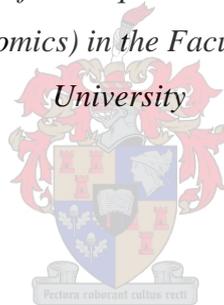


**The impact of economic policies and instruments on conservation agriculture in South  
Africa**

By

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*Thesis presented in partial fulfilment of the requirements for the degree of Master of Science  
in Agriculture (Agricultural Economics) in the Faculty of AgriSciences at Stellenbosch*



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## ABSTRACT

In South Africa, sustainable land use and management is paramount as the country's agricultural natural resources are diverse, complex and vulnerable to degradation. To realise sustainable agricultural production and development, an agro-ecosystem-specific approach entailing soil, water and nutrient conservation agricultural practices is imperative. Conservation Agriculture is one of the agricultural production method that can be employed to ameliorate and prevent the degradation of South Africa's agricultural land. The major aim of this study was to investigate how the uptake and adoption of conservation agriculture is influenced by economic policies and instruments in South Africa. To achieve this, an interactive research approach was followed initially involving an extensive literature review before scientific and empirical analysis was conducted.

Firstly it was noted in the study that currently there is not any specific policy for conservation agriculture that has been promulgated in South Africa, but however there are a number of policies (i.e. Climate change policy, Carbon Tax policy, Land Reform policy, Trade policy, Water policy, Food and nutritional security policy, NEMBA regulations, CRDP, CARA, Organic production policy, Policy on Agriculture in sustainable development and the Environmental policy) that have been drafted which have the potential to positively influence the uptake and adoption of conservation agriculture by farmers across all the farming typologies (i.e. small scale, emerging and commercial farmers). The afore-mentioned policies were described and analysed with the purpose of establishing how they affect conservation agriculture using analysis criteria adopted from the field of political sciences. Criteria of effectiveness, unintended effects, equity, cost, feasibility and acceptability were constantly employed. In this regard, all the policies were tested to see how they affect conservation agriculture and to check if there was any alignment and harmonisation within the policy environment. It was found in this study that an alignment of the aforementioned policies is imperative in order to make the policies politically and administratively feasible which will lead to the swift implementation and effectiveness of the policies in meeting their core objectives. On this basis, it was deduced that the aforementioned policy mix has the potential to advance the uptake and adoption of conservation agriculture to further contribute to an enhanced food security and a sustainable resource base in South Africa.

The policy mix analysed in this study, is however under specific constraints. These were identified and subsequently recommendations were made to ameliorate these constraints, in order to make the policies align with each other and to maximise the contribution of the policies towards the advancement of conservation agriculture in South Africa.

## OPSOMMING

Volhoubare grondgebruik en bestuur is belangrik in Suid-Afrika as gevolg van diverse, komplekse en kwesbare natuurlike hulpbronne wat maklik degradeer. As gevolg hiervan moet volhoubare bewaringspraktyke gevolg word wat spesifiek is tot die grond, water en voedingswaarde kompleks van verskillende boerdery-omgewings gevolg word. In hierdie opsig is bewaringsboerdery een metode wat ontplooi kan word om grond-degradasie te voorkom. Die hoofdoel van hierdie studie was dus om te bepaal tot watter mate die aanvaarding van bewaringsboerdery praktyke deur ekonomiese beleid en -instrumente beïnvloed word. Hiervoor is 'n interaktiewe benadering gevolg tussen 'n uitgebreide literatuurstudie en 'n wetenskaplike en empiriese analise.

Die eerste belangrike bevinding is dat daar tans geen formele staatsbeleid oor bewaringsboerdery in Suid-Afrika bestaan nie, maar daar is wel verwante beleidsuitsprake (oor klimaatsverandering, die koolstof belasting, grondhervorming, internasionale handel, voedsel- en voedingsbeleid, NEMBA regulasies, CRDP, CARA, beleid oor organiese produksie, beleid oor volhoubare landbou-ontwikkeling en omgewingsbeleid) wat wel die aanvaarding van bewaringsboerdery praktyke kan versnel. Hierdie stel van beleidsuitsprake is beskryf en ontleed deur middel van 'n analitiese raamwerk ontleen aan die politieke wetenskappe om hulle potensiële impak op bewaringsboerdery. Die spesifieke kriteria waarop gekonsentreer is sluit in doeltreffendheid, ongewenste gevolge, regverdigheid, koste, implementeerbaarheid en aanvaarbaarheid. Die doel van laasgenoemde was nie slegs om vas te stel hoe hulle bewaringsboerdery beïnvloed nie, maar ook of daar belyning bestaan tussen die verskillende beleidsuitsprake, omdat sulke belyning krities is tot suksesvolle implementering. Daar is dan bevind dat die huidige stel beleidsuitsprake wel die potensiaal het om by te dra tot die aanvaarding van bewaringsboerdery, en dus tot die volhoubare bestuur van Suid-Afrika se hulpbronne.

Hierdie bestaande beleidsraamwerk word egter onderwerp aan spesifieke beperkings. Laasgenoemde is dan geïdentifiseer, en is aanbevelings gemaak om dié beperkings aan te spreek om sodoende beter belyning te kry en dus om hulle bydrae tot volhoubare boerdery te bevorder.

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## **ABBREVIATIONS**

ACT	African Conservation Network Tillage
ARC	Agricultural Research Council
AU	African Union
BFAP	Bureau for Food and Agricultural Policy
DAFF	Department of Agriculture, Forestry and Fisheries
DBCCA	Deutsche Bank Climate Change Advisors
DEA	Department of Environmental Affairs
DGCIS	Department of Government Communication and Information Systems
DRDLR	Department of Rural Development and Land Reform
DTI	Department of Trade and Industry
DWA	Department of Water Affairs
FAO	Food and Agriculture Organisation
GHG	Greenhouse gas
GTZ	German Technical Corporation
IIRR	International Institute of Rural Reconstruction
NEPAD	New Partnership for Africa's Development
NPC	National Planning Commission
NT	National Treasury.
OECD	Organization for Economic Co-operation and Development
SADC	Southern Africa Development Community
UNEP	United Nations Environmental Programme
WTO	World Trade Organisation

## **Chapter 1: INTRODUCTION**

### **1.1 Background to the study**

In South Africa, sustainable land use and management is of paramount importance as the country's agricultural natural resources are diverse, complex and vulnerable to degradation. To realise sustainable agricultural production and development, an agro-ecosystem-specific approach entailing soil, water and nutrient conservation agricultural practices is imperative (ARC, 2009).

The agriculture sector of South Africa consists of a multi-part structure that could be summarised by the following three parts, namely: a commercial sector, an emerging sector and the small scale sector. The large scale commercial farmers produce 99 per cent of South Africa's marketed agricultural output and stand in contrast to the small scale and emerging farmers characterised by inefficient levels of production (Tregurtha and Vink, 2008 and Tregurtha *et al.*, 2010).

Conservation has always formed an important part of agricultural policy in South Africa. Kleynhans (2003) mentioned that, one reaction to the recognition of erosion as a problem was the initiation of scientific measurement and research from the 1940's onwards. Run-off plot and catchment experimentation were initiated, and this resulted in seminal work of the highest quality which further enhanced scientific understanding of the erosion process and the factors that affect it (Kleynhans, 2003). Another response was the promulgation of legislation aimed at controlling soil loss. The Forest and Veld Conservation Act of 1941, the Soil Conservation Acts of 1946 and 1969, the Conservation of Agricultural Resources Act of 1983 and the Environment Conservation Act of 1989 provided the basis for legal control of soil erosion in white-owned farming areas. These Acts were however not applied in the homeland areas that were occupied by black people. The third response was through government or quasi-government initiatives to enhance awareness and to actively promote soil conservation. Examples of these organisations were the National Veld Trust, the main purpose of which was educational, the Southern African Regional Commission for Conservation and Utilisation of Soil (SARCCUS), created to co-ordinate conservation activities across national and homeland boundaries in Southern Africa, as well as the establishment of regional Soil Conservation

Committees. According to Kleynhans (2003) approximately ZAR 300 million in financial support for soil conservation works had been spent by the government on soil conservation schemes by 1990 since its inception in the 1940s, mainly in white commercial farming areas. Table 1 shows the chronological overview of interventions and events that influenced soil conservation policies in South Africa from 1910-1989.

**Table Error! No text of specified style in document..1 Interventions influencing soil conservation policies in South Africa, 1910-1989**

<b>Date</b>	<b>Interventions and key events</b>
1910	Union of South Africa declared
1913	Natives' Land Act
1914, 1919	Drought, resulting in a Select Committee being appointed in 1914
1923	Drought Investigation Commission final report published
1925	Agricultural Extension Service created
1927	Native Administration Act
1929	Government organised soil erosion conference, Pretoria
1929-32	Economic depression
1930	Soil Erosion Advisory Council established; first financial aid schemes implemented
1933	First soil erosion schemes implemented; field surveys and agro economic surveys conducted as part of schemes
1933-34	Drought
1934	Drakensberg Conservation Area proclaimed
1936	Native Trust and Land Act
1939	Outbreak of World War II
1941	Forest and Veld Conservation Act promulgated
1943	Departmental Committee for the Reconstruction of Agriculture appointed National Veld Trust (NVT), an NGO, was established Social and Economic Planning Council appointed Land Bank Act No. 13 promulgated
1945	Tabling in parliament of White Paper on Agricultural Policy NVT Model Bill and Explanatory Memorandum tabled in parliament
1946	Soil Conservation Act No.45 promulgated Division of Soil Conservation and Extension established to administer the Act

1948	<p>Prevailing drought conditions</p> <p>Appointment of the Desert Encroachment Committee</p> <p>Fodder Bank Scheme established</p> <p>Formation of Southern African Regional Commission for the Conservation and Utilisation of the Soil (SARCCUS)</p>
1949	Proclamation 116
1950's	Green Cross Campaign
1956	Commission of Inquiry into European Occupancy of Rural Areas appointed
1960-61	<p>Drought peaked</p> <p>Drought feeding patterns investigation</p>
1966	Veld Reclamation Scheme established (concluded 1973)
1966	Land Tenure Act No.32 promulgated
1967	<p>Soil Conservation Act Amendment Act 15 of 1967</p> <p>Festival of the Soil campaign (government initiative)</p> <p>Environment Planning Act promulgated</p> <p>Betterment Areas Proclamation R196</p>
1968	<p>Forest Act No.72 promulgated</p> <p>National conference involving delegates from Organised Agriculture and other farming bodies</p>
1969	<p>Soil Conservation Act No.76 promulgated</p> <p>Stock Reduction Scheme established</p> <p>First soil classification scheme (binomial for South Africa) published</p>
1970	<p>Mountain Catchment Areas Act No.63 promulgated</p> <p>Subdivision of Agricultural Land Act No.70 promulgated</p> <p>State policy of optimum resource use initiated</p> <p>Awareness campaigns: Water Year (government initiative)</p> <p>Our Green Heritage (NVT initiative)</p> <p>Man and Environment (NVT initiative)</p>
1971	Bantu Homelands Constitution Act
1972	<p>Cabinet Committee on Environment Conservation established the South African Committee on Environment Conservation (became the Council for Environment in 1975)</p>
1974	Habitat Council established to co-ordinate NGO activities

1977	Soil Conservation Amendment Act No.22 promulgated
1980	Awareness campaigns: Man: Endangered Species (NVT initiative) Save Our Soil (NVT initiative)
1983	Conservation of Agricultural Resources Act No.43 promulgated
1984	White paper on South African Agricultural Policy published Forest Act No. 122 promulgated
1985	Regional Services Council Act No. 109 promulgated Regional Services Councils established National Grazing Strategy announced
1987	Natal floods
1988	Floods in the Free State
1989	Environment Conservation Act No.73 promulgated

Adapted from Kleynhans (2003).

The soil degradation problems in South Africa have been attributed to some segregation policies introduced during the apartheid era such as the native land legislation of 1913 (Zokwana, 2014 and Meadows and Hoffman, 2002). The degradation of agricultural land in South Africa was exacerbated by inequitable land ownership, and most of the degradation has happened in the former homeland areas. This degradation was also experienced in the commercial farming areas consisting of soil and veld degradation. The unjust distribution of land also led to overgrazing of agricultural land in the former homeland areas and decades of over-cropping. Basically the land tenure laws enacted pre-democratisation never gave any incentives for the marginalised people living in these former homeland areas to conserve land since they did not have clearly defined property rights that allowed them to have a stake in the land. The introduction of alien invasive species also promoted land degradation. These invasive plant species negatively impact on the ecosystems through excessive use of water and soil nutrients, promoting run-away fires and erosion (Richardson and Van Wilgen, 2004; Van Wilgen and Scott, 2001; Richardson and Van Wilgen, 1986). A classic example of this was the introduction of *Prosopis* as a fodder crop in the Karoo region of South Africa which led to dire consequences (Wise *et al.*, 2012).

Van der Linde (2006) states that the primary statute dealing with agricultural resources in South Africa is the Conservation of Agricultural Resources Act 43 of 1983 which was the successor to the Soil Conservation Act 76 of 1969. After World War II, the state used the full range of

instruments to support commercial farmers. Direct subsidies, mostly on the use of capital, state support for research and extension, and regulatory instruments to ensure health, safety and the protection of natural agricultural resources, were amongst the instruments that were used by the South African government before democratisation in 1994 (Kirsten *et al.*, 2007). After 1955 the story of agricultural policy towards commercial farmers involved widespread support, regulation and control in a climate of increasing isolation from the rest of the world, especially in the 1980s, followed by rapid trade liberalization and marketing deregulation during the course of the 1990s (Kirsten *et al.*, 2007).

Kirsten *et al* (2007) mentioned that the Ministry of Agriculture's policy of optimum agricultural development was based on three pillars during the 1980s namely: Financing and assistance, optimum agricultural resource utilisation and orderly marketing and price stabilisation. During the 1980s and through the 1990's deregulation became a fact of life in the agricultural sector of South Africa. The agricultural authorities started with a process of deregulation and policy change in the farm sector. Vink (1993) mentioned that these changes came about as a result of macroeconomic pressures, principally the tightening of monetary policy. The main effect on agriculture was caused by the weak exchange rate and higher interest rates which led to rising farm input prices; with interest also becoming the largest cost of production.

In 1994 the country became a signatory of the WTO's Agreement on Agriculture, while the new government liberalized the country's trade regime unilaterally. Towards the end of the decade the marketing of agricultural products was virtually completely deregulated with the promulgation of the Marketing of Agricultural Products Act in 1996. The main effect of this deregulation was to bring the domestic prices of agricultural commodities down to world prices. As a result, field crop farmers were forced to find ways of improving productivity, which resulted in a reorientation of production systems (less fertilizer was used, fewer tractors were bought and the average age of the tractor fleet increased, and marginal land was taken out of production) as well as a shift in the location of the industry (to the north and east in the maize areas of the interior and closer towards Cape Town in the wheat areas of the Western Cape), and the introduction of crop rotation systems as evidenced in the Western Cape Province and the gradual introduction of precision farming technologies ( Tregurtha and Vink, 2008; Tregurtha *et al.*, 2010 and Hardy *et al.*, 2011). At the same time farmers adopted conservation agriculture practices without much support from the state (Knott, 2015). Farmers had to adopt conservation agriculture or risk going out of business. The benefits of reduced input costs and

increased yields provided the necessary incentive, although had the state supported the process the rate of adoption would no doubt have been faster.

Given the aforementioned; the impact of economic policy and instruments to achieve a sustainable resource base and enhance food security will depend on how the policy approach is able to deal with collective issues and dimensions of interaction, organisation and management between the diverse stakeholders with various interests involved in the process. Its effectiveness significantly depends to what extent it is able to provide efficient and effective solutions which are tailored to the local agro-ecological and social conditions in South Africa. Thus the purpose of this study was to investigate how economic policies and instruments influenced conservation agriculture in South Africa at all farming scales (commercial, emerging and small scale) with the aim of enhancing food security and a sustainable resource base.

## **1.2 Problem statement**

Farm-level decisions are influenced by various factors known mostly to the farmers themselves. Little is known about why farmers do what they do and how this is shaped by policy. Conservation agriculture is currently not significantly supported by economic policy and instruments in South Africa but has been widely adopted, ostensibly for economic reasons rather than policy imperatives. There is currently no policy that has been promulgated to directly influence the uptake of conservation of agriculture in South Africa (Knott, 2015), yet there are policies that have the potential to positively influence its uptake. The aim of this research was to investigate what policy and instrument mix is required to support conservation agriculture, how this can be done and to measure how it influences this farming practice.

## **1.3 Significance of the study**

The agro-ecological environment is of paramount importance to human beings, flora and fauna; even though these services are not always fully reflected in market transactions (Mugido, 2011). Conservation agriculture is not significantly supported by comprehensive research which is capable of rigorously evaluating and examining the assumptions, approaches and

implementation procedures in the context of socio-economic, political, legal, cultural and technological dimensions in South Africa. Farmers base their decisions on economic and non-economic analyses. Hence, the promulgation of innovative economic policies and strategies is imperative to promote conservation agriculture as an alternative to conventional farming which has contributed to land degradation problems in agriculture.

The aim of this study was to identify how the adoption of conservation agriculture is affected by the State's policies (from macroeconomic through to national, provincial and local authorities/traditional leaders and across agricultural, land and other sector policies), and how this analysis can help generate a comprehensive and feasible database for policy formulation and decision making processes. These policies have the potential of becoming major footprints in conservation agriculture, and to influence farmers to alleviate agricultural land degradation to curb a reduction in yields and conserve the soil, ecosystems and biodiversity.

#### **1.4 Purpose of the study**

The overall objective of this research was to understand to what extent the current economic policies and instruments encourage or constrain conservation agriculture at all farming scales. The research findings will help to illuminate the current economic policy implementation approaches in the context of creating an enabling environment for conservation agriculture in South Africa. In order to reach the aforementioned overall objective, a number of specific research objectives needed to be met.

The specific research objectives were formulated as follows:

- Understanding the impacts of economic policy and instruments on conservation agriculture at all farming scales
- Identifying economic policy components that enhance or impede the adoption of conservation agriculture
- Considering ways of correcting market failures and other distorting factors in conventional farming
- Exploring prospective complementary economic policy opportunities that can help catapult conservation agriculture in South Africa

- Exploring global policy approaches that affect conservation agriculture and how these relate to the South African context
- Developing means to evaluate the success or failure of the policies and instruments affecting conservation agriculture

## 1.5 Definition of terms

- Conservation Agriculture:

Conservation Agriculture refers to a farming system where three principles – minimum disturbance of the soil, year round soil cover and sound crop rotations including legumes - are applied simultaneously (Blignaut *et al.*, 2014)

- Conventional Agriculture:

This refers to crop production systems that are normally based on soil tillage as the main operation and the most widely known tool for this operation is the plough, which has become a symbol of agriculture (FAO, 2006).

