environment.

4.4.7. Mechanisms or plans are put in place to ensure that the green economy approaches, methods and practices are sustainable in your company/organization

It is evident that the respondent's company's/organizations are embracing the change to a green economy, this is evident from the mechanisms in place to ensure that the green economy approaches, methods and practices are sustainable (Table 4.8). From this study, the main themes transpired were market needs, education and research, technology transfer, International Organization for Standardization (IOS), and energy mix.

Table 4. 8. Mechanisms or plans in place to ensure sustainability of the green economy approaches, methods and practices

Themes/sub-themes	Frequency
Market needs	2
Education and research	3
Technology transfer	2
International Organization for Standardization (IOS)	1
Incentives	1
Energy mix	3
None	1

In their own words, mechanisms or plans are put in place to ensure that the green economy approaches, methods and practices are sustainable in your company/organization are as follows:

"We attempt to do technology transfer through the publication of scientific and popular articles, farmers and information days and radio and TV interviews."

"Communication, education, research and enough resources to do research."

"Market education drives.

"Nothing to date."

“Energy mix, introducing low energy use equipment, heat harvesting equipment (Heat exchangers) installed.”

“Adoption of International Organization for Standardization systems.”

The literature indicates that for sustainability to be ensured, there is a need to have proper strategies (Megwai *et al*., 2016). Noteworthy, stakeholders are demanding information on business activities aside from financial performance (Brown, 2000) for sustainability, even the customers are asking about the origins of products, who made them, and what they contain. Furthermore, the employees are also keen to work for industry companies that are accountable for their duties to both environment and society at large (Keeble *et al*., 2003). For businesses, organizations, or companies to thrive, they need to have proper strategies on what are the indicators that they will use to ensure the sustainability of the green practices. There are no internationally agreed green economy practices for sustainable development (UNCSD, 2012).

4.4.8. Type of indicators are used to measure sustainability in the companies/organizations in agricultural and related sectors

Noteworthy, for this study most of the revealed themes of the indicators for sustainability were environmental and production-related indicators (Table 4.9).

Table 4. 9. The type of indicators used to measure sustainability in agricultural and related sectors

Themes/sub-themes	Frequency
Performance indicators	4
Production-related indicators	2
Environmental/Ecological indicators	4
Quality-based indicators	2
None	4

In their own words, according to the respondents, the type of indicators are used to measure sustainability in the companies/organizations in agricultural and related sectors are:

"Not in place."

"Veterinary inspections that check both animal welfare and optimum utilization of environmental resources."

"Sustainability is measured on the profitability of the company and the ability of the customer base to continue in the near future. Customer sustainable production is key for our ongoing business."

"Cost- reduction compare to previous."

"Power- Trips due to overloading reduced."

"Performance indicators such as water use reduction targets and CO_2 emissions reduction"

There are several types of indicators for the sustainability of green jobs in agriculture and related sectors (Warhurst 2002; Keeble *et al.,* 2003; GRI, 2006). These indicators could either be descriptive, performance, efficiency indicators, efficiency, production-related, regulatory indicators, accounting, and environmental, economic, quality-based and ecological indicators. According to ENEP (2011), a green economy is defined as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. It is therefore evident that the companies in agricultural and related sectors view a green economy as that one that is more focused on environmental conservation/preservation. Noteworthy, many indicators can be used to assess the sustainability of the jobs (Table 2.5), however, these indicators differ with the type of job. There are no internationally agreed sustainable development indicators that would help monitor the progress of greening the economy (UNCSD, 2012).

4.4.9. Current critical green jobs/occupations and skills available at company/organization to ensure sustainability through the green economy in agricultural and related sectors

In this research, the respondents enlisted several green jobs/occupations and skills gaps currently available in their respective companies (Table 4.10). Nevertheless, these critical jobs and the skills gaps are mostly environmental-related.