- Degradation:

Degradation refers to the steady alteration of ecological integrity and health (Society for Ecological Restoration, 2004).

- Biodiversity:

Biodiversity refers to the total collection of organisms within a certain geographic area in terms of taxonomic and genetic diversity, all the forms of life present within that place, and all the ecological roles carried out (Society for Ecological Restoration, 2004).

- Ecosystem:

An ecosystem is made up of plants, animals, and microorganisms in a certain area, the environment that sustains them, and their relations (Society for Ecological Restoration, 2004)

- Economic Policy

The set of government rules and regulations to control or stimulate the aggregate indicators of an economy.

- Policy instruments

"Policy instruments" is the term used to describe methods used by governments to achieve a desired effect. They include laws and regulations, market interventions, taxes and subsidies, moral suasion and force majeure, etc.

- Institutional framework

This refers to the systems of formal laws, regulations, and procedures, and informal conventions, customs, and norms that shape socioeconomic activity and behaviour.

- Market failure

A market failure is a situation where free markets fail to allocate resources efficiently (Stiglitz, 2000).

## **1.6 Delimitations of the study**

This study analysed the impact of economic policies and instruments on conservation agriculture in South Africa with a specific focus on dry land maize and beef production. This was done to try to evaluate the major agricultural enterprises within the above two typologies (crop and livestock enterprises) and also due to time and resource constraints facing the researcher.

This study also did not attempt to draft new policy documents, but rather to use the existing policies and instruments and to see how they can have some positive knock on effects on the uptake of conservation agriculture in South Africa. This study did not focus on agricultural policies alone, but rather included a variety of non- agricultural policies in general.

## **1.7 Thesis outline**

The first chapter presents an introduction and background of the study. The significance of the study, purpose of the study, definition of terms and the delimitations of the study are also presented in this chapter. The second chapter presents the literature review on conservation agriculture and economic policies within both a South African and a global context, while the

third chapter provides an overview of the history of conservation agriculture, again within a global and a South African context. Chapter four provides a description of the methodology and analytical framework used, while Chapter five presents the results and findings. The results are analysed using the methodological approach and analytical framework mentioned in chapter four. Finally, chapter six presents the conclusions based on the research findings and end by outlining the policy implications, recommendations and suggestion for further research.

## **Chapter 2: Literature review**

### **2.1 Introduction**

The objective of this chapter is to contextualise and review empirical studies relating to conservation agriculture and economic policies from both the South African and global perspective. Marginal attention has been paid by researchers to issues regarding the effects of policies and instruments on conservation agriculture within the South African context, therefore both local and international studies will be reviewed to seek guidance. This chapter ends by highlighting and explaining the link between conservation agriculture and other global and regional policy programmes.

### **2.2 A review of Conservation Agriculture and economic policies**

#### **2.2.1 Policies in South Africa**

Knott (2015) states that conservation agriculture in South Africa has been adopted in an environment lacking policy support frameworks directed at conservation agriculture. Most of the adoption that has taken place has been market driven (Knott, 2015), and currently, the economic policies and instruments around conservation agriculture are still fragmented (Nyamangara *et al.*, 2014). Van der Linde (2006) mentions that, environmental regulations and concerns about the preservation of arable land of the South African commercial agricultural sector processes have not been effective to address land degradation.

The Bill of Rights enshrined in South Africa's Constitution (Act 108 of 1996) stipulates that everyone has the right to have access to sufficient food and water and that every child has the right to basic nutrition, shelter, basic health care services and social services (Section 28). As the Constitution is considered the supreme law of the land, it cannot be superseded by any other governmental action. Despite this, the South African government has struggled for over two decades to adequately define the right to food and to develop a comprehensive legal and policy response to the issue. Policies dealing with the right to food, loosely arranged to address the elements of food security, have remained in silos and sometimes in contradiction to each other.

Key to this has been an ineffective and weakly conceptualised multi-sectorial coordination mechanism to enable an effective response to food insecurity (Blignaut *et al.*, 2014).

DAFF has embarked on a process of developing a Policy on Agriculture in Sustainable Development. This has been influenced by the commitments made by world leaders at the World Summit on Sustainable Development (WSSD) which was held in Johannesburg in 2002. This policy is part of the initiative of incorporating principles and objectives of sustainable development into the ethos of the agricultural sector of South Africa. The objective of this policy is to integrate and harmonise the three pillars of sustainable development, namely the social (people), environment (planet) and economic (prosperity) pillars. The policy also seeks to ensure socially responsible economic development while protecting the resource base and the environment for the benefit of future generations. The shared goals of government, farmers and conservationists, and the need for all stakeholders to work together to achieve a sustainable agricultural sector in South Africa are recognised in this policy. Whether this policy initiative will succeed will largely depend on the support and participation of farmers, consumers, government departments, parastatals, the private sector, non-governmental organisations (NGOs), community based organisations (CBOs) and other stakeholders (DAFF, 2011<sup>b</sup>).

South Africa is a signatory to a number of international agreements and conventions that require the matter of sustainability to be addressed in a responsible way. The Convention on Biological Diversity (CBD) which was held in Nairobi in 1992 has the objective of conserving the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. South Africa is also part of the United Nations Convention to Combat Desertification (1994), the International Treaty on Plant Resources for Food and Agriculture (2001), the Millennium Development Goals (2000) and the World Summit on Sustainable Development (2002). These international agreements pave the way for the promulgation of appropriate policy frameworks and instruments to speed up the uptake of conservation agriculture in South Africa.

The strategic direction of the agricultural sector has been shaped by three main policy documents: the *Agricultural White Paper*, the *Agricultural Policy in South Africa* discussion document; and the *Strategic Plan for South African Agriculture* (Tregurtha and Vink, 2008 and Tregurtha *et al.*, 2010). The 1995 White Paper has an agricultural policy goal which includes the undertaking of agricultural production based on sustainable use of natural agricultural and water resources; which presents an opportunity for the adoption of conservation agriculture in

the South African agriculture sector. The discussion document named *Agricultural Policy in South Africa* has amongst its goals an appreciation of the need to conserve agricultural natural resources and to implement policies and institutions for sustainable resource use. The Strategic Plan for South African Agriculture of 2001 aims to improve competitiveness and profitability and to ensure sustainable resource management, which clearly gives incentives to the adoption of conservation agriculture in South Africa.

Current policies in South African agriculture have been influenced by the deep policy reforms implemented from the mid-1990s. These policy changes resulted in deregulation of the marketing of agricultural products, liberalisation of domestic markets, and reduced barriers to agricultural trade (Kirsten *et al.*, 2007). These reforms reduced market price support and budgetary support to commercial farming resulting in a substantial reduction of total support to agriculture and an increased market orientation of the commercial sector (OECD, 2013). The trade policy to a greater extent has influenced the adoption of conservation agriculture by farmers in South Africa. This has been initiated by trade liberalisation that happened post 1994 which saw South African agriculture replacing direct controls over imports and exports, exercised in terms of the Marketing Act of 1968, by tariffs and then lowering of those tariffs below the bound rates of the Marrakech Agreement of 1994. One of the impacts of the trade policy reform has been the downward adjustment of field crop prices to world market prices. Commercial farmers in South Africa adapted by adopting conservation agriculture practices resulting in a decline in the use of inputs like fertilisers, herbicides, fuel and machinery in field crop production (Tregurtha and Vink, 2008 and Tregurtha *et al.*, 2010).

The most recent Strategic Plan for DAFF (2012/13 to 2016/17) is aimed at providing an effective framework to address the challenges facing the agricultural sector and to set the delivery targets for the departmental programmes from 2012 to 2017. The six programmes of the plan include: Administration; Agricultural Production, Health and Food Safety; Food Security and Agrarian Reform; Economic Development, Trade and Marketing; Forestry and Natural Resource Management; and Fisheries Management. Programme 3, focused on Food Security and Agrarian Reform, facilitates and promotes household food security and agrarian reform programmes and initiatives targeting subsistence and smallholder producers. It is emphasised that the concept of food security remains largely embedded within a food availability paradigm, with little conceptualisation about how these relate to other directorates in DAFF let alone other sectors within government. This remains the pervasive weakness in government policy focused on food security (Blignaut *et al.*, 2014)

The most recent policy directive to (begin to) emerge from DAFF is the Agricultural Policy Action Plan (APAP). This was approved in July 2013 by Cabinet to facilitate economic growth in favour of employment and food security. The APAP seeks to provide a long-term vision of the agricultural sector and more focused interventions in five-year rolling cycles. It is underpinned by the Integrated Growth and Development Plan (IGDP), which emphasises equitable growth and competitiveness, equity and transformation, governance, and environmental stability. The APAP, to its credit, argues that in order to support the sustainable management of natural resources within the agricultural system, an ecosystem-based management approach will be adopted. This highlights the conservation planning process aimed at conserving key natural resources and adopting a number of “well-developed” approaches to do so, many described as “climate-smart agriculture”. It takes a non-prescriptive view of these and encourages a broad use of different technologies (Blignaut *et al*, 2014).

In order to fast track the uptake of conservation agriculture in South Africa, the economic policies and instruments need to be comprehensive and effective; that is politically effective, administratively effective within the context of available capacity and financially affordable. Blignaut *et al* (2014) states that existing policies and interventions that aim to alleviate food insecurity have been fragmented and generally narrowly linked to the work of specific departments. These include agricultural credit and production programmes by DAFF, the National School Nutrition Programme by the Department of Basic Education, the Integrated Nutrition Programme by the Health Department, and the Department of Social Development’s “food for all” programme and “Zero Hunger” campaign (taken over from DAFF). The government policies around conservation agriculture are still fragmented (Nyamangara *et al.*, 2014) and the policies that influence South African agriculture have been implemented in a piecemeal, uncoordinated way and without proper consideration of the administrative feasibility of the intervention; hence there is a need to prioritise improved policy coordination at the heart of the country’s agricultural development strategy going forward (Tregurtha and Vink, 2008 and Tregurtha *et al.*, 2010).

Knowler and Bradshaw (2008) argue that conservation agriculture provides net benefits, both at the farm level and regionally. Policy-makers should promulgate laws and formulate policies that support farmers who would voluntarily like to switch from conventional agriculture, but are limited by access to financing for new equipment or by lack of knowledge and training. For non-mechanized agriculture, further research and development must drive technological

improvement to make conservation agriculture more feasible for small-scale farmers. Crop rotation systems must be optimized for local climatic and soil conditions.

As with all agricultural policies in South Africa, extension services for information and training are imperative. Current levels of extension and resources for training are insufficient (FAO, 2011), especially as South Africa undertakes land reform, increasing the number of inexperienced farmers. Provincial agricultural departments should focus on developing specific and localized crop rotation systems, since their development is particularly resource-intensive and their benefits widespread.

Kassam *et al* (2009) states that conservation agriculture may also concurrently benefit from and help to imbue a sense of stewardship, as farmers become more explicitly aware of the role of ecosystem services in the success of their operations. Through the promulgation and provision of effective and efficient economic policies and instruments, the South African government may harness this emerging awareness to draw farmers from all scales (commercial, emerging and small scale) into related conservation programs, and help farmers to prepare for climate change. Findlater (2013) recommends that all policies (from a national to a provincial scale) need to be better integrated with land reform and climate change policies, to ensure the success of each program and encourage approaches that will result in comprehensive benefits.

### **2.2.2 Policies in the USA**

The United States Department of Agriculture (USDA) conservation programs are closely tied to State and local programs. Federal and State agencies cooperate with a system of special-purpose local (county) conservation districts that are authorized by State law to provide education and technical assistance to farmers and county Agricultural Stabilization and Conservation (ASC) committees to handle cost-sharing (Uri, 1998). Another manifestation of agricultural program policy is the Federal Agriculture Improvement and Reform (FAIR) Act of 1996. Uri (1998) states that the promulgation of this act modified the conservation compliance provisions of the Food Security Act of 1985 to provide farmers with greater flexibility in developing and implementing conservation plans, in self-certifying compliance and in obtaining variances for problems affecting application of conservation plans. Another condition set out by this act was that if producers temper with conservation plans, or fail to use a conservation system on highly erodible land they risk loss of eligibility for many payments

including production flexibility contract payments. Nelson and Schertz (1996) mentioned that the important feature of this Act is that in self-certifying compliance, there is no requirement that a status review be conducted for farmers who certify themselves.

The Environmental Quality Incentive Program (EQIP) was established by the FAIR Act, and this program incorporated the functions of the Agricultural Conservation Program (ACP) and some other environmental programs, designed to encourage farmers to adopt production practices that reduce environmental and resource problems. This program was initiated in order to come up with plans that improve soil, water and related natural resources including grazing lands, wetlands and wildlife habitat. Uri (1998) suggests that EQIP must be carried out to maximize environmental benefits provided per dollar expended.

The USA government has used a number of policy tools to alleviate and minimise the problem of soil erosion from agricultural lands. The major policy instruments that have been used are (Uri, 1998):

- education and technical assistance
- financial assistance
- land retirement
- Research and development
- And conservation compliance requirements

The National Research Council (1993) states that conventional agriculture farming systems pose negative externalities that can cause harm to the environment. The deleterious effects caused by conventional agriculture systems consist of; offsite erosion related problems which impairs water resource use through siltation, sedimentation, eutrophication and pesticide contamination of rivers and lakes which leads to the lowering of water quality (US Environmental Protection Agency, 1995).

Educational and technical assistance applies under certain circumstances where conservation agriculture would be profitable to the farmer, but the farmer is unaware of its benefits. The education policy can lead to voluntary efforts (Uri, 1998). Educational activities under this policy are namely demonstration projects and information campaigns in print and electronic media. Uri (1998) states that when adoption of a practice leads to benefits or profits in the long run in the case where either new skills are required or farming techniques must be adapted for the practice to produce the greatest net benefits, the technical assistance can be provided to

those who adopt. The United States Department of Agriculture Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service, provides technical assistance to farmers and other land users, including local, State and Federal agencies that manage publicly owned land. NRCS helps district supervisors and others to draw up and implement conservation plans (Uri, 1998).

Financial assistance can be granted to overcome either short term or long term impediments or barriers to adoption (Uri, 1998). Farmers are assisted if the adoption of conservation agriculture leads to a situation that involves high initial investment costs and adjustment expenses. Single cost share payment is an instrument that can be used to encourage the switch from conventional agriculture to conservation agriculture. When conservation agriculture is not more profitable for the farmer than conventional agriculture, but the environmental or other off farm benefits are substantial, public funds can be allocated on an ongoing basis to defray the loss in profits to the farmer. Tax credits can be used as a policy instrument for the adoption of CA. Uniform subsidy rates are also applied but these have been criticised because they lead to production distortions since production conditions vary from one farm to another (Uri, 1998).

Research and development is applied in the USA to enhance the benefits of conservation agriculture with the objective of either improving its performance or of reducing its costs. Uri (1998) suggests that data gathering and analysis with adequate monitoring also supports research and development by providing information necessary to assess the determinants of conservation agriculture adoption and its effectiveness in achieving its goals. Uri (1998) also states that research and development is a long term policy strategy with an uncertain probability of success, but it has the potential of reaping the greatest results in influencing farmers to adopt conservation agriculture since it can increase profitability of this farming technique for a wide range of potential adopters. The USDA has funded several major surveys to provide data to assess the extent and determinants of adoption for particular production practices across a wide range of crops and regions.

Land retirement is the policy that has the largest influence on farmer's choice of practices or technologies (such as conservation agriculture) in the USA. The rationale behind this policy is that large social benefits can be realised by radically changing agricultural practices on a certain area of agricultural land and that the changes in individual practices would not necessarily provide sufficient social benefits (Uri, 1998). Thus for farmers to retire their land for conservation uses, they would expect compensation due to the loss in farm income and profits

by taking the land out of production. Lump sum payments and annual rental fees are used as policy instrument to encourage voluntary adoption of conservation techniques amongst the farmers. Lump sum payments are basically easements whereby the farmer's right to engage in non-conserving uses is purchased by the government for a specific period (Uri, 1998). Payment to farmers to retire land will eventually influence farmers to voluntarily change from conventional agriculture systems to conservation agriculture. The Conservation Reserve Program (CRP) provides for the USDA to enter into 10-15 year agreements with owners and operators to remove highly erodible and other environmentally sensitive cropland from production. Osborn (1996) states that in conjunction with conservation, the CRP originally had a second objective of reducing surplus crop production, however, the more recent emphasis on CRP has been to provide environmental benefits rather than to control the supply of commodities (Uri, 1998).

### **2.2.3 Policies in Australia**

There are currently three policy programmes directed at farmers that have the possibility of influencing the adoption of conservation agriculture in Australia (Rouchecouste and Crabtree, 2014 and Jat *et al.*, 2014). These are the Care for Our Country Programme, the Carbon Farming Initiative, and the Clean Energy Future Plan.

The Care for Our Country programme is an AUD2 billion spending initiative aimed at improving Australia's environmental assets and maintaining a sustainable resource base. These policy programmes also consist of a multi-year AUD15 million budget directed at sustainable farming practices. The target for this programme includes initiatives to reduce tillage, maintain residue cover and to promote the accumulation of soil organic matter (Rouchecouste and Crabtree, 2014 and Jat *et al.*, 2014).

The Carbon Farming Initiative (CFI) aims to reduce carbon dioxide and other harmful greenhouse gases in the atmosphere and to move Australia to a clean energy future by establishing a price on carbon to give an incentive for big emitters to cut pollution, promoting innovation and investment in less polluting types of energy, encouraging efficiency and creating opportunities in the agricultural sector to cut greenhouse gas emissions (Government of Australia, 2012 and Rouchecouste and Crabtree, 2014). Rouchecouste and Crabtree (2014) state that the CFI was initiated by the government in 2010 to give farmers, forest growers and

land holders access to domestic voluntary and international carbon markets by providing a framework to eliminate carbon dioxide from the atmosphere and to prevent the emission of greenhouse gases. The farmers, forest growers and land holders are exempted from paying a carbon price on their agricultural emissions, but they are not excluded from carbon market opportunities. Under the CFI, they may be able to earn carbon credits from activities such as reducing livestock emissions, increasing efficiency of fertiliser use, enhancing carbon in agricultural soil and storing carbon through revegetation and reforestation (Government of Australia, 2012). The CFI is legislatively supported by the Carbon Credit (Carbon Farming Initiative) Act of 2011, a market based instrument aimed at influencing farmers to become a net carbon sink (Rouchecouste and Crabtree, 2014 and Government of Australia, 2012).

The government of Australia promulgated the Conservation Tillage Refundable Tax Offset 3.1 Schedule 2 to the clean Bill 2011 as part of the Tax Act in order to provide a Refundable Tax Offset (RTO) for certain new depreciating assets in conservation agriculture farming practices (Rouchecouste and Crabtree, 2014). This law entitles the taxpayer to an RTO of 15 per cent of the cost of an eligible asset (including tine machines, disc openers and other suitable hybrid machines).

Rouchecouste and Crabtree (2014) state that these three policy programmes offer some form of incentives to reduce tillage, retain on farm biomass, increase soil organic carbon and to support new farming practices to reduce on farm greenhouse gas (GHG) emissions. This gives conservation agriculture farmers the opportunity to benefit from these three policy programmes.

#### **2.2.4 Policies in Europe**

There is a general lack of enabling government policies to support conservation agriculture in Europe, with very few exceptions. Friedrich *et al* (2014) mentions that the Common Agricultural Policy applied in the European Union (EU) is currently not providing any incentives for the adoption of conservation agriculture because it has been formulated using conventional agriculture as the standard method leading to disincentives for farmers to adopt conservation agriculture. Subsidies are imperative to farmers in the EU as they constitute a significant part of their total farm income, thus compliance with EU regulations and laws has a high priority for farmers even if those work against good farming practices (Friedrich *et al.*,

2014). The low adoption of conservation agriculture in Denmark and Ireland has been partly influenced by reluctance to publicly promote conservation agriculture adoption at different levels within the official institutions (Friedrich *et al.*, 2014).

Friedrich *et al* (2014) states that Switzerland is one of the few countries that has policies to support conservation agriculture in Europe. This has been mainly through instruments such as penalties and incentives. Farmers undertaking production on erosion prone land are required to maintain soil fertility in the long run as legislatively provided by the federal law relating to environmental protection and the implementation of preventive principles (Soils Report, 2009). In the case repeated erosion reports at the same site, this will be considered management failure which can lead to prosecution in accordance to the guidelines of the requirements of the Proof of Ecological Performance leading to a reduction in their direct payments received. The incentives have mainly been in the form of subsidies on implements, however there was a cut in subsidies after 2008 due to the big economic crisis and recession, and as a part must be co-financed at regional level (Friedrich *et al.*, 2014).

Friedrich *et al* (2014) argues that there is relatively little public support to conservation agriculture research in Europe, and it is mainly focused on minimum tillage and on comparison trials, rather than on optimising the performance of conservation agriculture systems. Very few other countries in Europe promote conservation agriculture with national policies and if done, it is limited at a provincial or regional level within the respective countries (Friedrich *et al.*, 2014).

### **2.3 Conservation Agriculture link with global and regional development policy**

The global and regional policy programmes link very well with the benefits yielded by the uptake of conservation agriculture in South Africa (as well as the whole African continent). This also applies to the Millennium Development Goals (MDG's). The most relevant are MDG 1, which aims to eradicate poverty and hunger by fifty percent in 2015 and MDG 7, which seeks to integrate the principles of sustainable development into country policies and programmes and restore the loss of environmental resources as a result of degradation (UN, 2013). This can be addressed through the uptake of conservation agriculture as a sustainable production system base for enhancing the production of crops and livestock, livelihood and the quality of life of farmers across South Africa and the whole African continent. From a Southern

African Development Community (SADC) point of view, the Namibian government has recognised the importance of conservation agriculture in the aforementioned argument and as a result they have implemented a comprehensive conservation agriculture programme for the country for the period 2015-2019 to help meet MDG 1 and MDG 7 (Government of Namibia, 2015).

Conservation Agriculture can also act as a direct response to the Comprehensive African Agricultural Development Programme (CAADP) of the New Partnership for African Development (NEPAD) of the African Union. The CAADP is built upon six pillars (NEPAD, 2003), four of which potentially align with the uptake of conservation agriculture, namely:

- Extending the area under sustainable land management and reliable water control systems;
- Upgrading of rural infrastructure and trade related issues for effective market access;
- Increasing food supply to ensure food security and the eradication of hunger; and
- Agricultural research and development, technology dissemination and adoption.

In addition conservation agriculture can potentially contribute to the realisation of three of the five objectives of the draft SADC Regional Agricultural Policy (SADC, 2011), namely:

- To promote and aid the production, productivity and competitiveness of the agricultural sector and the enhancement and development of trade related capacities and markets;
- To support and advance the growth of incomes for agricultural communities, with specific reference to small-scale farmers, fishers and foresters; and
- To promote sustainable use and management of natural resources.

Conservation agriculture can potentially act as an agro-ecosystem technique in which the enhancement of output and productivity go hand in hand with the delivery of the ecosystem services. The restoration of degraded agricultural land, the conservation of agro ecosystems and maintenance of soil fertility are, therefore essential to improve the efficiency and effectiveness of inputs used while achieving increased productivity. In order to achieve food security in the future, it is not enough to only seek higher food production and adequate access to food, but it is also imperative to mitigate and eradicate the destructive consequences of conventional agriculture production practices on the environment. This will also increase the resilience of production practices to the effects of climate change. The uptake and adoption of conservation agriculture as a novel production technique will help address the problems of

insufficient erratic rainfall patterns through the use of methods that reduce water evaporation losses, and improve the infiltration rate and low soil nutrient status by increasing soil carbon and nitrogen through the use of organic soil cover and sound crop rotations (i.e. with legumes) leading to sustainable intensification of agriculture (Government of Namibia, 2015).

## **2.4 Conclusion**

The background on policies and instruments affecting conservation agriculture was provided by the literature reviewed in this chapter. Firstly a review of government policies affecting conservation agriculture was analysed from a both South African and an international perspective, taking into consideration relevant case studies where conservation agriculture uptake and adoption has been advanced by policy. It was noted in this chapter that South Africa has a number of policies relating to conservation, but none of these are directly aimed at conservation agriculture. There is a need for the various economic and sectoral policies to be aligned so as to mitigate the high fragmentation amongst these policies and it is therefore imperative for the South African government to develop a conservation agriculture policy to speed up the uptake and adoption of conservation agriculture by all farmers (i.e. small scale, emerging and commercial farmers).

A number of studies have also shown that conservation agriculture has been adopted in the USA, Australia and to a lesser extent the Europe due to policy. The low influence of policy within the EU has been caused by a general lack of enabling economic policies and instruments to support conservation agriculture with only a few exceptions. Finally, the link between conservation agriculture, and, regional and global policy programmes was also evaluated to identify ways in which conservation agriculture can assist those policy programmes to achieve their respective goals and objectives.

## **Chapter 3: An overview of Conservation Agriculture from a South African and global context**

### **3.1 Introduction**

It is imperative to relate the conservation agriculture movement in South Africa to what has happened from a global perspective since farmer's decisions are influenced by various factors and operate in different environments. Therefore this section will focus on the historical overview and progression of conservation agriculture from both the South African and global context.

### **3.2 Global history and progression of Conservation Agriculture**

While there is some evidence that conservation agriculture was practiced by the Mayans and the Egyptians, Jat *et al* (2014) state that conservation agriculture was adopted in the mid-west USA as a result of the dust bowls that devastated agricultural lands in the 1930s. This led to new concepts of reduced tillage to be introduced as an alternative against the conventional intensive tillage system to ensure minimum soil disturbance and to protect the soil from water and wind erosion. Seeding machinery that causes minimum soil disturbances was then developed to ensure optimum crop stand (Friedrich *et al.*, 2012). However, it is clear that conservation agriculture in a modern sense began in the mid-20th century, with the introduction of effective herbicides. No-till, direct sowing of crops was first successfully demonstrated in the USA in the 1950s. At first adoption was slow but began to accelerate as experience accumulated and better planters and herbicides were developed (Harrington, 2008).

Historically, conservation agriculture practices and systems emerged as a response to soil erosion and profitability crisis in the USA, Brazil, Argentina and Australia (Scopel *et al.*, 2004). Their development was allowed by the discovery and availability of herbicides, which for the first time gave farmers a practical and economic option to control weeds other than by agronomic and mechanical means. The transition from conventional plough-based agriculture to conservation agriculture was neither fast nor without hurdles: in most places, it took several decades of hard work and trial- and- error by a variety of actors to get to the point where

conservation agriculture systems were profitable and adapted to the specific local conditions that each user had to face.

Conservation agriculture was adopted in Brazil in the early 1970s as a potential remedial measure to the severe problem of soil loss due to water erosion in the tropical and subtropical regions of Brazil. It was then refined to suite the local requirements with the active support and collaboration of researchers, extension workers and progressive farmers; and with government support (Jat *et al.*, 2014). Brazil became the cradle for the evolution and transformation of the conservation agriculture movement. Currently, Brazil, Argentina, Paraguay and Uruguay are the leading countries of the world having the greatest area under conservation agriculture of their total cropland. However, there are concerns about the quality of conservation agriculture being practiced in these countries since some farmers are undertaking monoculture practices of the soybean crop without any cover crops in-between the successive crops of soybean (Friedrich *et al.*, 2012)

The rapid adoption of conservation agriculture in Canada only started in the early 1990s (Lanfond *et al.*, 2014). The necessity to protect the soil against devastating wind erosion during the fallow dry season, the introduction of wheat in the Canadian prairies, availability of low cost and effective herbicides, progressive determination by farmers, supportive government policies, knowledge transfers through farmer's associations, and the design and development of no till planters by the private manufacturers matching the local farmers' needs, were the major contributing factors that led to the success and adoption of conservation agriculture in the Canadian Prairies ( Jat *et al.*, 2014). Currently there are 13.5 million hectares under conservation agriculture in Canada, and the farmers are witnessing the benefits in terms of reduced wind erosion, increased hectarage under winter wheat, improved soil quality, and biodiversity.

In Australia, conservation agriculture was initiated in the mid-1970s after local researchers and progressive farmers had visited the USA and the UK (Jat *et al.*, 2014). This was aided by the availability of herbicides at competitive rates by private manufacturers. The main reasons that influenced the switch from conventional intensive tillage to conservation agriculture were: soil protection against erosion, soil moisture conservation and timely sowing of the crops. The government of Australia has been proactively supporting the adoption of conservation agriculture by giving incentives through programmes such as 'Care for our Country', 'The

Carbon Farming Initiative’ and ‘Clean Energy Future Plan’, which have catapulted conservation agriculture since the early 1990’s (Rouchecouste and Crabtree, 2014).

Conservation agriculture is not wide spread in Europe, with only 1 per cent of arable land under no till systems (Friedrich *et al.*, 2012), France, Spain, Finland and the UK have made the most progress. The slower adoption of conservation agriculture in the EU has been caused by agricultural policies such as direct payments to farmers and subsidies on certain commodities, the moderate climate and the opposition of certain interest groups (Friedrich *et al.*, 2014). Kassam (2009) states that conservation agriculture principles have not been supported by the environmental management custodian schemes because they fail to incentivise special rewards in the form of single farm payments to European farmers. This can be further attributed to commodity related subsidies and payments for set aside land that oppose the adoptions of conservation agriculture (Kassam, 2009).

In Asia, conservation agriculture has been introduced with the support of development agencies such as FAO, CIMMYT and ICARDA, with Kazakhstan and Uzbekistan having made good progress with adoption. This has been influenced by the concentration of large land areas under agricultural joint-stock companies and government subsidies for adopting conservation agriculture practices (Kienzler *et al.*, 2012 and Jat *et al.*, 2014). In China progress has been very slow due to low labour costs and low share of machinery and fuel in the total cost of cultivation, which gives few incentives to farmers to adopt conservation agriculture practices (Wang *et al.*, 2010 and Jat *et al.*, 2014).

Conservation agriculture and no till systems have always been used in Africa (FAO, 2009). FAO (2009) mentions that conservation agriculture in Africa dates back to the past when the people used sticks to dig holes in the ground to prepare the land for seeding. This only changed after the colonial settlers introduced conventional agricultural systems that brought about mechanisation and the introduction of ploughing implements. However not all farm land was converted to conventional agriculture practices, and some conservation agriculture and no till practices were still conducted in a few cases (FAO, 2009). IIRR and ACT (2005) state that conservation agriculture developed in numerous different places at almost the same time in Africa. A classic example comes from Zimbabwe and Zambia, where conservation agriculture was adopted to protect the land from degradation, beginning on one large-scale commercial estate in Zimbabwe, where zero-tillage and direct planting into deep straw mulch were jointly used to bring a slow but sure recovery for degraded land (IIRR and ACT, 2005). Efforts are

being made to transfer this achievement to some of the various new small-scale farmers in Zimbabwe (IIRR and ATC, 2005).

In Zambia around the same time, a dedicated extension unit, supported by donor funds, spread the message (IIRR and ACT, 2005). The small-scale farmers in Zambia have appreciated conservation agriculture as a profitable and sustainable farming practice. Currently more than 100,000 small-scale farmers in Zambia have adopted conservation agriculture (Friedrich and Kienzle, 2007 and IIRR and ACT, 2005). The manual preparation and sowing of crops in ‘potholes’ for water retention, combined with crop residue retention in these potholes, is said to have been taken up by 50,000 – 75,000 farm families. However adoption has largely taken place in areas where about 15 per cent of the population own animal draft power (Harrington, 2008).

Large-scale farmers in Kenya, South Africa and Namibia also use conservation agriculture practices. In South Africa, no-till farmers’ clubs similar to those in South America have been set up (IIRR and ACT, 2005). Initiatives by government research and extension agencies, donors and the private sector to encourage conservation agriculture for smallholder farmers in Cameroon, Ghana, Kenya, Madagascar, Malawi, Namibia, Tanzania, Uganda, Zambia, Zimbabwe and other countries have been established (IIRR and ACT, 2005). Many countries conduct research or encourage conservation agriculture, but it is important to note that the most important researchers and promoters of conservation agriculture in Africa are the farmers themselves (Friedrich and Kienzle, 2007 and IIRR and ACT, 2005).

The adoption of conservation agriculture has been very slow in Africa (with only one percent of total conservation agriculture area in the world) despite nearly 20 years of promotional efforts by numerous international development agencies and the national extension programmes (Jat *et al.*, 2014). South Africa is leading with the highest hectareage under conservation agriculture (368,000 ha i.e. 36.3 per cent of total conservation agriculture area in Africa) followed by Zambia (200,000 ha i.e. 19.7 per cent of total conservation agriculture area in Africa), Mozambique (152,000 ha i.e. 15 per cent of total conservation agriculture area in Africa) and Zimbabwe (139,300 ha i.e. 13.7 per cent of total conservation agriculture area in Africa) (Jat *et al.*, 2014). Currently Africa is lagging behind all the other continents with only 1.01 million hectares (1 per cent of total conservation agriculture area in the world) under conservation agriculture (Jat *et al.*, 2014). In Tunisia and Morocco there has been considerable

progress with the adoption of conservation agriculture in the large estates, and this has been largely due to the fact that the owners had access to information, enough money to buy the quality no till seeders from Brazil, France or Spain and they could bear the risk of trying new practices (Jat *et al.*, 2014). There are various reasons for the slow adoption of conservation agriculture in Africa, including: a low degree of mechanization within the smallholder system, lack of appropriate implements, lack of appropriate soil fertility management systems, problems of weed control under no till systems, lack of access to credit, lack of appropriate technical information, blanket recommendations that ignore the resource status of rural households, competition for residues in the mixed cop-livestock systems and limited availability of household labour (Twomlow *et al.*, 2006 and Harrington, 2008). Until these constraints can be overcome, adoption of conservation agriculture in Africa will be slow. The history of conservation agriculture adoption in this continent remains to be written.

The Africa Conservation Tillage Network (ACT), established in 1998, is the major advocate of conservation agriculture in Southern Africa (IIRR and ACT, 2005). It recently evolved into a Pan African network with global links, and is now active in technology development, networking, information exchange, and policy advocacy (IIRR and ACT, 2005 and Harrington, 2008). Combining agro-forestry with conservation agriculture is a good alternative to augment bio-mass supply for conservation agriculture in the rain fed tropics and subtropics where residues are used for cattle feeding or where biomass production is low due to water stress and several other factors (Sims *et al.*, 2009). With climate change happening all around the world causing unfavourable climatic conditions at the critical crop growth stages, conservation agriculture is a feasible solution relevant to achieve and enhance food security and a sustainable resource base (Corsi *et al.*, 2012).