Table 4. 10. Green jobs/occupations currently available in agriculture and related sectors

Themes/sub-themes	Frequency
Qualified production officers	4
Environmental compliance officer	3
Occupational and health safety officer	3
Engineer	3
Quality manager	2
None	3

Greening the agricultural sector is projected to create millions of green and sizeable jobs, benefitting African countries in particular (UNEP, 2008; FAO, 2012; Babugura, 2020). Through the transition from a brown to a green economy, it is notable that jobs will be created in some sectors and destroyed in some sectors. Noteworthy, South Africa considers that the Green Economy entails growing economic activity (which leads to investment, jobs, and competitiveness) in the green industry sector. The policy brief report by the International Labour Office (ILO) identified several skills challenges for agricultural green economies. Furthermore, the respondents also indicated the green scare occupations in their respective organizations (Table 4.11).

Table 4. 11. Green scarce occupations in agriculture and related sectors

Themes/sub-themes	Frequency
Production officers	3
Renewable energy experts	1
Environmental compliance officer	2
Occupational health and safety officer	1
Engineer	1
Quality manager	1
None	4

To address the above-mentioned scarce occupations, there is a need for training interventions. The literature indicates that if there are skills gaps are identified, there should be an intervention to address them (ACT, 2011). The respondents enlisted the training interventions that their respective companies embarked on to address these skills gaps (Table 4.12), this includes formal skills training, informal skills training, conferences and organizing farmers' day. The structural changes in the economy are exacerbating the skills shortages (Rasool & Botha, 2011). Notable, some of the companies do not have the strategies in place to address such gaps.

Table 4. 12. Training interventions to address the skills gap

Themes/sub-themes	Frequency
Formal skills training (accredited)	3
Informal skills training (non-accredited)	4
• Farmer-worker training	3
• Farmers day	1
• Conferences	1
None	6

Skills development strategies can only efficiently address labour market needs when they are linked to broader national or sectoral strategies (ILC, 2004; ILC, 2008). Training is one of the most important sphere that needs great attention in order to close the skills gap in green economy (ILO. 2010, 2011, 2013; Kriechel *et al*., 2016). Furthermore, the respondents recommended several strategies that

can be used to ensure sustainability through the green economy in agricultural and related sectors (Figure 4.13). The suggested recommendation strategies by the respondents are in agreement with those outlined by several reports (ILO. 2010, 2011, 2013; Kriechel *et al*., 2016).

Table 4. 13. Recommended strategies to ensure sustainability through the green economy in agricultural and related sectors

Themes/sub-themes	Frequency
Collaboration	4
Research and innovation	4
Funding	3
Uniform rating across the country	2
Workshops and trainings	3
Incentive rewards	3

4.4.10. How technological advancement (Fourth Industrial Revolution (4IR)) will affect the skills aligned to the green economy in agricultural and related sectors

The perception of the respondents on the impact of 4IR technologies in the green economy is summarised in Table 4.14. It is evident from the data collected that the emergence of 4IR has both negative and positive impacts on the agricultural and related sectors.

Table 4. 14. Impact of the new technologies such as 4IR in green economy in agriculture and related sector

Impact (negative *vs* positive)	Frequency
Negative	
• Unavailability of new tech spare parts	2
• Unavailability of resources to invest in green-technology research	2
• Loss of jobs	5
Positive	
• Attract young people to the agriculture and related sector	2
• Accuracy of equipment	2
• Lower production expenses	4
• Shorten production period	1
Uncertain	3

The emergence of 4IR technologies will affect the skills that are aligned with the green economy. The literature indicates that the emergence of the 4IR technologies ensures sustainability. Furthermore, the green processes are a significant part of the relationship between the 4IR and sustainability outcomes (Rusinko, 2007; Aichholzer *et al*., 2015).

4.4.11. How COVID-19 pandemic influenced the nature of agriculture and related sector's business within the green economy

As the study was conducted during the COVID-19 pandemic, it was also of great importance to assess the effect of this pandemic on the agricultural and related sectors, in general. Notably, COVID-19 led to a decline in agricultural produce and increase in production costs, and others (Figure 4.15).