### **3.3 Historical overview and progression of conservation agriculture in South Africa**

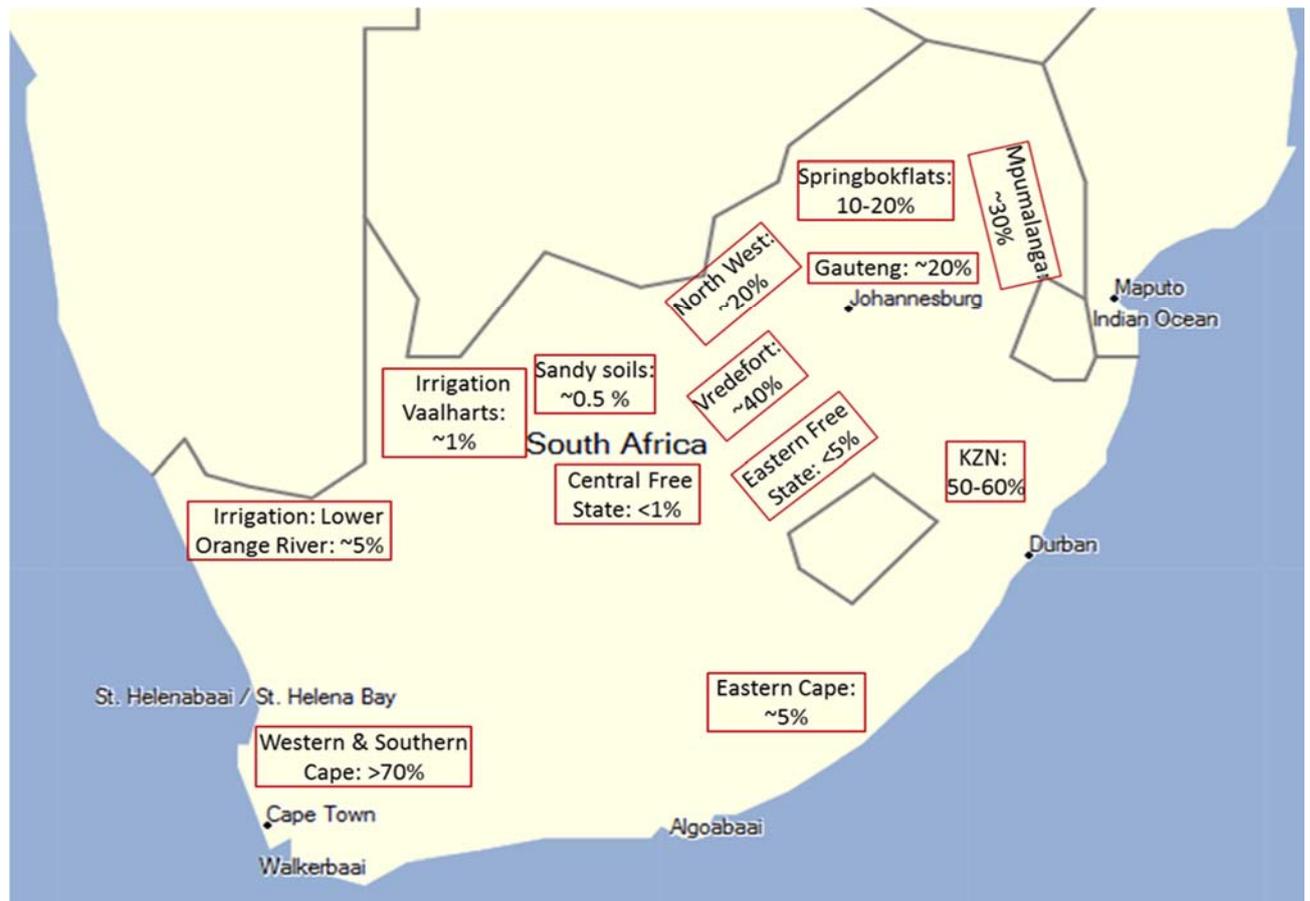
Conservation agriculture research trials were first conducted in South Africa around 1976, spearheaded by the Small Grains Institute of the Agricultural Research Council of South Africa, with trials conducted over the maize growing areas of South Africa (Berry *et al.*, 2001). Nyamangara *et al.* (2014) states that, currently in South Africa conservation agriculture is mainly practised by the large-scale commercial farmers. Most of the smallholder farmers practising conservation agriculture in Southern Africa have adopted minimum tillage, while

the inclusion of crop rotation with legumes and achieving the 30 per cent residue cover is still low (Nyamangara *et al.*, 2014). This implies that the strong mixed crop-livestock interactions in the smallholder areas results in the residues being unavailable for mulching in preference to livestock feed as evidenced in South Africa's Limpopo Province (Nyamangara *et al.*, 2014).

Conventional agriculture is contributing to increased erosion (Laker 2004; Mills and Fey 2004 cited in Blignaut *et al.*, 2014 and Kassam, 2009) and therefore, indirectly, to the decline of soil organic matter. Land degradation is one of the major challenges to sustainable agriculture in South Africa (Du Preez *et al.*, 2011 cited in Blignaut *et al.*, 2014)). Blignaut *et al.* (2014) states that commercial farmers in South Africa have already started reducing tillage on their farms, mainly due to rising fuel prices. An example of this is that farmers will plough every second or third year rather than annually. Also observed is a shift towards secondary tillage where mouldboard ploughing and deep ripping is replaced by chisel ploughing, shallow ripping and multiple disking. Conventional agriculture is associated with bare fallow as part of the crop rotation systems. Fallow under conventional agriculture systems is practiced for improved water harvesting and breaking of pest cycles, but the use and need of bare fallow is a contested practice under more sustainable farming systems (Sooby *et al.* 1997; McNee *et al.* 2008, cited in Blignaut *et al.*, 2014)

Successful adoption of conservation agriculture in South Africa has taken place among grain and sugar cane farmers in KwaZulu-Natal, and among the grain farmers in the Western Cape and Free State. This however suggests that more hectares of land have been put under conservation agriculture contrary to the 368 000 hectares reported by Jat *et al.* (2014). It has however been slow in other production areas (Fowler, 2000). The majority of crop production in South Africa is subjected to intense and frequent ploughing practices of conventional farming (Brady and Weil, 1999). There is generally a lack of information and statistics concerning conservation agriculture in South Africa. South Africa's agricultural production regions are heterogeneous in nature, in terms of precipitation, temperature and soils; therefore technology inference from one region to another might not be realistic. A good example is in KwaZulu-Natal, where the KwaZulu-Natal No Till Club has conducted research since 1997, Here the adoption and success of conservation agriculture has been influenced by the favourable rainfall conditions and soils with high clay content. These conditions however are absent in a province like the North West and there has not been any recent research conducted (BFAP, 2007). Agricultural systems are complex, affected by various factors and adapted to local conditions and farmer circumstances; therefore the transfer of an agricultural system is

likely to be successful if the system is tailored to the local conditions (Wall, 2007). Figure 3.1 gives an illustration of the current status of conservation agriculture adoption in South Africa.



**Figure Error! No text of specified style in document..1 Current status of Conservation Agriculture adoption in South Africa**

Source: Personal communication: Sybrand Engelbrecht, Maize Trust (2015)

Currently conservation agriculture has been widely adopted by commercial wheat farmers in the Western Cape Province, and according to Strauss (personal communication 2015), at least 90 per cent of all commercial wheat farmers have adopted conservation agriculture, making it the number one province in terms of the uptake and adoption percentage. The successful and high uptake of conservation agriculture in the Western Cape Province has mainly been farmer and market driven (Knott, 2015), and has been driven due to economic reasons and also support from the Western Cape Government and the Western Cape No-Till Club. This can also be attributed to the effects of the trade policy as mentioned in section 1.1 in chapter 1 by Tregurtha

*et al* (2010) as a result of the effects of the deregulation and trade liberalisation which saw the agricultural sector losing all state support.

On the upper left side of the map (in figure 3.1), the uptake of conservation agriculture has ranged between 0.5 per cent to 5 per cent mainly because of the high sandy soils due to the encroachment of the Namib Desert from Namibia and the Kalahari Desert from Botswana, and as a result these areas are not really suitable for the adoption and uptake of conservation agriculture. However, all the other areas from the interior to the far right of the map, could potentially be converted to conservation agriculture, hence the government of South Africa, NGOs, farmers and other relevant stakeholders should step up their efforts to promote conservation agriculture and effective and efficient policies and instruments are imperative to achieve this. Most of the adoption in this case has been by commercial farmers, and uptake by small scale and emerging farmers is still very low. This is an aspect that needs to be addressed.

In the case of the North West province a different scenario has taken place in influencing the current low adoption of conservation agriculture. Despite the experimental work conducted during the late 1980s and 1990s, conservation agriculture had not been mastered for a number of reasons including: inadequate tillage equipment, build-up of diseases, unavailability of cheap herbicides and a lack of passion and commitment to the conservation agriculture concept (BFAP, 2007). The news of the failure of conservation agriculture during these times was noted in the North West province and the grain farmers in this region have to date maintained the status quo and are convinced that nothing less than the ploughing of fields will suffice for crop production (BFAP, 2007). However, there are now sufficient equipment retailers, improved and effective herbicides and considerable progress in biotechnology which enable the farmers to adopt conservation agriculture techniques in a manner that is biologically and economically sustainable. All that is needed is a shift in their mind-set from a pessimistic view of conservation agriculture to a more optimistic view.

The general lack of knowledge and inexperience with regards to conservation agriculture prevents many farmers from adopting this approach. South Africa suffers from erratic climatic conditions, such as floods and drought. Conservation agriculture techniques can help reduce erosion, allow more constant water flow into rivers and re-activate wells. For example, almost all farmers in the Karkloof Valley in KwaZulu-Natal practice conservation Agriculture. As a result, the river running through the Karkloof Valley is reported to be visibly clearer than rivers

in neighbouring areas, and the number of fish species in the river has increased (ACT, 2011 and FAO, 2007).

The adoption of the conservation agriculture movement in South Africa has been slowed down by the current traditional land tenure, uncontrolled communal grazing, lack of sufficient soil cover, as well as socio-economic constraints (GTZ, 1998). Research and development and appropriate policy initiatives as well as diffusion strategies have to be initiated to solve these problems before conservation agriculture becomes an attractive alternative for farmers in South Africa and the African continent as whole. ACT (2011) and FAO (2007) state that the HIV/AIDS pandemic has adversely affected the farming sector in South Africa and Southern Africa as a whole, thus causing labour constraints at the time of seeding. This may be an opportunity for conservation agriculture to be adopted among farmers in South Africa.

### **3.4 Conclusion**

This chapter presented the overview and background information of conservation agriculture from both a global and South African context. Different countries were used as case studies to see how conservation agriculture originated and progressed to date and giving a snapshot of various prospects and challenges faced within the conservation agriculture revolution.

The majority of farmers have adopted conservation agriculture due to the result of a crisis, (e.g. the dust bowls in the USA, extensive soil erosion in Brazil, Argentina, Australia and the degradation experienced in Zimbabwe) (Jat *et al.*, 2014 and IIRR and ACT, 2005). Conservation agriculture has been proven in all the case studies as a novel approach that can mitigate the agricultural land degradation as a result of conventional farming operations and practices. However for farmers to switch from conventional farming to conservation agriculture, they need to acquire adequate technical knowledge about conservation agriculture and also appropriate implements and herbicides. The next chapter provides information on the methodology and analytical framework used for the purpose of this study.

## Chapter 4: Methodology and analytical framework

### 4.1 Introduction

The purpose of this research is to investigate how economic policies and instruments influence the adoption of conservation agriculture in South Africa at all farming scales (commercial, emerging and small scale) with the major aim of enhancing food security and a sustainable resource base. This statement is based on the assumption that farmer's decisions are influenced by various factors known to the farmers themselves and it is not known how these decisions are shaped by policy. This section elucidates the methodological approach that was undertaken to deal with the problem statement and achieve the research objectives of the study.

### 4.2 Research method

The knowledge synthesis method was used to gain a robust view on how policies and instruments affect the uptake and adoption of conservation agriculture in South Africa. This method is inspired by the field of political science, policy analysis, literature on evidence informed decision making in conservation and sustainability and theoretical developments related to deliberative processes (Morestin *et al*, 2010).

The knowledge synthesis method is characterised by four steps (Morestin *et al*, 2010):

- The initial step involves compiling an inventory or list of economic policies and instruments that can potentially address the targeted objective/goal (i.e. the uptake and adoption of conservation agriculture), and selecting the appropriate policies on which the knowledge synthesis will focus.
- The second step aims at aligning the sequence of effects expected to link the policies and instruments under study to the targeted objective/goal (i.e. the uptake and adoption of conservation agriculture).
- The third step is conducted by means of a literature review, involving synthesising data on the effects of the policies and instruments in contexts of how they have been implemented (effectiveness, unintended effects, effects related to equity) and on issues regarding their implementation (cost, feasibility, acceptability).

- Lastly, the fourth step seeks to enhance and contextualise the data and information drawn, through the literature, through deliberative processes that bring together actors concerned by the targeted goal/objective (i.e. the uptake and adoption of conservation agriculture) and working within the context in which implementation of the policies and instruments are being considered.

This approach encourages the analysis of the effectiveness of the options or alternatives under consideration. Nutley *et al* (2007) argues that many governments have advocated to analyse policies and various programs to determine what really works.

### **4.3 Analytical framework**

The aforementioned methodological approach applies an analytical framework that is two-pronged, focussing on the effects of the policies under study and on the matters pertaining to the implementation of the policies; and takes into account a wide range of both quantitative and qualitative data from scientific and non-scientific sources. Issues relating to the implementation of economic policies and instruments are imperative in order to assess the probability of success and to ensure that a proper implementation planning framework is in place. Drawing on the works from the field of political science (Salamon, 2002) and on policies applicable to sustainability and conservation in agriculture, the aforementioned two analytical dimensions that affect policies can be broken down to six analytical criteria that can potentially influence decision making, namely: effectiveness, unintended effects, equity, cost, feasibility and acceptability.

Durability is also considered to determine the capacity to be sustained over time, cutting across all six analysis criteria. This implies recording and keeping track of the capacity of policies and instruments under study to remain effective overtime and in the long run. Table 4.1 shows the specified elements that should be taken into consideration for each analysis criterion to guide the analysis.

**Table Error! No text of specified style in document..2 Criteria for analysing policies and instruments**

Effects	Effectiveness	What effects does policy have on conservation Agriculture?	D U R A B I L I T Y
	Unintended effects	What are the unintended effects of this policy?	
	Equity	What are the effects of this policy on different groups?	
Implementation	Cost	What is the financial cost of this policy?	
	Feasibility	Is this policy technically feasible?	
	Acceptability	Do the relevant stakeholders view the policy as acceptable?	

Adapted from Morestin *et al.*, 2010.

#### 4.3.1 Effectiveness

Effectiveness is the first element to be considered when undertaking policy analysis. This analysis criterion measures the extent to which a particular policy or programme is meeting its targeted goals or objectives. Salomon (2002) states that one should initially evaluate policy in terms of its effectiveness at achieving its objectives. In the case of conservation agriculture policies, the objective is to prevent or remedy soil degradation problems, or to otherwise promote sustainable agriculture as a viable option for enhanced food security and a sustainable resource base. It is also imperative to report a possible absence of effects of the various policies and instruments, or the negative effects of the policies and instruments that could aggravate the problem. These neutral or negative effects are recorded under the effectiveness dimension because they are measured against the objective being pursued by the policies and instruments under study.

#### 4.3.2 Unintended effects

Unintended effects refer to all the consequences that arise due to implementation of the various policies and instruments under study, but that are not related to the objective pursued. It is practically impossible to control a policy so fully as to ensure that it produces the desired effect and no other. Reychtnik *et al* (2002) state that these unintended effects can be positive or negative and can be produced in all kinds of areas. Complementary measures that alleviate negative unintended effects should also be put in place.

### **4.3.3 Equity**

Equity refers to the distributional effects of a policy in terms of “who gains or who loses” as a result of a particular programme or policy. The aim is to determine whether the policies and instruments under evaluation result in different impacts on various groups in terms of gender, socio economic status, ethnicity, sexual orientation, etc., or whether the policies and instruments could potentially create, increase or correct inequalities in the distribution of the targeted problem (Milton *et al*, 2011 and Morestin *et al*, 2010). A good example of this is conservation agriculture has proven to be less effective among those with less knowledge about the technique, whereas this group are generally already affected by problems of low yields, soil erosion and high input costs.

### **4.3.4 Cost**

Costs should be evaluated and analysed over time (Pineault and Daveluy, 1986), as well as their visibility that is, the degree to which the costs are apparent or hidden (Salamon, 2002). These factors significantly impact on the ways in which stakeholders react to given policies.

### **4.3.5 Feasibility**

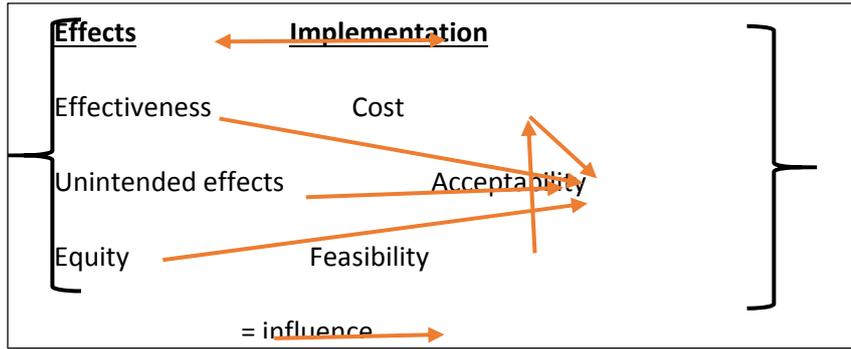
Feasibility deals with means of achieving the end of a given policy. Swinburn *et al* (2005) argue that feasibility depends on the availability of the required resources including personnel, material resources and technology in the broader sense. If a given policy is formulated and implemented with inadequate resources, there is no magic or evaluation that can be undertaken but rather to conclude that such a given policy is not feasible.

#### 4.3.6 Acceptability

Acceptability refers to how the current and proposed policies are judged by stakeholders (Swinburn *et al.*, 2005). This criterion is based on subjective judgements of the various stakeholders. Peters (2002) argues that factors that are external to the policy and instruments under consideration are also imperative to the stakeholder's judgments, because the position of each stakeholder is caused by his or her knowledge, beliefs, values and interests, be they political, economic or otherwise defined. A policy that does not receive the required adequate support is likely to have difficulties in being adopted and implemented, and may thus be constrained in producing the desired effects (Salamon, 2002).

#### 4.3.7 The relationship between the six analysis criteria

It is important to note that the six analysis criteria mentioned in section 4.3 are interrelated. Morestin *et al* (2010) states that the acceptability criterion is influenced by all the other criteria without exception, because stakeholders usually evaluate economic policies and instruments on the grounds of their assessment of the other criteria. In the other way around, the acceptability can potentially have an influence on the feasibility of a policy or instrument: this is the case for example, if specific stakeholders judge a policy as ineffective and constraining (Acceptability criterion) and, consequently, they decide to take action to block the implementation (Feasibility criterion). In addition, the cost criterion can potentially be influenced by feasibility; meaning that the greater the feasibility of a policy is taken for granted, the greater the risk of high implementation costs. Lastly, the effects dimension (i.e. effectiveness, unintended effects and equity) of policy analysis is collectively influenced by the implementation dimension (i.e. cost, feasibility and acceptability) as a result of its potential and probability to yield those effects. Figure 4.1 gives an illustration of the aforementioned relationship between the six analysis criteria.



**Figure Error! No text of specified style in document..2 Relationships between the analysis criteria**

Adapted from Morestin *et al* 2010

#### 4.4 Data collection

The research process was qualitative in nature and involved mainly the use of secondary data and to a lesser extent primary data. The data used in this study was collected through literature reviews, individual reflection, focus group discussions, deliberative processes and consultations with policy experts. The study involved the review and analysis of published and unpublished policy documents, development plans, statistical information and reports to seek guidance.

The individual reflection method is an approach that involves trying to answer questions pertaining to the six analysis criteria to bring about a personal reflection by the researcher on how the policies under study can be evaluated; and bringing out a synthesis on the effects and implementation dimensions of the policy analysis (Morestin *et al.*, 2010). The consultation with experts was conducted to gain an insight from policy experts and other relevant stakeholders about their views pertaining to the problem statement and research objectives.