Table 4. 15. The effect of the COVID-19 pandemic on the agricultural and related sectors

Themes/sub-themes	Frequency
Decline in production	4
Working from home is ineffective	1
Reduce the number of staff	2
Business activities halted	4
Increase in equipment's and spare parts costs	2
None	4

The literature indicates that COVID-19 pandemic will influence the job industry across all the sectors (Andersen *et al*., 2020; Barrot *et al*., 2020; Béland *et al*., 2020; Fana *et al*., 2020), agriculture would also be affected. For example, these reports indicate that COVID-19 pandemic resulted in a decline in most of the production, job losses and some business even closed as their operational costs were excessively higher than the income generated. This is in line with the effects outlined by the respondents in this research.

CHAPTER 5: DISUSSION, CONCLUSION, AND RECOMMENDATIONS

This section of the report presents discussions of the main findings from the study, conclusions remarks, and recommendations on training interventions for ensuring sustainability through the green economy in agricultural and related sectors

5.1. Main findings from the study

5.1.1. The green economy methods, practices and approaches in agriculture and related sectors

Generally, the respondents indicated that green economy in agriculture involves environmental sustainability, the use of renewable energy and energy management in farming, and social responsibility. The study indicated that the green methods, practices and approaches used by the companies/organizations in agriculture and related sectors are renewable energy use (biogas and solar panels), organic farming, rain harvesting, waste recycling, water re-cycling approaches, and emission level monitoring. Notably, these companies/organizations have aligned themselves towards green economy by adopting green practices such as the environmental impact-free products and services, and recycling and re-use of valued resources such as water. The adoption of green economy approaches, methods and practices resulted in both positive (lower operational costs, increased revenue and allowed additional business venture) and negative results (increased input costs and slowed production).

5.1.2. Challenges for ensuring sustainability through the green economy in agricultural and related sectors

The challenges that the companies/organizations in agriculture and related sectors face in ensuring sustainability through green economy were financial-related (capital expansion and increased production cost), human capital related (skills

development), regulatory challenges (lack of consistent standards and barriers related), technological related (lack of technology and the inefficient use of recent technologies) and operational challenges. Government also posed some challenges through strict laws and regulations and inability to supply electricity. Lack of incentives from the government is also a challenge as the most of the green agricultural practices are expensive. The results also indicated the challenge in terms of affordability of the agricultural products produced using the green economy practices, as South African customers buy their food based on affordability.

Taking into considerations the challenges highlighted, mechanisms that are in place to ensure sustainability of the green economy approaches, methods and practices are stimulation of market need for products and services produced through green economy methods, practices and approaches, education and research in green economy, technology transfer and the use energy mix practices. Development of indicators to measure sustainability was also mentioned, these indicators include performance, production-related, environmental/ecological and quality-based indicators

5.1.3. Skills required and job trends for ensuring sustainability through the green economy in agricultural and related sectors

The green jobs/occupations that are required by companies/organizations in agriculture and related sectors are production officers, environmental compliance officers, occupational and compliance officers, engineers and quality managers. Some of these occupations such as production officers, environmental compliance officers, occupational and compliance officers, engineers and quality managers were also scares at the same time. Additionally, some of the scares occupations were renewable energy experts. It was found out that COVID-19 pandemic and new technologies such as 4IR have affected companies/organizations in green economy in agriculture and related sector negatively (loss of jobs, decline in production, halted business activities). Notably, the above mentioned skills gaps were suggested to can be addressed through formal skills training and informal training (farmer-worker training, farmers day and conferences)

5.2. Conclusions

This study has noted various deficient skills in the green economy to ensure sustainability and strategic objectives of various organizations/companies in agriculture and related sector. This has shed some light on the possible training and development needs of the current workforce in the agriculture and related sector.