Focus group discussions were also conducted guided by conservation agriculture experts in order to try to learn about different opinions on how policies and instruments affect the uptake and adoption of conservation agriculture in South Africa, and to seek guidance for future action. The deliberative process is an approach that brings together representatives of relevant stakeholders, whereby a facilitator stimulates discussion among participants by referring to a summary list of questions and agenda points, with the major aim of gathering and classifying all the contributions under the various dimensions of the analytical framework (Morestin *et al.*,

2010). This was achieved through student colloquiums (i.e. academic seminars led by different lecturers and experts) and policy workshops organised by ASSET Research.

#### **4.5 Conclusion**

This chapter outlined the methodological approach and analytical framework used in the study. Most of the data was collected using literature reviews of published and unpublished policy documents (i.e. both promulgated policies and policy drafts), journal articles, governmental publications and other literature relevant to conservation agriculture and sustainability. Focus group discussions, expert consultations, deliberative processes and individual reflection were also employed to make the research process more robust and holistic. The knowledge synthesis model was adopted to analyse each of the major policies with a potential to influence the uptake and adoption of conservation agriculture. The next chapter presents the research findings and results of this study based on the methodological approach and analytical framework discussed in this chapter.

## **Chapter 5: Research results and findings**

### **5.1 Introduction**

This chapter presents the results and findings and analyses them using the methodological approach and analytical framework discussed in chapter 4. Firstly, the major economic policies with potential impacts on conservation agriculture are presented followed by the policy instruments that can potentially enhance the uptake and adoption of conservation agriculture in South Africa. Thirdly a brief description of other South African legislation applicable to conservation in agriculture is provided. Lastly, the major policies with possible impacts on conservation agriculture are then analysed using the knowledge synthesis method and the analysis criteria adopted from Morestin *et al* (2010) to show the impacts of the policy mix on the uptake and adoption of conservation agriculture in South Africa. This is followed by the conclusions.

### **5.2 Policies with possible impact on conservation agriculture**

There is currently no policy for conservation agriculture that has been promulgated in South Africa, however, there are some that have been drafted which have the potential to induce some positive knock-on effects on the uptake of conservation agriculture in South Africa across all farming typologies (i.e. small scale, emerging and commercial farmers). The afore-mentioned policy mix is illustrated in Table 5.1.

**Table Error! No text of specified style in document..3 Policies with possible impact on conservation agriculture**

<b>Policy</b>	<b>Major Purpose</b>	<b>Department</b>
Climate Change Policy	Carbon Sequestration	DEA
Land Reform Policy	Redress of Social injustices	DRDLR
Carbon Tax Policy	Instrument for Climate Change policy	DEA
Trade Policy	Instrument for Industrial Policy	DTI
Policy on Organic Production	Promoting Organic Agriculture in SA	DAFF and DTI
Policy on Agriculture in sustainable development	Transition of Agricultural sector to a greener economy	DAFF
Food and Nutritional Security Policy	Eliminate food insecurity	DAFF
Environmental Policy	Environmental management	DEA
Water Policy	Water resources management	DWA
CARA	Control and regulation of the conservation of agriculture	DAFF
CRDP	Creation of decent work and sustainable livelihoods	DRDLR
Invasive and Alien Species Policy (NEMBA)	Control and elimination of Invasive and Alien Species	DEA and DAFF

### 5.2.1 Climate change policy

Climate change is one of the major problems faced by the global economy as a whole. Louw and Ndanga (2010) mention that the temperature in the African continent has warmed up by 0.5 degrees Celsius since the year 2000, and the average annual temperature is likely to rise an additional 3-4 degrees by 2099 (IPCC, 2012, World Bank, 2009 and DBCCA, 2009). It is forecasted that dry areas will become drier whilst wet areas will become wetter posing an

additional challenge to livelihoods and economic activities that depend on natural resources (IPCC, 2012 and Louw and Ndanga, 2010). Carbon concentrations in the atmosphere are the major reasons why the climate is changing.

Climate change significantly affects the agricultural sector and it is important that measures have to be put in place to mitigate climate change and build on resilience to the adverse effects associated with climate change. Agriculture contributes 14 per cent of greenhouse gas emissions from a global perspective. With the currently anticipated 4 degrees Celsius rise above pre industrial levels there is a high risk of a permanent decline in the annual per capita income of 4-5 per cent for Africa in contrast to minimum losses in developed countries and it is also forecasted that there could be a further 1 per cent loss of the average global GDP (Louw and Ndanga, 2010; DBCCA, 2009; World Bank, 2009; Bradford, 2009 and IPCC, 2012). The aforementioned losses will be driven by the impacts on agriculture in Africa, since agriculture is an imperative sector of the continent as a whole.

South Africa is a water scarce country and agriculture uses 62 per cent of all water available in the country (CSIR, 2010). Climate change is posing serious challenges to the agricultural sector due to variability in rainfall patterns. Agriculture in general is very sensitive to rainfall variability and this will impact heavily upon the poor farmers (namely the communal and emerging small scale farmers) within the country whose livelihoods are dependent on agriculture as the main source of income and sustenance. The small scale farmers have low capacity to adapt climate change and this might further make their lives more vulnerable and fragile.

It is important to take note of the triple bottom line of sustainability that is taking into consideration environmental sustainability, social sustainability and economic sustainability in order to make a smooth and balanced transition towards a greener agricultural sector. Conservation agriculture is one way in which greenhouse gas emission can be mitigated, whilst at the same time improving the health of the ecosystem and biodiversity and gradually increasing the yields of crops. Conservation agriculture has the advantage of providing healthy investment returns whilst providing broader economic, social and environmental benefits (Louw and Ndanga 2010 and Knott, 2015). Ndanga and Louw (2010) recommend that to fully achieve a transition from conventional agriculture practices to sustainable farming methods (like conservation agriculture) it is imperative to consider the effects of climate change on Africa and the steps needed to try to rectify these changes and still ensure sustainable economic

growth. It is important to note that the use of herbicides to control weeds in conservation agriculture systems pose negative externalities such as contamination of the environment, and harm other non-targeted ecosystem species and so forth. This trade off should be considered when conservation agriculture decisions are made.

The DEA published a policy document in 2011 named the National Climate Change Response White Paper, and in this policy document it recognised that climate change severely impacts agriculture and forestry and they have significant potential for adaption. Synergy and overlap exists between adaptation and mitigation measures for both agriculture and commercial forestry, and climate-resilient sectorial plans have the potential to directly address the plight of those most impacted by climate change – the rural poor (DEA, 2011<sup>a</sup>). Climate resilience in agriculture addresses major issues of national importance such as food security, water, health, and land reform. The National Climate Change white paper also recognises the fact that agriculture uses most of the available water resources and that conventional agriculture commercial input-intensive agriculture has a range of negative environmental, social and economic externalities, which increasingly render it an unsustainable model.

A climate resilient agricultural response will only be successful if it is recognised that agriculture should not only be seen as a way of producing food, but rather as a way of producing a range of other environmental and socio-economic benefits. The appropriate use of small-scale labour-intensive agriculture techniques and models could reverse the present decrease in agricultural jobs; contribute to empowerment goals; promote food security; conserve soil quality and structure; and contribute to biodiversity (DEA, 2011<sup>a</sup>).

Given the aforementioned arguments, the climate change policy has the potential to positively influence the transition of current agricultural practices to more sustainable agricultural farming practices such as conservation agriculture. However, to the contrary, conservation agriculture makes use of herbicides to control weeds, and this poses negative environmental impacts. This trade-off should be considered before making the conclusion that conservation agriculture is environmentally sustainable.

### **5.2.2 Land reform policy**

South African agriculture consists of a dual system which has basically been created by the legacy of apartheid. Sol Plaatje in his book mentioned that; “AWAKING on Friday morning, June 20 1913, the South African native found himself, not actually a slave, but a pariah in the land of his birth”. The Glen Grey Act was the precursor of most of the legislation that saw the black farmers relegated to a marginal 13 per cent of the total land, and these laws were namely the Natives’ Land Act of 1913, the Native Administration Act of 1927 and the Native Trust and Land Act of 1936 (Weideman, 2004).

The degradation problems characterised in South Africa were caused by apartheid and these are mainly evidenced in the former homeland areas resulting from segregatory policies and laws pre-democratisation such as the native land legislation of 1913 (Zokwana, 2014 and Meadows and Hoffman, 2002). The degradation of agricultural land in South Africa was exacerbated by inequitable land ownership, and most of the degradation has happened in the former homeland areas (Meadows and Hoffman, 2002). Basically the segregative land tenure laws enacted before 1994 never gave any incentives for the marginalised people living in these former homeland areas to conserve land since they did not have clearly defined property rights that allowed them to have a stake in the land.

After democratisation in 1994, the government of South Africa enacted a land reform programme to redress the injustices of the racialised dispossessions of land of the past. The land reform programme of South Africa consists of three parts namely; the restitution programme, land tenure reform programme and the redistribution exercise (Weideman, 2004, CDE, 2005; CDE, 2008 and Greenberg, 2010). There has been progress with the restitution programme with 75674 claims having been settled by 31 October 2009 (Greenberg, 2010). The programme has failed to meet its target of transferring 30 per cent of white owned farm land to the previously dispossessed black farmers. Only 6.7 per cent of total white owned farm land has been distributed under both the restitution and the redistribution programme (Greenberg, 2010). On the other hand, the tenure reform programme has failed to address the issue of land rights and to improve the way that black farmers own, occupy and use their land meaning that the tenure of black communal farmers is still invariably inferior to that of white commercial farmers (Greenberg, 2010).

The Department of Rural Development and Land Reform (DRDLR) published a green paper on land reform in 2011 which encompasses a new vision and new strategies aimed at improving the current land reform policy in South Africa. In the Department’s vision, they seek to re-

configure a single, coherent four tier system of land ownership which will ensure that all South Africans will have reasonable access to land with secure rights that will enable them to fulfil their basic needs for housing and productive livelihoods. The DRDLR also seeks to clearly define property rights, secure forms of long term land tenure for resident non-citizens engaged in appropriate investments which enhance food sovereignty and livelihood security, and improved agro-industrial development and also to ensure effective land use planning and regulatory systems (DRDLR, 2011).

Given the aforementioned arguments, the land reform policy of South Africa has adversely affected the adoption and uptake of conservation agriculture, due to the fact that the pre democratisation land legislation gave no incentive for the black farmers to conserve their lands due to lack of clearly defined property rights. Most of the soil conservation acts and soil erosion laws were only applied in the white controlled areas and thus that's why conservation agriculture has been widely adopted by commercial farmers in contrary to the communal farmers and emerging farmers. The land reform policy after 1994 has failed to achieve its aims and the issue of property rights remains unresolved which further complicates the ability of the communal farmers in the home land areas to adopt any conservation agriculture practices. From a conservation point of view, no one will have any incentive to adopt noble conservation farm practices if they do not have any sense of ownership for the land. In economic terms, there is non-rivalry and non-excludability in terms of who can use and who cannot use the land in the communal areas.

Taking into consideration the new shift in policy towards land reform as highlighted in the green paper on land reform, there is a possibility that if this new vision is supported by adequate and skilled human resources and well implemented, then this will have some positive knock on effects on conservation agriculture uptake and adoption in terms of the communal small scale farmers and emerging farmers since the issue of property rights will have been addressed. In order to make this a success, the land reform policy also has to be well aligned to other major policies such as the climate change policy, the national water policy, fiscal policy and a host of other applicable policies so as to avoid any chances of replication and other unintended effects.

### **5.2.3 Carbon tax policy**

Environmental challenges such as climate change, air and water pollution are posing serious challenges for the global economy as a whole. The costs incurred as a result of these negative environmental externalities are not always fully reflected in market prices and as a result society is adversely affected by these negative externalities and the resulting pollution, and in most cases the individuals responsible for the pollution are not held accountable for these costs. In economic theory the aforementioned scenario leads to a market failure, because the costs of the negative externalities are not fully reflected in the final prices of goods and services (NT, 2013). In order for the market failure to be corrected the government can use market based instruments to ensure that the costs imposed by the negative externalities are fully reflected in the prices of goods and services to ensure efficient and effective beneficial environmental outcomes. The carbon price is one mechanism that can be used to influence producer and consumer behaviour, which will eventually help in addressing the issue of climate change (NT, 2013). The NT (2013) states that the implementation of a carbon tax policy will;

- encourage a shift in production patterns towards low-carbon and more energy-efficient technologies by altering the relative prices of goods and services based on their emissions intensity, and by encouraging the uptake of cost-effective, low-carbon alternatives
- ensure that carbon-intensive factors of production, products and services are replaced with low-carbon-emitting alternatives
- Create dynamic incentives for research, development and technology innovation in low-carbon alternatives. It will help to reduce the price gap between conventional, carbon-intensive technologies and low-carbon alternatives.

The NT published a policy paper for public comment in 2013 on a carbon tax aimed at reducing GHG emissions and facilitating the transition to a green economy. This is however yet to be gazetted by the Minister of Finance. The National Development Plan, published by the National Planning Commission in 2013, also recognises the importance of creating a framework for the transition to an environmentally friendly sustainable low carbon economy (NPC, 2013). The carbon tax is basically a fiscal policy tool or instrument that has the potential to influence the transition of the South African agricultural sector towards a green economy that will see farmers adopting sustainable agricultural practices such as conservation agriculture.

The carbon tax policy has been successful in Australia to influence farmers to adopt conservation agriculture. The Carbon Farming Initiative (CFI) (a policy initiative promulgated

and implemented by the Australian government) aims to reduce carbon dioxide and other harmful greenhouse gases in the atmosphere and to move Australia to a clean energy future by establishing a price on carbon to give an incentive for big emitters to cut pollution, promote innovation and investment in less polluting types of energy, encourage efficiency and creating opportunities in the agricultural sector to cut greenhouse gas emissions (Commonwealth of Australia, 2012). Rouchecouste and Crabtree (2014) state that the CFI was initiated by the government in 2010 to give farmers, forest growers and land holders access to domestic voluntary and international carbon markets by providing a framework to eliminate carbon dioxide from the atmosphere and to prevent the emission of greenhouse gases. The farmers, forest growers and land holders are exempted from paying a carbon price on their agricultural emissions, but they are not excluded from carbon market opportunities. Under the CFI, they may be able to earn carbon credits from activities such as reducing livestock emissions, increasing efficiency of fertiliser use, enhancing carbon in agricultural soil and storing carbon through revegetation and reforestation (Government of Australia, 2012). The CFI is legislatively supported by the Carbon Credit (Carbon Farming Initiative) Act of 2011, a market based instrument aimed at influencing farmers to become a net carbon sink (Rouchecouste and Crabtree, 2014).

#### **5.2.4 Trade policy**

Tregurtha and Vink (2008) mention that the major feature of trade policy in South African agriculture has been the replacement of direct controls over imports and exports, exercised in terms of the Marketing Act of 1968, by tariffs, and the lowering of those tariffs below the bound rates agreed to in the Marrakech Agreement of 1993. Before 1994 South African trade policy was characterised by quantitative restrictions, a multitude of tariff lines, a wide dispersion of tariffs, and formula, specific and ad valorem duties and surcharges (Tregurtha *et al.*, 2010). The main aim of the National Trade Policy of South Africa is to lower the average level of tariffs, to maintain a typical tariff escalation profile, and to simplify the tariff structure.

Tregurtha *et al.* (2010) argue that commercial farmer's decisions have been influenced by the trade policy reforms which have been articulated to the downward adjustment of field crop prices to world market prices. Commercial farmers in South Africa have widely adopted conservation agriculture practices resulting in a decline in the use of external inputs on the

farms, with the exception of herbicides. This is because the success of conservation agriculture depends on the availability of effective herbicides to control the weeds (Jat *et al.*, 2014). Unproductive land has been taken out of production and sound crop rotations have been adopted and also the gradual initiation of precision farming as evidenced in the wheat production areas of the Western Cape. According to Tregurtha and Vink (2008), these locational and cropping pattern effects have led to less ploughing of the land whilst maintaining total output of the main field crops.

Thus it can be argued that the trade policy reforms have indirectly influenced the adoption of conservation agriculture by commercial farmers in South Africa. Trade policy is an instrument of industrial policy in the broader policy framework and has the potential to directly influence conservation agriculture as well. Based on the fact that South Africa is a water scarce country and the agricultural sector of South Africa uses 62 per cent of all the available water through irrigation (CSIR, 2010), it would be wiser to take some land out of production and shift production to countries like Zambia, Zimbabwe and Malawi where water is more abundant, with better soils as well) and rather import these field crops. In this way trade policy can help South African agriculture towards a smooth transition to sustainable farming practices. It would rather be wise from an economic point of view for South Africa to take out some of the irrigated field crops in which the sector has a comparative disadvantage.

### **5.2.5 Environmental policy**

There are three policy documents that have been published by the Department of Environmental Affairs (DEA) pertaining to the management of the environment, namely the White Paper on Environmental Management (1998), the National Framework Strategy for Sustainable Development (2009) and the National Strategy for Sustainable Development 1 (2011). The legislative mandates for the aforementioned policies are supported by an Acts of Parliament, the National Environment Management Act (NEMA), 1998, (Act No. 107 of 1998) which facilitates the overall governance and establishment of environmental management principles. The environmental policy of South Africa applies to all government institutions and to all activities that impact on the environment.

The mandate of the environmental policy of South Africa is to ensure that there is improved quality of life through the protection of the environment as provided for in the Bill of rights in

the South African Constitution (DEA, 2014). Section 24 provides that everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

As a result, environmental policy can influence farmer's decisions and can help advance the uptake of conservation agriculture. This is also supported constitutionally by Section 8 of the Bill of Rights which binds the government to give effect to environmental rights stated in Section 24. The government is further obligated to promulgate and implement reasonable and effective policies, laws and regulations that conserve the environment, prevent pollution and ecological deterioration, promote conservation, secure sustainable development and ensure compliance with this legislation (DEAT, 1998). The government must fulfil its duty of public trust and act as the custodian of the nation's environment and all resources.

Conventional agriculture is one of the factors that have led to the degradation of agricultural land which has led to loss of top soil through erosion and also eutrophication of rivers and other water bodies due to leaching of fertilisers and washing of chemicals and herbicides which have poisoned water systems and damaged the natural operation of many ecosystems. The government must enforce environmental policy and associated laws to force conventional farmers to adopt sustainable farming practices such as conservation agriculture. Compliance and punitive measures should be applied to the agricultural sector as provided for in the environmental policy framework.