5.3. Recommendations

Noted below are some of the recommendations derived from the research:

- There is a need to move from the brown economy towards the green economic practices in agriculture and related sectors.
- Demand for green economy skills varies across occupations and the size of the organisation, this study determined that whilst some skills gaps are cutting across the various subsectors, some are unique to a particular subsector depending on the product or service offered by those organizations/companies.
- There are various policies and strategies at sectoral, local, national and international arena on the green economy-related to agricultural sectors.
- Since there are no universal sustainability indicators for jobs and businesses at large, every business and type of job must develop its own personalized sustainability indicators.
- For the organizations/companies in agricultural and related sectors to decide upon the appropriate approach to closing their skills gaps, they need to establish the wideness of the identified skills gaps per employee and then decide whether to hire new talent or up-skill the existing workforce through learning programmes or on-the-job training.
- Different green agricultural practices and methods can be used, however, there is a need for skills development/reskilling in this sector to ensure a smooth transition.

3. REFERENCES

ACT. (2011). A Better Measure of Skills Gaps. Retrieved July 24, 2017, from http://www.act.org/content/dam/act/unsecured/documents/abettermeasure.pdf

Aichholzer, G., Rhomberg, W., Gudowsky, N., Saurwein, F., & Weber, M., 2015. Industrie 4.0 - Gesellschaftliche Dimension der nächsten industriellen Revolution, AIT.

Alvarez, R., & Steinbach, H.S. 2009. A review of the effects of tillage systems on some soil physical properties, water content, nitrate availability and crop yield in the Argentine Pampas. ***Soil and Tillage Research***, 104, 1-15.

Andersen, A. L., Hansen, E. T., Johannesen, N., & Sheridan, A., 2020. Pandemic, shutdown and consumer spending: lessons from scandinavian policy responses to COVID-19. ***Papers arXiv***, May 2005.

Aquis Group. 2009. Creating the green enterprise – why bother? 2009. [Online] Available at: http://www.acquisgroup.com/pages/news.htm. Accessed: 9 September 2009.

Babugura, A.A., 2020. Gender and green jobs in agriculture. ***Agenda***, DOI: 10.1080/10130950.2020.1719705

Barrot, J.-N., Basile, G., & Sauvagnat, J., 2020. Sectoral effects of social distancing. COVID Economics, ***Centre for Economic Policy Research*** 3, 85–102.

Béland, L.-P., Brodeur, A., & Wright, T., 2020. The short-term economic consequences of COVID-19: exposure to disease, remote work and government response. ***IZA Discussion Paper Series*** (13159).

Brandt, D., 2007. A world gone green. ***Industrial Engineer*** 39(9), 29-33.

Brown, D., 2000. The Accountable Business: Managing Corporate Responsibility in Practice (Arthur D. Little).

Carr, P., Mäder, P., Creamer, N., & Beeby, J., 2012. Editorial: Overview and comparison of conservation tillage practices and organic farming in Europe and North America. ***Renewable Agriculture and Food Systems*** 27(1), 2-6.

Creswell, R. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. USA: SAGE Publications.

De Ponti, T., Rijk, B., & van Ittersum, M.K., 2012. The crop yield gap between organic and conventional agriculture. ***Agricultural System*** 108,1–9.

Fana, M., Torrejón Pérez, S. & Fernández-Macías, E., 2020. Employment impact of COVID-19 crisis: from short term effects to long terms prospects. ***Journal of Industrial and Business Economics*** 47, 391–410.

FAO. 2011. Save and Grow: A Policymaker's Guide to the Sustainable Intensification of Smallholder Crop Production**. Food and Agriculture Organization of the United Nations (FAO)**.

Farrell, A., & Hart, M., 1998. What Does Sustainability Really Mean? ***Environment*** 40(9), 5-31.

Figge, F., Hahn, T., Schaltegger, S., & Wagner, M., 2002. The sustainability balanced scorecard. Linking sustainability management to business strategy. ***Business Strategy & the Environment*** 11(5), 269–284. doi:10.1002/bse.339

Garrity, D.P., Akinnifesi, F.K., Ajayi, O.C., Weldesemayat, S.G., Mowo, J.G., Kalinganire, A., Larwanou, M., & Bayala, J., 2010. Evergreen Agriculture: a robust approach to sustainable food security in Africa. ***Food Security*** 2, 197e214.

Global Reporting Initiative (GRI), 2006, Sustainability Reporting Guidelines: Version 3.1, 2000 – 2011, **GRI**, Amsterdam, The Netherlands.

Hassanali, A., Herren, H., Khan, Z.R., Pickett, J.A., & Woodcock, C.M., 2008. Integrated pest management: the push-pull approach for controlling insect pests and weeds of cereals, and its potential for other agricultural systems including animal husbandry. ***Philosophical Transactions of the Royal Society B*** 363, 611-621.

Heshmati A. 2018. An empirical survey of the ramifications of a green economy. ***International Journal of Green Economics*** 12(1), 53–85.

Hobbs, P.R., Sayre, K., & Gupta, R., 2008. The role of conservation agriculture in sustainable agriculture. ***Philosophical Transactions of the Royal Society B*** 363, 543-555.

International Energy Agency (IEA). Ensuring green growth in a time of economic crisis: the role of energy technology. **Siracusa: IEA**; 2009

International Labour Office (ILO)., 2010. A Skilled Workforce for Strong, Sustainable and Balanced Growth. A G20 Training Strategy (ILO, Geneva).

International Labour Office (ILO)., 2011. Comparative analysis of methods of identification of skill needs on the labour market in transition to the low carbon economy (ILO, Geneva).

International Labour Organisation (ILO)., 2013. Meeting skills needs for green jobs: Policy recommendations. ILO, Switzerland.

Kaplan, R.S., & Norton, D.P., 2000. Having trouble with your strategy?. Then map it. ***Harvard Business Review***, September-October, pp 50–61

Keeble, J.J., Topiol, S., & Berkeley, S., 2003. Using Indicators to Measure Sustainability Performance at a Corporate and Project Level. ***Journal of Business Ethics*** 44, 149–158.

Khan, Z.R., Charles, A.O., Midega, C.A.O., Hooper, A., & Pickett, J.A., 2016. Push-Pull: Chemical Ecology-Based Integrated Pest Management Technology. ***Journal of Chemical Ecology*** 42, 689–697

Khan, Z.R., Midega, C.A.O., Pittchar, J.O., Murage, A.W., Birkett, M.A., Bruce, T.J.A., & Pickett, J.A., 2014. Achieving food security for one million sub-Saharan African poor through push-pull innovation by 2020. ***Philosophical Transactions of the Royal Society B*** 369:20120284

Kings, D., & Ilbery. B., 2011. Farmers' attitudes towards organic and conventional agriculture: a behavirourl perspective, pp. 145–168. In M. Reed (ed.), Organic food

and agriculture: new trends and developments in the social sciences. ***InTech Open Access Publishers***, Rijeka, Croatia.

Kriechel, B., Mereuta, C., & Monteleone, D., 2016. Skills needs identification and skills matching in South Eastern Europe. European Training Foundation. Available at http://www.etf.europa.eu/web.nsf/pages/Skills_needs_identification_and_skills_matching_SEE

Lawrence, G., 1997. Indicators for Sustainable Development, *in The Way Forward*, ***Earthscan Publications Ltd***., London.

Mbow, C., Van Noordwijk, M., Luedeling, E., Neufeldt, H., Minang, P.A., & Kowero, G., 2014. Agroforestry solutions to address food security and climate change challenges in Africa. ***Current Opinion in Environmental Sustainability*** 6, 61e67.

Medel-González, F., García-Ávila, L., Acosta-Beltrán, A., & Hernández, C., 2013. Measuring and Evaluating Business Sustainability: Development and Application of Corporate Index of Sustainability Performance. *In M. G. Erechtchoukova et al. (eds.),* ***Sustainability Appraisal: Quantitative Methods and Mathematical Techniques for Environmental Performance Evaluation***, EcoProduction, Springer-Verlag Berlin Heidelberg. pp 33 – 61. DOI: 10.1007/978-3-642-32081-1_3.

Musvoto, C, Nortje, K, de Wet, B., Mahumani, B.K., & Nahman, A. 2015. Imperatives for an agricultural green economy in South Africa. **South African Journal of Science**, 111(1-2), 01-08. https://dx.doi.org/10.17159/sajs.2015/20140026

Nnyepi, MS, Gwisai, N, Lekgoa, M et al. 2015. Evidence of nutrition transition in Southern Africa. ***Proceedings of the Nutrition*** **Society** 74, 478–486.