### **5.2.6 Policy on organic production and agriculture in sustainable development**

Currently there is no policy that has been promulgated directly to cater for conservation agriculture and organic agriculture. There has been a series of draft documents in the past decade and this has been caused by a host of factors ranging from administrative red tape to political and legislative barriers. The policy on Agriculture in Sustainable Development seeks to achieve the triple bottom line of sustainability within the agricultural sector of South Africa with the aim of alleviating poverty, achieving food security and sustainable economic development (DAFF, 2011<sup>a</sup>). This emphasizes the creation of a prosperous agricultural sector

while protecting the national biological and physical resource base, as well as enhancing human health and well-being

The policy on Agriculture in Sustainable Development recognises various challenges that are faced by the agricultural sector of South Africa such as addressing social issues (i.e. food security, health, equity and unemployment), addressing environmental issues (i.e. water use efficiency, soil erosion and biodiversity and genetic resources) and economic issues (i.e. global competitiveness, development of well-functioning methods, infrastructure, agricultural research systems etc.).

The National Policy on Organic Agriculture seeks to unify all stakeholders in the organic sector of South Africa. The organic agricultural sector is currently marred by a high level of fragmentation and there is not a single organisation that represents the interests of all organic farmers (DAFF, 2011<sup>b</sup>). There have also been negative perceptions towards organic agriculture whereby people stereotype it as a phenomenon meant for the wealthy and the rich. There have been derogatory campaigns by chemical industries who have been advocating for the use of pesticides as the only effective way to control pests and this has adversely affected the organic agriculture sector. There is also a lack of information regarding organic agriculture and there are problems with the certification and inspection of organically farmed produce in South Africa as whole.

Sustainable farming methods such as conservation agriculture and organic agriculture have advantages that not only bring environmental sustainability, but instead the full triple bottom line sustainability benefits. Conservation agriculture and organic agriculture are reported to conserve the soil and water, and sustain biodiversity. The need for external input use is reduced due to the adoption of “climate smart agriculture” methods like conservation agriculture and organic agriculture bringing about a reduction in input costs and an increase in yields and profit margins. Conservation agriculture and organic agriculture also help in the mitigation and adaptation to climate change which is one of the global threats to agriculture. The sustainable farming methods sequester carbon, thereby reducing greenhouse gas emissions. Through the correct application and implementation of the aforementioned farming types, resilience to climate change is also built.

If the policy drafts on organic production and agriculture in sustainable development are successfully implemented, most farmers will potentially be motivated to start adopting

sustainable farming and agro ecological production systems. It is important to note that conservation agriculture and organic agriculture are not a “once all and fix all” remedy. The use of herbicides makes conservation agriculture environmentally unsustainable. The organic agriculture concept is poorly understood in South Africa, and its uptake is likely to be unsuccessful.

### **5.2.7 Water policy**

South African law relating to water has its roots in four different legal systems namely; the Roman law, Roman Dutch law, English and American law. The cornerstone for the South African water law is the Roman law classification of water in a flowing stream as either private or public (Van der Linde, 2006). A river had to flow all year round and had to be of a sizeable nature to be regarded as public whereas private streams including underground water, were regarded as private property. Historically the water policy applied the riparian policy instruments whereby it only benefited those people who owned land adjacent to the rivers and those who were first to claim the water rights. After the 1956 Water Act the only private rights to water that still existed were riparian rights, and all the other rights were nationalised by the state. Black people were excluded from owning water rights as a result of the segregative land laws.

After 1994 the Department of Water Affairs (DWA) published a white paper on the new South African water policy in 1996 after a two year consultative process and engagement of all relevant stakeholders, organisations and sectors (DWA, 1996). The policy was drafted bearing in mind the constitutional mandate stated in the Bill of Rights in section 27 (1) (b) of the South African Constitution which mentions that everyone has the right to have access to sufficient water. The Bill of rights also gives all South Africans the right to an environment that is “not harmful to their health and well-being”, as well as the right to have their environment protected for the benefit of present and future generations. The government thus has the mandate to ensure that water pollution is prevented and that there is adequate water to sustain the ecological integrity of our water resources and that water conservation and sustainable, “justifiable economic and social development” are promoted. However, on the contrary, the constitution also states that the government should act within its means meaning that these rights are not absolute but they are attenuated.

In an effort to ensure equitable access to water by all people, the government promulgated the Water Services Act 108 of 1997 and the National Water Act 36 of 1998 (Van der Linde, 2006). Of these two acts, the National Water Act is the primary legislation governing the regulation of water in South Africa with the aim of ensuring that the nation's water resources are protected and managed in ways that take into account, *inter alia*, meeting the basic human needs of present and future generations.

The new water policy takes away riparian rights (i.e. the last remaining water rights) and recognises the fact that water is a very sensitive and scarce resource in South Africa. Currently agriculture uses more than half (i.e. 62 per cent) of the available water through irrigation (CSIR, 2010); however there is now increased competition for water from other sectors such as the energy sector, the mining sector and also urban uses. There have been some arguments concerning this issue where by pro-mining and energy advocates have been claiming that their respective sectors use water equivalent to only a third as much as that used for irrigation in agriculture yet they create four times more jobs per litre than in the agricultural sector. The importance of water conservation through sectorial efficiency management practices has also been highlighted in the new water policy (DWA, 1996). This encourages the various sectors that make use of water to use this precious resource efficiently and avoid wastage.

Given the aforementioned discussion, the water policy has the potential to influence the adoption of sustainable farming, since practices like conservation agriculture conserve water and help build resilience to climate change. Sustainable farming practices also use fewer external inputs meaning that inputs like fertiliser, herbicides and pesticides are reduced which further lower the risks of eutrophication of rivers and contamination of water by agricultural chemicals.

### **5.2.8 Food and nutritional security policy**

The Department of Agriculture Forestry and Fisheries (DAFF) has embarked on a process to develop a National Food Security policy to ensure that key stakeholders reach a consensus on food security diagnosis. The establishment of DAFF's Food Security policy is based on the Bill of Rights enshrined in the constitution in Section 27, 1 (b) which states that every citizen

has the right to access to sufficient food and water and the state should take reasonable legislative and other measures within its available resources to achieve the realisation of this right; and in Section 28, 1 (b) states that every child has the right to basic nutrition, shelter, basic care services and social services (DAFF, 2012).

The South African Food policy defines food security as the right to have access and control over the physical, social, and economic means to sufficient, safe and nutritious food at all times to meet dietary food intake requirements for a healthy life. In short, food security is all about availability, accessibility and the utilisation of nutritious food. Table 5.2 shows the threshold measure for food security adopted by DAFF.

**Table Error! No text of specified style in document..4 WHO recommended adequate daily energy intake for different population groups**

Category	Infants: 6-12 months	Child: 1-5 years	Adult/ Adolescent	Pregnant women	Lactating Mother
Energy (Kj)	3121	5693	11113	11130	11626
Energy requirements for survival not active people (Kj)	3121	5460	8820	9870	10920

Adapted from DAFF (2012)

It is recognised in the food security policy that approximately 2.8 million households are vulnerable to food insecurity and 72 per cent of those vulnerable actually reside in the rural areas of the country (Stats SA General Households Survey, 2009 cited in DAFF, 2012). The Food security policy also takes into account the fact that South Africa is one of the most unequal societies in the world and that this inequality worsens poverty levels, hunger, and morbidity linked to the different population groups in South Africa. The link between food insecurity, poverty, income generation and capital asset ownership is also taken into account and the fact that poverty spreads along racial lines, with estimates indicating that 56 per cent of African are poor compared to 36 per cent of coloureds, 15 per cent of Indians and 7 per cent of whites (DAFF, 2012).

The current challenges to food security in South Africa are mainly due to the shortcomings in the implementation of the Land Reform programme, sustainable use of agricultural resources and land use, skewed food storage and distribution networks and reformation of domestic markets. On average consumers in rural areas had to pay ZAR16.74 more than consumers in urban areas to buy the same basket of selected products during the period between January 2008 and October 2010 (DAFF, 2012). The poverty levels are highest in the rural areas meaning that these areas are characterised by high levels of food insecurity and malnutrition. Consumer costs and production costs, unemployment, climate change, economic growth and equity challenges and lack of a long term agricultural plan have amongst other factors also posed food security challenges.

The Integrated Food Security Strategy (IFSS) formulated by DAFF seeks to bring about a six step policy strategy that will see an improvement in food security in South Africa. The strategy seeks to result in optimal use of land and agrarian reform contributions to economic empowerment of the vulnerable groups; food distribution strategy for access by all; centralised food safety control system; food security risk management, establishment of food insecurity information systems and finally to improve food utilisation (DAFF, 2002). Currently there is no legislation that is directly promulgated for food security and it is imperative for the South African government to promulgate laws to regulate the coordination of food security as prescribed by the proposed food security policy.

The food security policy has the potential to influence a positive uptake of sustainable farming practices if it's implemented in the future. Conservation agriculture is a low cost and high output agricultural method that could help communal and emerging farmers in the former homeland areas improve their food security status, and eradicate hunger, poverty and unemployment problems. Conservation agriculture uses fewer external inputs (excluding herbicides) and brings about higher yields it has the potential to leave this group of farmers with more disposable income to spend on health care, education and the purchase of other food items. The lack of legislation directed at food security is also another "brick wall" that has been constraining the food security policy process.

### **5.2.9 Comprehensive Rural Development Programme (CRDP)**

The CRDP is a policy programme that was initiated by the South African government through the Department of Rural Development and Land Reform in 2009 (DGCIS, 2011). The major aim of the CRDP is to ensure the creation of decent work and sustainable livelihoods within the rural areas of South Africa. The CRDP consists of three pillars namely Land Reform, Agrarian Transformation and Rural Development, with a strategic focus on social cohesion and development (DRDLR, 2009). There are various stakeholders that have partnered with the DRDLR with the major aim of maximising the socio economic development agenda. These stakeholders consist of government departments, non-governmental organisations, the business sector and the local communities.

At the initial implementation of the CRDP, the DRDLR, the first site was launched in Muxex, Limpopo, by Minister Gugile Nkwinti and President Jacob Zuma with an overall 21 sites being implemented throughout South Africa, with the major aim of rolling this out to 160 sites country-wide by the end of 2014 (DGCIS, 2011 and DRDLR, 2009). Specific constraints have been noted within the CRDP sites which includes underutilisation and unsustainable use of land resources; lack of adequate and comprehensive access to socio-economic and cultural infrastructure and services, lack of water for household use and agricultural development; low literacy and skills levels; migratory labour practices that erode the social fabric; and untapped opportunities within the agriculture, mining, tourism and manufacturing industries (DGCIS, 2011). The implementation of the CRDP was envisioned to enhance and promote the creation of vibrant, equitable and sustainable rural communities and food security.

### **5.2.10 Conservation of Agricultural Resources Act (CARA) (Act 43 of 1983)**

This is the primary statute dealing with the conservation of agricultural resources in South Africa. This Act provides for the regulation of control over the utilisation of the natural agricultural resources of the Republic of South Africa in order to promote the conservation of soil water sources and vegetation (including wetlands) and aims to combat and control weeds as well the elimination of invasive alien plant species in agriculture (Van der Linde, 2006).

### **5.2.11 Alien and Invasive Species Policy (NEMBA Regulations)**

The DEA is mandated by the government to manage alien and invasive species in terms of the National Environmental Management: Biodiversity Act 10 of 2004. This act provides for the management and protection of the country's biodiversity within the framework established by NEMBA. It provides for the protection of species and ecosystems in need of protection, sustainable use of indigenous biological resources, equity in bio prospecting and the establishment of a regulatory body on biodiversity- South African National Biodiversity Institute (SANBI) (Van der Linde, 2006).

## **5.3 Policy instruments with possible impacts on CA**

### **5.3.1. Taxes**

Taxes can potentially be used as a way to force farmers adopt conservation agriculture. This can be done by heavily taxing conventional agriculture implements (such as ploughs, heavy tractors and disk harrows). This action should be corresponded by tax reductions in conservation agriculture implements and inputs. Farmers usually base their decisions on economic analyses, hence the tax hikes on conventional agriculture implements and inputs will increase the production costs of the farmer leading to a reduction in profitability. This will potentially influence conventional agriculture farmers to adopt conservation agriculture yields benefits of low production costs and higher yields. When farmers lost all state support during the period of trade liberalisation in the 1980s, they were forced to adopt conservation agriculture practices to avoid the risk of being drive out of business. The farmers in the wheat production areas experienced increased yields and lower production costs (Tregurtha and Vink 2008 and Tregurtha *et al.*, 2010). Lowering or eliminating taxes on conservation agriculture equipment will potentially make the vital implements affordable to farmers which will incentivise farmers to adopt conservation agriculture. Stonehouse and Bohl (1993) mention that taxes on soil erosion losses have been applied in Ontario, Canada and this has influenced farmers to adopt conservation agriculture. On the contrary, raising taxes on soil erosion losses was found to be ineffective in bringing soil erosion under control, but relentlessly eroded the farmers' cash flow (Stonehouse and Bohl, 1993).

### **5.3.2 Subsidies**

The South African government can also use subsidies to promote the uptake of conservation agriculture by farmers. The government can consider subsidising the purchase of conservation agriculture implements and inputs to make them affordable to farmers. Most of the implements required for conservation agriculture are not locally available and these have to be imported at a high cost which is unaffordable for most farmers (especially the small scale and emerging farmers). Subsidies will potentially incentivise farmers to adopt conservation farming practices since the initial capital investment will have been carried by the state making it cheaper and affordable for most farmers. Stonehouse and Bohl (1993) state that a net cash flow rise was experienced in Ontario, Canada after the Canadian government implemented a one-time 20 per cent subsidy on no till equipment. However it is important to note that subsidies are market distorting by nature, however in this case, subsidies can help the farmers in South Africa to transition towards the green economy by adopting production methods like conservation agriculture. The government should also subsidise the production of rotational crops so as to avoid mono cropping in conservation agriculture. There has been concerns of farmers in Brazil (the leader of conservation agriculture) have been practicing soya bean mono cropping.

### **5.3.3 Tariffs and non-tariff barriers**

The South African government can also make use of tariffs and non-tariff to influence the uptake of conservation agriculture. This can be achieved through the elimination of all import tariffs/ exercise duties on imported conservation agriculture implements. This will make the imports much cheaper for the farmers in South Africa, thus potentially incentivising them to adopt conservation agriculture. The government must eliminate any non-tariff barriers by allowing foreign firm to open agri-businesses that supply conservation agriculture equipment and inputs. This can be done through the industrial policy framework and trade policy that's provides room for such businesses to open in South Africa without any hurdles or problems.

### **5.3.4 Moral suasion**

Moral suasion can be defined as an approach of pressurising (without the use of force) by an authority to enable people to adhere to laws or policies (Romans, 1966 and Krishna *et al.*, 2006). This approach is widely evaluated in the field of resource and environmental economic, and monetary economics (Krishna *et al.*, 2006). This approach can potentially influence the uptake of conservation agriculture by farmers. The government of South Africa can embark on a moral suasion exercise by seeking to make all farmers aware of conservation agriculture and inform them on the benefits about the benefits of adopting this production method such as increase in yields, climate resilience, reduction in production cost and increases in profitability margins. The NGO community can also partner with the South African government to make this exercise (moral suasion) successful. Most of the conservation agriculture adoption that has taken place in Africa has been driven by farmers themselves and the NGOs. Against this background, we can conclude that a partnership by the government and NGOs has the potential to enhance the uptake of conservation Agriculture.

### **5.3.5 Special purpose vehicles**

A special purpose vehicle is usually initiated to carry out a specific business purpose or activity. The South African government can potentially influence the uptake of conservation agriculture through initiating special purpose vehicle. In its quest to incentivise the awareness of conservation agriculture and its rapid uptake by all farmers in South Africa, the government should ensure wide spread capacity building (especially on small scale and emerging farmers) and provide training and development to as many farmers as possible. The establishment of an independent conservation agriculture organisation is one possibility. This will act as a special purpose vehicle to provide practical and purposeful training to all the participating conservation agriculture farmers in South Africa. This independent conservation agriculture research organisation will be wholly owned by the government, but all its operations will fall outside the management structures of the government to allow for independence in the execution of the organisation's day to day operations. This special purpose vehicle will be significant to all farmers given the current absence of policy directed at conservation agriculture and the need to capacitate small scale and emerging farmers. The farmers (i.e. small scale, emerging and

commercial) will potentially benefit from the research outputs generated by the special purpose vehicle (i.e. the independent conservation agriculture research organisation).

### **5.3.6 Tax credits**

The South African government can potentially use tax credits to incentive the uptake of conservation agriculture by all farmers (i.e. small scale, emerging and commercial). The government must promulgate tax credit Acts that recognise and reward farmers that put their land under conservation agriculture and announce an attractive figure that will incentivise farmers to put their land under conservation. To make this feasible a conservation certifying body has to be established by a relevant government department such as the Department of Environmental Affairs. A proper criterion of land that can earn tax credits should be established so that the full benefits of conservation can be achieved. A tax credit can be explained by means of an example, for instance if one farmer qualifies for a ZAR50, 000 tax credit and owes the government ZAR 10, 000 in tax liabilities in the same calendar year; the tax credit will reduce the farmers taxes to ZAR 0 for that respective year and when he/she file for tax, a check back of ZAR40, 000 will then be paid back to the farmer. However South Africa has to balance sustainability issues against social development programmes, hence the success of this policy instruments will largely depend on the availability of funds to bankroll this initiative.

### **5.3.7 Education and training programmes on sustainable farming**

Farmers and extension workers should be trained on “climate smart agriculture” techniques of farming. The successful transition of the South African agricultural sector towards a greener economy largely depends on the availability of highly trained and skilled personnel. Sustainable farming methods should be integrated into the primary, secondary and tertiary education curriculum. Funding should be mobilised to further research on these farming methods so as to improve the efficiency and effectiveness of sustainable farming.

### **5.3.8 Research and development programmes**

Sustainable agriculture requires intensive and in-depth knowledge. Research and technology development is imperative to the overall success of sustainable farming. There are still gaps and controversies that need to be clarified. Sustainable agriculture needs to be supported by holistic research approaches that can convince all stakeholders to abandon conventional agricultural practices and to adopt more agro ecological agricultural practices like conservation agriculture.

### **5.3.9 Regulatory framework**

An efficient and effective regulatory framework is imperative for the development of a sustainable agricultural sector. The South African government must immediately promulgate policies, laws and regulations for sustainable farming as stated in Section 24 of the constitution of the republic.

### **5.3.10 Adequate technical support base**

Extension services are imperative in the successful adoption of sustainable farming as an alternative to conventional farming. According to DAFF (n.d), the current extension officers are biased in support of conventional agriculture. Extension support is of paramount importance to small scale communal, emerging and commercial farmers, therefore extension officers must receive specialist training in sustainable farming instead of just receiving generalist knowledge in order to positively contribute support to the small scale, emerging and commercial farmers.

### **5.3.11 Environmental standards**

The Department of Environmental Affairs has already set some environmental standards, and any individuals who do not meet these standards are subject to punitive measures and

prosecution. According to the Annual Report 2013/2014 of the DEA, 262 officials completed the Environmental Management Inspectorate (EMI) training and a total of 26 criminal investigations were finalised and dockets handed over to the National Prosecuting Authority for a prosecutorial decision (DEA, 2014). The environmental compliance and enforcement strategy should also be implemented in the South African agriculture sector, and this will force farmers to adopt sustainable farming practices and abandon conventional agriculture practices. It is important to note that environmental legislation is not well understood in the South African judiciary system (Van der Linde, 2006), hence this might experience so difficulties in the courts of law.

### **5.3.12 Carbon offsets**

A carbon offset is an external investment that allows a firm to access GHG mitigation options in a manner that is cheaper than investment in its own operations (NT, 2014). Carbon offsets involves the undertaking of specific projects or activities that reduce, avoid, or sequester carbon and GHG emissions (NT, 2014). If carbon offsets are implemented, they will enable firms to lower their carbon tax liability and incentivise investment in least-cost mitigation options in the country which will drive up investments in GHG mitigation projects that deliver carbon emissions reduction at a cost lower than carbon tax. The National Treasury (2014) argues that such projects have the potential to yield significant sustainable development benefits in South Africa including channelling capital to rural development projects, creating employment, restoring landscapes, reducing land degradation, protecting biodiversity, and encouraging energy efficiency and low carbon growth. Given the aforementioned discussion carbon offsets are a fiscal policy tool or instrument that can incentivise the uptake of sustainable farming practices such as conservation agriculture.

## **5.4 Other South African legislation applicable to conservation in agriculture**

### **5.4.1 Genetically Modified Organisms Act (Act 15 of 1997)**

This Act introduces a regulatory framework for measures to promote responsible development, production, use and the application of genetically modified organisms. The Act also seeks to

ensure that all activities arising from the use of GMO materials do not pose any harm to the environment and provides a measure for the evaluation and reduction of potential risks that might arise due to the use of GMO materials. The Act also ensures that all GMO materials are appropriate and do not pose any harm to the environment (Van der Linde, 2006).

#### **5.4.2 National Environmental Management: Protected Areas Act (Act 57 of 2003)**

This Act provides for the protection and conservation of ecologically viable areas representative of the country's biological diversity, its natural landscapes and seascapes. It also provides for the establishment of a national register of protected areas, the management of these areas, co-operative governance, public participation and matters related to protected areas (Van der Linde, 2006).

#### **5.5 Analysis of major policies with possible impacts on conservation agriculture**

It has been noted that currently there is no conservation agriculture policy in SA, while there are policies impact on conservation agriculture. Currently the DAFF, the ARC and FAO are working on developing a conservation agriculture policy that will enhance the uptake of conservation agriculture in South Africa (Verschoor, personal communication, 2015 and Mampholo, personal communication 2015). In the event that a conservation agriculture policy is implemented it may potentially assist the other policies to achieve their goals and bring about an alignment between various policies that have the potential to positively influence the uptake of conservation agriculture by all farmers (i.e. small scale, emerging farmers and commercial farmers) ( Midgley *et al.*, 2015). The policies analysed for the purpose of this study were analysed using the policy analysis criterion adopted by Morestin *et al* (2010) from the field of political sciences. The policy mix was analysed by taking into consideration the effects and implementation dimensions and specifically using six analysis criteria as explained earlier in Chapter 4. Another criterion was added into the policy matrix to investigate how a conservation agriculture policy will enable the alignment of the policy mix under study in achieving their aims *inter alia* an advancement of conservation agriculture adoption and uptake. Table 5.3

gives a snapshot of how the policies affect conservation agriculture based on the methodology adopted from Morestin *et al* (2010).

**Table Error! No text of specified style in document..5 Policy matrix with analysis of policies and instruments with possible major impacts on conservation agriculture**

	<b>Effectiveness (What effects does policy have on conservation agriculture uptake?)</b>	<b>Unintended effects (What are the unintended effects of this policy?)</b>	<b>Equity (What are the effects of this policy on different groups?)</b>	<b>Cost (What is the financial cost of this policy?)</b>	<b>Feasibility (Is this policy technically feasible?)</b>	<b>Acceptability (Do the relevant stakeholders view the policy as acceptable?)</b>	<b>Possible impacts of the conservation agriculture policy</b>
<b>Climate change policy</b>	Potentially effective	Increase in production costs and job loses	-ve impact on carbon intensive industries +ve impact on society	High cost policy	Currently not technically feasible	Resistance from SA business sector	Conservation agriculture sequestrates carbon and mitigates GHG and leads to adaptation to climate change

<b>Land reform policy</b>	Constraining effect	Beneficiaries are worse-off than before	+ve effect on vulnerable groups -ve effect on tenants	High cost policy, Government is failing to fund the policy	Not adequately feasible	Resistance from the commercial farmers union, Welcomed by politicians (EFF and ANC)	Limited effect on emerging and small scale farmers
<b>Carbon tax policy</b>	Potentially effective	Same as climate change	Agriculture sector exempted	Same as climate change	Same as climate change	Same as climate change	Same as climate change
<b>Trade policy</b>	Very effective	Decline in manufacturing employment, high income inequality	Agriculture sector lost all government support, costly for the overall economy	Costly for the domestic economy	Feasible	The current policy more acceptable than previous one	High impact on commercial farmers but very low on small and emerging farmers
<b>Policy on organic production</b>	Limited effectiveness	Revolt by chemical co's and food insecurity	-ve effect for CV advocates +ve effect for consumers	Costly for the overall economy	Currently not technically feasible	Policy likely to draw lots of criticism	High impact due to some similarities in principles of agro ecology

<b>Policy on agriculture in sustainable development</b>	Potentially effective	Same as organic policy	+ve effect on all farmers -ve effect on CV advocates	Cost saving implications	Feasible if well aligned with other policies	Likely to be accepted by majority of stakeholders	Conservation agriculture policy will potentially align well with this policy
<b>Food and nutritional security policy</b>	Potentially effective	Moral hazard, market failure and bureaucratic red tape	+ve effect on women and children and vulnerable, poor groups	High cost policy due to social safety nets and government purchase programmes	Currently not technically feasible	Generally acceptable to all stakeholders	Conservation agriculture leads to high yields and reduced costs which means high income for small scale and emerging farmers
<b>Environmental policy</b>	Potentially effective	Conflicts, disagreements and industrial action risks	-ve effect on polluters -ve effect on society	Very costly	Has shown a great degree of feasibility	Generally acceptable to all stakeholders	Conservation agriculture can help meet major goals of the environmental policy

<b>Water policy</b>	Potentially effective	Challenges for large water users	+ve effect on small-scale producers	Costly for the SA government	Feasible and is backed by legislation	Not generally accepted by all stakeholders	Conservation agriculture can help conserve water and build on resilient crop systems
<b>Alien and invasive species policy</b>	Potentially effective	High cost for farmers who are mandated to control these plants, Affects bee farmers	+ve effects for farmers and society in general	Costly for the SA government	Feasible	Not generally accepted by all stakeholders (especially the farmers required to clear invasive plants on their farms)	Conservation agriculture can help ameliorate “soil mining” cause by invasive alien plants
<b>CRDP</b>	Potentially effective	Same as land reform	Same as land reform	High cost policy	Feasible	Generally acceptable to vulnerable groups	Conservation agriculture can help improve food security of small-scale and emerging farmers

<b>CARA</b>	Potentially effective	Same as alien and invasive species policy	+ve effects on pro conservation stakeholders -ve effect on conventional farming advocates	High cost policy	Not feasible, It is now outdated	Not generally acceptable	Conservation agriculture aligns well to the CARA principles
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### 5.5.1 Climate change policy

Climate change policy is potentially effective in enhancing the adoption of conservation agriculture by farmers in South Africa should it be promulgated and approved by Cabinet. Conservation will help farmers to mitigate risks associated with drought and climate change, by building on climate resilient crop systems (Jat *et al.*, 2014; Midgley *et al.*, 2015 and IIRR and ACT, 2005). Conservation agriculture sequesters carbon and reduces greenhouse gas emissions (GHG) and the mulch from the thirty percent residue cover helps to conserve water in the soil which in turn reduces risks associated with dry spells and drought. This study specifically focused on the impacts of policy and instruments on conservation agriculture in South Africa across all three farming scales and with a specific focus on the dryland maize and beef sector. Climate change policy can potentially encourage the uptake of conservation agriculture by all dryland maize farmers due to such benefits of conservation agriculture. Where intensive and mixed beef production systems use the feed lot system it is also imperative that all the feed used in the feedlot systems is produced using conservation agriculture methods which will help mitigate GHG emissions and build climate resilience. The intensive and mixed beef production systems are normally used by commercial beef farmers, hence the Climate Change policy will have minimal effect on the uptake of conservation agriculture by small scale and emerging farmers and also the competition for crop residues between conservation agriculture and the livestock might see a decline in availability of mulch as required by the conservation agriculture principles.

In terms of unintended effects, it is highly unlikely that the Climate Change policy will have any unintended consequences since the agricultural sector will be exempted from paying any carbon tax for the first six years of implementation of the policy (DEA, 2011<sup>a</sup>). As for the equity criterion, all dryland farmers (i.e. small scale, emerging and commercial) are likely to experience the same effect. In the case of intensive and mixed beef production commercial farmers, the same scenario as that mentioned for the dryland maize farmers is expected, thus, all the aforementioned farmers will benefit from the adoption and uptake of conservation agriculture. Commercial farmers who have widely adopted conservation agriculture have already started experiencing the benefits such as climate resilience, increased yields and restoration of degraded agricultural lands. The beef farmers utilising feedlots can potentially benefit from increased yields produced through conservation agriculture, *inter alia*, low external inputs which results in more feed being availed and also a significant reduction in

production costs. However, from a macro-economic point of view high carbon intense industries (e.g. Sasol) argue that the climate change policy will lead to an increase in production costs which will lead to job losses (Mail and Guardian, 2011).

In terms of the cost criterion, it's unlikely that the climate change policy will impose any financial cost on farmers due to the fact that the agricultural sector is exempted from paying carbon tax within the first phase of implementation due to the anthropogenic nature of GHG emissions within this sector. It is therefore imperative to find a way of adequately and accurately measuring the GHG emissions from the agricultural sector before any carbon tax can be enforced on farmers. In this case both dryland maize farmers and beef farmers will not endure any costs as the result of the implementation of the climate change policy. In the case of the feasibility criterion, the climate change policy is potentially feasible since the adoption of conservation agriculture will lead to the mitigation of climate change due to carbon sequestration and this applies to both dryland maize farmers and beef farmers. The beef sector contributes immensely to GHG emissions into the ozone layer leading to global warming (UNEP, 2012). These emissions can be attributed to methane emission caused by enteric fermentation, nitrous oxide from excreted nitrogen and chemical nitrogenous fertilisers used to produce feed for animals in intensive beef systems (that make use of feedlots) (UNEP, 2012; Lesschen *et al.*, 2011; Herrero *et al.*, 2011, O' Mara, 2011 and Reay *et al.*, 2012). The only problem at hand is the fact that the agricultural sector is exempted from paying a price on carbon.

As far as the acceptability criterion is concerned, the agricultural sector of South Africa is vulnerable to climate change impacts. Climate change has the potential to affect crop yields, affect rain fall pattern, drought risks etc. Climate change policy is likely to be welcomed by all farmers (i.e. both dry land maize and beef farmers) since adopting conservation agriculture will reduce the risks of changes in water availability, increased water pollution and soil erosion from more intense rainfall and so forth. Despite the fact that the agricultural sector is the second biggest emitter of GHG, they will be exempted from paying the carbon tax, which will make the policy potentially acceptable by stakeholders in the agricultural sector, hence, the implementation of the climate change policy will be beneficial for the whole agricultural sector (NT, 2014 and DEA, 2011<sup>a</sup>). Lastly, should the conservation agriculture policy be drafted and implemented, it will potentially align well with the climate change policy since conservation agriculture sequesters carbon and mitigates GHG emissions leading to adaptation to climate

change. The conservation agriculture policy can potentially help the climate change policy achieve its aims and goals.

### **5.5.2 Land reform policy**

The land reform policy has a constraining effect on the uptake and adoption of conservation agriculture by farmers in South Africa for a number of reasons. This effect is specifically applicable to the small scale and emerging farmers (i.e. from both dryland maize and beef farmers) as a result of lack of security of tenure. Without clearly defined property rights, there is no incentive for the aforementioned farmers to adopt conservation approaches and methods. Due to the non-excludability nature of communally owned land, farmers who farm under communal tenure arrangements in the former homelands and those land reform beneficiaries who hold and operate land collectively have no incentive to protect their crop or grazing land from degradation. In many areas in the former homelands the competition for residues between livestock and conservation agriculture cannot be regulated due to the lack of fencing while grazing lands cannot be protected from overgrazing by individual farmers. Where collective action fails, therefore, a ‘tragedy of the commons’ often arises

The land reform policy has had some unintended consequences on the South African agricultural sector. Greenberg (2010) argues that most of the land reform beneficiaries have been found to be worse off and there has not been an improvement in terms of poverty alleviation and the food security status of the vulnerable groups in the former homeland areas.

In terms of the equity criterion, the land reform policy has affected stakeholders in the agricultural industry in different ways. This policy has corrected some of the historical injustices (as a result of the Natives’ Land Act of 1913) particularly for the formerly disadvantaged and vulnerable groups in the former homeland areas. This policy has had marginal impact on the commercial farmers since the redistribution exercise and the willing buyer-willing seller programme have proved to be splendid failures in achieving their set goals and objectives.

As for the cost criterion, this policy is costly for the domestic economy and the agricultural sector. Most of the previously productive land that has been distributed is no longer under production leading to a decrease in agricultural production because most of the land reform

beneficiaries lack agricultural knowledge and adequate support services. The current land reform programme can potentially lead to food insecurity due to poor land tenure which make the emerging and small scale communal farmers not to get capital to undertake efficient agricultural practices. The land commission spent a total of R1.8 billion by the year 2003 and deemed this insufficient. In the period 2004-2005, R1.6 billion was budgeted and in 2005 a total of R6 billion rolling budget was set aside by the South African government to settle restitution claims but however this was still deemed not enough (Greenberg, 2010). The aforementioned facts clearly outlines that this policy is costly for the domestic economy.

The land reform policy has not been feasible as far as its goals and aims are concerned. This can be attributed to a lack of adequate resources to achieve the goals of the land reform programme. As mentioned earlier, the money that was budgeted to fund the land reform process was deemed insufficient by the land commission. The government of South Africa's budget towards land reform was one percent of the national budget meaning that financially land reform was not being prioritised (Greenberg, 2010). As far as the agricultural sector is concerned, this policy targets the previously disadvantaged and vulnerable groups in the former homelands areas, but the land tenure system under which this group operates remains invariably inferior to that of commercial farmers. In general most small scale and emerging farmers who benefited from the land reform programme have experienced very little progress in their livelihoods rendering the land reform policy infeasible.

In terms of the acceptability criterion, this policy has been widely accepted by the vulnerable groups in the former homeland areas as it seeks to redress the injustices of the past as a result of the colonial segregation legislation (i.e. the native land act of 1913) of the apartheid era. The majority of the landless blacks have been advocating for the redistribution of land which has seen political parties like the EFF calling for the expropriation of land without compensation (EFF, 2014). On the other hand, the ANC is also pressing for the stepping up of efforts to speed up the land reform process as evidenced in President Jacob Zuma's State of the nation address (SONA 2015). The commercial farming sector has generally been slow or unwilling to accept the policy as evidenced by the failure of the willing buyer-willing seller government-initiated programme. The commercial farmers union of South Africa has argued that the current land reform programme redresses social injustices of the past at the expense of food security and employment creation (De Villiers, 2003). It further claims that that most of the intended beneficiaries do not possess the required human and financial capital to undertake effective and efficient farming (De Villiers, 2003). In light of the afore-mentioned factors, a conservation

agriculture policy is unlikely to align well with the current land reform policy and tenure system due to the lack of properly defined property rights.

### **5.5.3 Carbon tax policy**

The Carbon tax policy could potentially have the effect as the climate change as explained earlier in section 5.5.1. This policy is an instrument of the fiscal policy which has been proposed in the climate change response white paper. Placing a price on carbon has been recommended as the instrument that will empower the climate change policy to achieve its aims and objectives of mitigating greenhouse gas emissions, building climate resilient production system such as the conservation agriculture (DEA, 2011<sup>a</sup> and NT, 2014). This policy has been applied in Australia and help farmers to adopt conservation agriculture (Rouchecouste and Crabtree, 2014 and Government of Australia, 2012)

### **5.5.4 Trade policy**

The Trade policy has been very effective in enabling the uptake of conservation agriculture by the commercial farmers (Tregurtha and Vink, 2008 and Tregurtha *et al.*, 2010). Maize farmers in the inland provinces of South Africa (i.e. the interior) as well as wheat farmers in the Western Cape have adopted conservation agriculture practices for economic reasons such as cutting down on production costs. This has led to farmers ceasing production in all marginal lands and introducing sound crop rotational practices in their crop enterprises. These measures have increased soil fertility, improved crop yields, and extended the expected life-span of farm vehicles and implements (Tregurtha and Vink, 2008 and Tregurtha *et al.*, 2010). The trade policy has indirectly led to the implementation of conservation agriculture practices in the production of grain crops such as maize and wheat) and the beef sector.

There has also been a downside to the trade policy where it has led to unintended effects such as loss of jobs by the unskilled labour force as commercial farmers cut down on production costs. The agricultural sector lost all state support due to trade liberalisation, which in turn led to government shifting focus away from conservation to other social development and economic issues such as land reform and redress of past social injustices. The rise in capital

investment, technological advancement and demand for skills in production resulted in an increase in production intensity and output in the private sector (Edwards *et al.*, 2009; Thurlow, 2006 and IMF, 2015). However, the downside to this was that it fuelled high income inequality in South Africa (Edwards *et al.*, 2009; Thurlow, 2006 and IMF, 2015).