OECD, 1994 Natural Resource Accounts. ***Environmental Monographs,*** no 84, OECD, Paris.

Oladimeji, H., Singh, S., & Afolabi, O.O., 2021. Sustainability and Green Operations Management: Concept, Theory, and Practice. In O. Olarewaju, & I. Ganiyu (Ed.), *Handbook of Research on Climate Change and the Sustainable Financial Sector* (pp. 134-143).

Organisation for Economic Cooperation and Development (OECD) 2010. Interim report of the green growth strategy: implementing our commitment for a sustainable future. Paris: **OECD**.

Pattanayak, S.K., Mercer, D.E., Sills, E. & Yang, J.C. 2003. Taking stock of agroforestry adoption studies. ***Agroforestry Systems*** 57, 173–186.

Peterson, R.K.D., Higley, L.G., & Pedigo L.P., 2018. Whatever happened to IPM? ***American Entomologist*** 64, 146–150.

Pickett, J.A., Hamilton, M.L., Hooper, A.M., Khan, Z.R., & Midega, C.A.O., 2010. Companion cropping to manage parasitic plants. ***Annual Review of Phytopathology*** 48,161–177

Pickett, J.A., Woodcock, C.M., Midega, C.A.O., & Khan, Z.R., 2014. Push-pull farming systems. ***Current Opinion in Biotechnology*** 26, 125–132

Pittelkow, C.M., Linquist, B.A., Lundy, M.E., Liang, X., van Groenigen, K. J., Lee, J., van Gestel, N., Six, J., Venterea, R.T., & van Kessel, C., 2015. When does no-till yield more? A global meta-analysis. ***Field Crops Research*** 183, 156-168.

Ponisio, L.C., M'Gonigle, L.K., Mace, K.C., Palomino, J., de Valpine, P., & Kremen, C., 2015. Diversification practices reduce organic to conventional yield gap. ***Philosophical Transactions of the Royal Society B*** 282, 20141396.

Pumarino, L., Sileshi, G.W., Gripenberg, S., Kaartinen, R., Barrios, E., Muchane, M.N., Midega, C., Jonsson, M., 2015. Effects of agroforestry on pest, disease and weed control: a meta-analysis. ***Basic and Applied Ecology*** 16, 573e582.

Rasool, F., & Botha, C. J. (2011). The Nature, Extent and Effect of Skills Shortages on Skills Migration in South Africa. ***South African Journal of Human Resource Management***, 9(1), 1-12.

Rusinko C., 2015. Green Manufacturing: An Evaluation of Environmentally Sustainable Manufacturing Practices and Their Impact on Competitive Outcomes. ***IEEE Transactions on Engineering Management*** 54 (3), 445–454.

Salahuddin, M., Gow, J., & Vink, N. (2020). Effects of environmental quality on agricultural productivity in sub Saharan African countries: A second generation panel based empirical assessment. ***The Science of the Total Environment*** 741, 140520. https://doi.org/10.1016/j.scitotenv.2020.140520

Saunders, M., Lewis, P. & Thornhill, A. (2019) Research Methods for Business Students, 8th Ed, New York: Pearson, Revised edition

Seufert, V., Ramankutty, N., & Foley, J.A. 2012. Comparing yields of organic and conventional agriculture. ***Nature*** 485, 229–232.

Shisana, OLD, Rehle, T, Simbayi, L et al. (2014) South African National Health and Nutrition Examination Survey (SANHANES-1): 2014 Edition. Cape Town: **HSRC Press**.

Smith E.E., & Perks, S. 2010. A perceptual study of the impact of green practice implementation on the business functions. ***Southern African Business Review*** 14 (3) 2010: 1 – 29.

South Africa National Development Plan (NDP) Vision 2030 South Africa, Department of Environmental Affairs 2020.

South Africa, National Framework for Sustainable Development 2008.

South Africa, White Paper on Science, Technology and Innovation 2019

Souza, H.N. de, de Goede, R.G.M., Brussaard, L., Cardoso, I.M., Duarte, E.M.G., Fernandes, R.B.A., Gomes, L.C., & Pulleman, M.M., 2012. Protective shade, tree diversity and soil properties in coffee agroforestry systems in the Atlantic Rainforest biome. ***Agriculture, Ecosystem & Environment*** 146, 179e196

Steyn, NP, Nel, JH, Parker, W et al. 2012. Urbanisation and the nutrition transition: a comparison of diet and weight status of South African and Kenyan women. ***Scandinavian Journal of Public Health*** 40, 229–238.

Tamiru, A., Bruce, T.J.A., Midega, C.A.O., Woodcock, C.M., Birkett, M.A., Pickett, J.A., & Khan, Z.R., 2012. Oviposition induced volatile emissions from African smallholder farmers' maize varieties. ***Journal of Chemical Ecology*** 38, 231-234.

Tanzil, D., & Beloff, B.R., 2006. Assessing Impacts: Overview on Sustainability Indicators and Metrics. ***Environmental Quality Management***. DOI: 10.1002/tqem.20101.

Tscharntke, T., Clough, Y., Bhagwat, S.A., Buchori, D., Faust, H., Hertel, D., H€olscher, D., Juhrbandt, J., Kessler, M., Perfecto, I., Scherber, C., Schroth, G., Veldkamp, E., & Wanger, T.C., 2011. Multifunctional shade-tree management in tropical agroforestry landscapes - a review. ***Journal of Applied Ecology*** 48, 619e629

Tuomisto, H.L., Hodge, I.D., Riordan, P., & Macdonald, D.W., 2012. Does organic farming reduce environmental impacts? –a meta-analysis of European research. ***Journal of Environmental Management*** 112, 309–320.

UNCSD, 2012. RIO 2012 Issues Briefs. [Online] UNCSD Secretariat (6.0) URL http://www.uncsd2012.org/index.php?page=view&type=400&nr=218&menu=45 Accessed June 22 2012

United Nations Environment Programme (ENEP). 2011. Green Economy Report.

United Nations Environment Programme (UNEP). A guidance manual for green economy policy assessment. New York: United Nations; 2014.

United Nations Sustainable Development Goals (SDGs) Agenda 2030.

USDA-ARS (United States Department of Agriculture-Agricultural Research Service). 2018. A national road map for integrated pest management. https://www.ars.usda.gov/ARSUserFiles/OPMP/IPM%20Road%20Map%20FINAL.pdf

Uygur, A., Musluk, B.Y., Ilbey, N., 2015. Examining the influence of green management on operation functions: case of a business. ***Research Journal of Business and Management*** 2(3): 348 – 368.

Van Kessel, C., Venterea, R., Six, J., Adviento-Borbe, M., Linquist, B.A., & Van Groenigen, K.J., 2013. Climate, duration and N placement determine N2O emissions in reduced tillage systems: a meta-analysis. ***Global Change Biology*** 19, 33-44.

Veleva, V., & Ellenbecker, M., 2001. Indicators of sustainable production: a new tool for promoting business sustainability. ***New Solutions*** 11(1), 41-62.African Union Agenda 2063. Goals & Priority Areas of Agenda 2063.

Verhulst, N., Govaerts, B., Verachtert, E., Castellanos-Navarrete, A., Mezzalama, M., Wall, P., Deckers, J., Sayre R., & Lal, B.A., 2010. Conservation agriculture, improving soil quality for sustainable production systems? Stewart (Eds.), ***Advances in Soil Science***: Food Security and Soil Quality, CRC Press, Boca Raton, FL, USA, pp. 137-208.

Waldron, A., Garrity, D., Malhi, Y., Girardin, C., Miller, D.C., & Seddon, N., 2017. Agroforestry can enhance food security while meeting other sustainable development goals. ***Tropical Conservation Science*** 10, 194008291772066

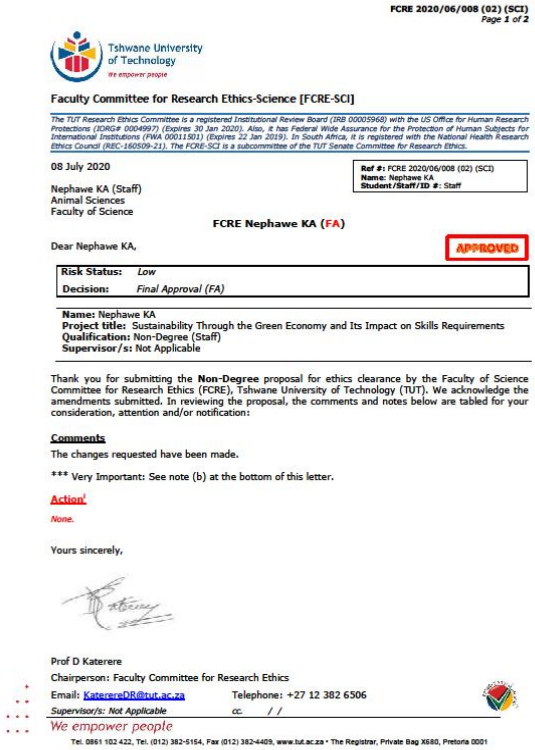
Warhurst, A., 2002. Sustainability Indicators and Sustainability Performance Management.

Warhurst, A., Wood, G., & Macfarlane, M., 2000. Issues in the Management of Socioeconomic Impacts of Mine closure: A Review of Challenges and Constraints, *in Warhurst A and Noronha L (Eds) Chapter 5 in Environmental Policy in Mining*: Corporate Strategy and Planning for Closure, (CRC Press, Florida).

Yang, C.L., Lin, S.P., Chan, Y.H., & Sheu, C., 2010. Mediated effect of environmental management on manufacturing competitiveness: An empirical study. ***International Journal of Production Economics*** 123, 210-220.

ANNEXURES

Annexure 1: Ethics Approval Letter



FCRE 2020/06/008 (02) (SCI)
Page 1 of 2

Tshwane University of Technology
We empower people

Faculty Committee for Research Ethics-Science [FCRE-SCI]

The TUT Research Ethics Committee is a registered Institutional Review Board (IRB 00005968) with the US Office for Human Research Protections (IORG# 0004997) (Expires 30 Jan 2020). Also, it has Federal Wide Assurance for the Protection of Human Subjects for International Institutions (FWA 00011501) (Expires 22 Jan 2019). In South Africa, it is registered with the National Health Research Ethics Council (REC-160509-21). The FCRE-SCI is a subcommittee of the TUT Senate Committee for Research Ethics.

08 July 2020

Ref #: FCRE 2020/06/008 (02) (SCI)
Name: Nephawe KA
Student/Staff/ID #: Staff

Nephawe KA (Staff)
Animal Sciences
Faculty of Science

FCRE Nephawe KA (FA)

Dear Nephawe KA,

APPROVED

Risk Status: *Low*
Decision: *Final Approval (FA)*

Name: Nephawe KA
Project title: Sustainability Through the Green Economy and Its Impact on Skills Requirements
Qualification: Non-Degree (Staff)
Supervisor/s: Not Applicable

Thank you for submitting the **Non-Degree** proposal for ethics clearance by the Faculty of Science Committee for Research Ethics (FCRE), Tshwane University of Technology (TUT). We acknowledge the amendments submitted. In reviewing the proposal, the comments and notes below are tabled for your consideration, attention and/or notification:

Comments
The changes requested have been made.

*** Very Important: See note (b) at the bottom of this letter.

Action
None.

Yours sincerely,

Prof D Katerere
Chairperson: Faculty Committee for Research Ethics
Email: KatthereDR@tut.ac.za Telephone: +27 12 382 6506
Supervisor/s: Not Applicable cc. / /

We empower people

Tel. 0861 102 422, Tel. (012) 382-5154, Fax (012) 382-4409, www.tut.ac.za • The Registrar, Private Bag X680, Pretoria 0001

Annexure 2: Semi-structured questionnaires

Adobe Acrobat Document