With regards to the equity criterion, the trade policy has indirectly led to the adoption of conservation agriculture on a wide scale by the commercial grain farmers (Tregurtha and Vink, 2008 and Tregurtha *et al.*, 2010). The trade policy has however had insignificant effects on the small scale and emerging communal farmers as evidenced by the low adoption of conservation agriculture by farmers under this farming typologies. From a macroeconomic point of view, the trade policy has also seen the rapid liberalisation of trade where producers, agents and buyers are now trading more openly in various markets (Thurlow, 2006 and Edwards *et al.*, 2009).

The trade policy is also regarded as a high cost policy since the cumulative costs of protection results in growth reduction, less private consumption and job losses (Freytag, 2011). The current protection of special sectors is a cost to the economy in specific reference to the unprotected industries (Freytag, 2011). This clearly outlines that the current trade policy is costly for the domestic economy. Dryland maize and beef farmers have been affected both negatively and positively by the trade policy. In the negative sense, all state support to agriculture was lost with the introduction of this policy, while in the positive sense farmers became innovative, adopted sustainable production methods such as conservation agriculture and increased production output (Tregurtha and Vink, 2008 and Tregurtha *et al.*, 2010).

With regards to feasibility, the policy has been technically feasible given the increase in performance, productivity and output and the adoption of conservation agriculture practices by the commercial grain farmers in the Western Cape and in the interior provinces (mainly maize production areas) of South Africa. In light of the afore-mentioned developments and gains witnessed in the South African agriculture sector as a result of trade reforms, it can be concluded that the South African trade policy has largely been a success despite the negative effects it has had on other people and sectors of the economy.

With respect to the acceptability criterion, it can be concluded that the policy is generally acceptable, given that it is the only current policy that has been instrumental in initiating the widespread adoption of conservation agriculture practices by the commercial grain farmers in

South Africa. The acceptability of this policy can only be directly attributed to grain commercial farmers (other than beef farmers) as there is no evidence of conservation agriculture adoption by small scale and emerging farmers as a result of the trade policy in South Africa. In the event that a conservation agriculture policy is implemented as an act of law, it will potentially align well with the current trade policy, with its greatest impacts likely being evident in the commercial grain farming sector. However it will most likely yield very little impact on the small scale and emerging farmers due to the shortfalls of the Land reform policy (i.e. lack of clearly defined property right and failures of the redistribution and restitution programmes).

### **5.5.5 Environmental policy**

The environmental policy is potentially effective in enhancing the adoption of conservation agriculture by farmers in South Africa. Currently most of the legislation concerned with environmental sustainability issues is covered by the environmental policy under the umbrella of the National Environmental Management Act (NEMA) (DEAT, 1998 and DEA, 2014). This environmental policy is the major driving force spearheading sustainable development and transition of all business sectors (including the agriculture) towards a greener economy (DEA, 2014). This policy provides the framework for adoption of sustainable farming practices by the agricultural sector as evidenced by issues such as the preservation of natural resources, restoration, pollution prevention and climate change (DEA, 2011). On the other hand there are likely to be conflicts between environmental sustainability and development due to disagreements over appropriate use of land, access to scarce natural resources and the management of polluting materials. For example, conflicts can arise when workers are exposed to harmful substances that pose health risks, work with inadequate equipment to the detriment of their safety or when there is a risk to the environment.

In terms of the equity criterion, the environmental policy is likely to negatively impact stakeholders whose activities or by-products cause some degree of pollution or degradation to the environment. However these negatives are counterbalanced by the benefits of the policy such as its alignment with agricultural sector policies and the equitable access to environmental

resources which it permits for all stakeholders (Midgley *et al.*, 2015). This policy will also ensure sustainable practices whose benefits would still be enjoyed by future generations.

The environmental policy is costly for the South African government. The 2014 annual report released by the Department of Environmental Affairs (DEA) shows that there are resource constraints which have handicapped the department's ability to fund the entire structure that is ideal to cater and provide for the required human resources capacity. In other areas of work such as climate change management and other environmental management issues, the DEA has partnered with international donors to fund some of the key priorities and initiatives, however there has also been a delay in the release of these donor funds (DEA, 2014). It is important to note that this policy is not directly aimed at the agricultural sector, thus no direct costs are incurred by farmers.

The environmental policy has shown a degree of feasibility since it has acted as the main policy cutting across all governmental departments and spheres on matters of sustainable development. The environment policy is legislatively backed by National Environment Management Act (NEMA Act 107 of 1998). The DEA's 2014 annual report shows that significant progress has been made by the department in meeting its environmental management and enforcement efforts as evidenced by enhanced capacity for compliance monitoring through the training of more enforcement officials.

As for the acceptability criterion, this policy has generally been acceptable to the majority of stakeholders, but however there is potential of resistance by the non-compliant parties. From an agricultural point of view, this policy is likely to be accepted by all farmers because it calls for the preservation of soil, ecosystem and the environment. The implementation of a sound conservation agriculture policy will potentially align well with the environmental policy since conservation agriculture practices are compatible with the aims and objectives of the environmental policy such as climate change mitigation, conservation of land resources and preservation of water (Midgley *et al.*, 2015).

### 5.5.6 Policy on organic production

This policy on organic production is likely to have limited effectiveness on the uptake of conservation agriculture. This is mainly because conservation agriculture and organic farming are two different agro-ecological approaches with the former built on three pillars namely minimal soil disturbances, sound crop rotations and thirty percent residue cover, whereas the latter based on farming without the use of synthetic inputs. The organic production policy seeks to promote the interests of the organic farming and consumer sector of South Africa as well as to unify all concerned stakeholders (DAFF, 2011<sup>a</sup>). However there seems to be no mention of the promotion of conservation agriculture within the organic production draft policy document.

In terms of the unintended effects criterion, the policy might drive chemical agro-dealers out of business due to its opposition to the use of pesticides and synthetic inputs. Adopting organic agriculture as the mainstay of farming from a commercial point of view can potentially lead to food security risks in the event of insect, mite, weed and disease pest outbreaks. People do not seem to understand what organic farming entails, hence proper consultation with all relevant stakeholders is imperative to avoid the possible unintended consequences.

In terms of the equity criterion, this policy might potentially have adverse effects on commercial farmers in the event of pest outbreaks. Such events can detrimentally lower the yields with serious adverse implications on profitability and cash flows of farmers. This policy is also likely to negatively affect conventional farming agri-businesses that supply synthetic inputs like pesticides, growth hormones and fertilizers as they would effectively be pushed out of business demand for their products declines. However from a consumer perspective, the policy is desirable, as it is empowered to addresses concerns about wrong labelling, certification issues and myths around organic products. Furthermore, provided that the small scale and emerging farmers are adequately trained in organic farming, they potentially stand to benefit from the policy due to cost saving resulting from the reduction in use of synthetic inputs. It is this group of farmers that is currently faced with capital constraints as a result of the adoption of organic agriculture. Organic farming will improve the soil health, lead to better crops and yields which will ensure safe and nutritious food and thus improve livelihood and food security status of the vulnerable groups (DAFF, 2011<sup>a</sup>; Midgley *et al.*, 2015 and Seufert, 2012). The major aim of the organic production policy is therefore to address the afore-

mentioned aspects and bring about a total unification of the stakeholders in the South African organic sector (DAFF, 2011<sup>a</sup>).

As for the cost criterion, this policy is potentially costly to the economy of South Africa due to its opposition to the use of synthetic products. This might lead to the closure of several industries and agencies that produce and supply these product and severe job losses. With regards to agricultural production, it is yet to be proven whether or not organic farming can sustain the food security demands of the growing world population. Commercial farmers, may be negatively affected by the high risks of yield decline due to pest outbreaks which in turn has a knock on effect on net farm income and profitability.

In terms of the feasibility criterion, this policy is not technically feasible in the South African context for example, as the organic sector is currently highly fragmented, and there is a high degree of uncertainty about this phenomenon. Most importantly, knowledge on organic farming in South Africa is still very limited and there seems to be no organisation that represents the interests of organic farmers. Against this background, it can be concluded that South Africa currently does not have adequate human resources and capacity to implement this policy due to the intense fragmentation and a host of other constraining factors.

With regards to the acceptability criterion, this policy will potentially draw a lot of criticism because generally in South Africa knowledge on organic agriculture is still very limited. There is a great potential that the policy will be fiercely opposed by pro-conventional farming players and advocates in view of the negative implications and threats it poses to their business operations. This is policy will likely be accepted by people conducting backyard gardening for subsistence means and NGO organisations promoting organic farming in urban and rural communities.

As noted above in the cost criterion, there is still widespread scepticism as to the ability of organic agriculture to produce food for the global population and meet food security. However, small scale and emerging communal farmers might welcome this policy due to its cost cutting implications with regards to use of synthetic inputs provided they are adequately trained on this type of farming system. However if the risk of massive or total loss of yield due to pest outbreaks is high, an organic agriculture policy will not be desirable even to the small scale farmers who are constrained by the high cost of inputs. Nevertheless the conservation agriculture policy and organic production policy will be compatible should they be implemented due to the similarity in principles they promote.

### 5.5.7 Water policy

The water policy is potentially effective in enhancing the uptake of conservation agriculture if it is aligned with other policies, such as climate change policy, land reform and environmental policy (Midgley *et al.*, 2015). South Africa being a water scarce country (DEA, 2011<sup>b</sup> and DWA, 2008) could benefit through the adoption of conservation agriculture by all farmers, since it leads to benefits of water conservation and climate resilience during drought and dry spells (Jat *et al.*, 2014). As for the unintended consequences, this policy poses challenges for stakeholders that utilize large quantities of water even though no particular group is targeted (Vink, 2004).

As for the equity criterion, the water policy favours small scale producers and poses challenge to the large water users (Vink, 2004). The policy has positively impacted the previously disadvantaged people through the intensified provision of on-site water and the free delivery of a basic quota (Vink, 2004). This has the potential to improve household food security as a result of possible improved sanitation and food safety.

In terms of the cost criterion, this policy is costly for the agricultural sector. Water is scarce in South Africa (DEA, 2011<sup>b</sup> and DWA, 2008) and agriculture is the largest user of water (using 62 per cent of the available water) (CSIR, 2010) amongst the various competing sectors for this precious resource. The building of dams as proposed in the water policy will cost both the government and farmers substantial amounts of money. Taping underground water for agricultural use has been deemed expensive further rendering this policy to be costly. The policy is also costly in the sense that the financial burden for water use is not borne by all users as government exempts some households from paying for water despite the resource being scarce.

With regards to feasibility, the policy is feasible given that it seeks to redress the social injustices of the segregative land laws that excluded the black people from owning water rights which was in effect before democratisation of South Africa and favoured water use only by the people owning land adjacent to the rivers. In addition, the current water policy is legally supported by the existing National Water Act (Act 36 of 1998). The current policy is generally acceptable to farmers since agriculture uses the larger part of the available water resources in South Africa (CSIR, 2010) compared to other sectors such as mining and energy generation that are also in competition for the same scarce resource. In the event that the conservation

agriculture policy is implemented; there is great potential for alignment with the water policy (Midgley *et al.*, 2015) because conservation agriculture production practices help conserve water for example through the residue cover which acts as a mulch resulting in reduced water loss through evaporation (Jat *et al.*, 2014).

#### **5.5.8 Policy on agriculture in sustainable development.**

This policy has great potential to enhance the uptake of conservation agriculture by all farmers given that the principles of the policy promote the transition of the agricultural sector towards a greener economy. For example in intensive and mixed beef production systems, most of the stock feeds used in the feed lots will potentially be produced through conservation agriculture instead of conventional farming. The crop enterprises will realise benefits of increased yield, decrease in fertiliser requirements, climate change resilience and increased profit margins (Jat *et al.*, 2014; Tregurtha and Vink 2008 and Tregurtha *et al.*, 2010).

The unintended effects of the policy may include conflicts and disagreements between pro conservation agriculture and pro conventional farming stakeholders. This is because the policy advocates for agro-ecological (pro-natural, multi-cropping and ecosystem conservation) production methods in place of conventional farming methods that are based on intensive mono-cultural production system (DAFF, 2011<sup>b</sup>)

As for the equity criterion; this policy is likely to affect farmers (small scale, emerging and commercial) positively. It is recognised in the policy that agro ecology is one of the viable alternative to resolve the negative effects imposed by conventional farming (DAFF, 2011<sup>b</sup>). Provided that the necessary training is provided and the methods of agro ecology (like conservation agriculture) are implemented correctly all farmers are likely to experience an increase in yields, reduce production costs, develop climate resilient crop systems, reduced degradation and restore the productivity of agricultural land. However the pro-conventional farming advocates are likely to be negatively impacted if methods like organic farming are introduced (which oppose the use of synthetic chemicals and herbicides) is implemented and the use of mechanised production systems are phase out through adoption of conservation agriculture. This will probably drive the relevant agribusinesses out of business.

With regards to the cost criterion, the policy is likely to be beneficial to the agricultural economy of South Africa owing to a decrease in production costs. This policy will also help mitigate adverse climate effects such as droughts, floods and erratic rainfall patterns through carbon sequestration (which reduces GHG emissions) (Jat *et al.*, 2014)

This policy on agriculture in sustainable agriculture is potentially feasible if it is aligned to other policies such as the land reform policy, water policy and trade policy discussed above. However in South Africa there is currently a shortage of skilled human resources in the area of conservation agriculture and other agro-ecology, hence information dissemination and training on these aspects are necessary for the successful implementation of the policy on agriculture in sustainable development. As for the acceptability criterion; this policy is likely to be accepted by all stakeholders since currently there has been a lot of pressure on the transition of agriculture to a greener economy. It is widely accepted that degradation of agricultural land has serious consequences to food security and the economy (Jat *et al.*, 2014). Conservation agriculture has been pinpointed as one of the production methods that can reverse degradation and lead to a transition towards a greener economy for the South African agricultural sector (DAFF, 2011<sup>b</sup> and Midgley *et al.*, 2015). The implementation of the conservation agriculture policy will therefore align well with this policy on agriculture in sustainable development and positive outcomes will be achieved as aimed in the respective policy documents.

### **5.5.9 Food and nutritional security policy**

The food and nutritional security policy can potentially lead to the uptake of conservation agriculture. The benefits of conservation agriculture such as increases in yields and reduction in production costs can potentially enhance the food and financial security of the vulnerable rural populations and small holder sectors. This has been evidenced in Zambia where many small scale farmers adopted conservation agriculture (IIRR and ACT, 2006). This will potentially have a larger impact on the uptake of conservation agriculture by the small scale and emerging farmers.

As for the unintended effects criterion, the policy might lead to moral hazard due to the provision of social safety nets (cash and food transfers). The proposed centralised food security system (proposed in the food security policy brief ) might lead to bureaucratic red tape with respect to the decision making process as power is concentrated at the top of the system and

the channels of communication being inefficient. The proposed fair pricing of food products for the public might lead to market failure as a result of the bypassing of the free market mechanisms (i.e. the laws of supply and demand).

In terms of the equity criterion, the food and nutritional security policy is likely to improve the food security status of the vulnerable poor rural household communities. Vulnerable groups are likely to be economically empowered as a result of the prioritization and promotion of women and youth equity in land ownership (DAFF, not dated). As for the cost criterion, this policy is costly for the South African government in view of the subsidies linked to the provision of social safety nets and government purchase programmes. However from an agricultural point of view; this policy has an indirect effect on conservation agriculture hence it is likely not to impose any costs on the farmers.

The food and nutritional security policy is not technically feasible since currently there is no legislation for food security and as a result of this it will be difficult to implement and legally enforce it. There have been challenges with providing an accurate and all-encompassing definition for food security from both a global and local perspective. This poses problems with crafting and implementing policies that are aimed at addressing food security issues. Nevertheless the acceptability of the food and nutritional security policy is likely to be accepted by the vulnerable groups (food insecure groups in both rural and urban areas). The government and NGO's have recognised the importance of this policy suggesting that there is general acceptability of this policy probably by most stakeholders. The implementation of a conservation agriculture policy will potentially help to align the food security policy with other agricultural policies leading to highly productive and sustainable agriculture sector and economy.

#### **5.5.10 Comprehensive Rural Development Framework (CRDP)**

The CRDP is likely to have the same effect as that explained as explained in section 5.5.2 on land reform. The CRDP consists of three pillars namely Land Reform, Agrarian Transformation and Rural Development, with a strategic focus on social cohesion and

development (DRDLR, 2009). The CRDP seeks to bring about decent employment and sustainable livelihoods in the rural areas and is built upon the principles of the land reform policy.

#### **5.5.11 Conservation of Agricultural Resources Act (CARA)**

This Act of law is potentially effective if it is updated and aligned with other sectoral policies such as climate change policy, environmental policy and carbon tax policy. In terms of the unintended effects of this policy, there has been degradation of the environment despite this Act being there, however in terms of the control of invasive alien species, this policy instrument has caused the farmers who have been mandated to control these plants to incur high cost and there has been concerns that these plants under control also act as a carbon sink which could potentially mitigate climate change. In the case of eucalyptus trees, pollination bees overwinter in these plantations and these bees are responsible for most of the pollination in the deciduous fruit industry of South Africa (SANBI, 2015).

In terms of the equity criterion, this policy instrument is regarded as the primary statute for conservation within the agricultural sector of South Africa (Van der Linde, 2006). It can potentially yield positive benefits for the whole agriculture sector, since the control of invasive alien plants lead to increase water supply, reduced fire hazards and restoration of degraded and improved pastures (Van Wilgen *et al.*, 2008; Richardson, 1998 and De Wit *et al* 2001).

As for the cost criterion, this Act of law is costly for the government since the government need to spend a significant budget enforce compliance and restore degraded land and also for research that will bring about incentives for pro conservation behaviour. In terms of the control of invasive alien species, the government needs to set aside a budget that will enable the bio control research and programmes pertaining the control of the plants. According to Van Wilgen *et al* (2012), the South African government spent more than ZAR3.2 billion in the control of invasive plant species through the Working for Water programme.

In terms of the feasibility criterion, this policy instrument is not technically feasible because it's outdated and needs to be updated to make it more effective in bringing out pro conservation behaviour within the South African agricultural sector. However on the contrary, it has succeeded to reduce the negative impacts caused by invasive alien plants such as increased

water loss, loss of pastures, erosion and fire hazards (Van Wilgen *et al.*, 2012). This success can largely be attributed to the promulgation of the NEMBA regulations.

As for the acceptability criterion, CARA is not generally acceptable since environmental degradation has gone unabated despite this instrument being there, but rather it has become outdated having not achieved the reasons for its existence. CARA is now outdated and it's in the process of being updated, however this has not been finalised (Mampholo, personal communication 2015). In the event that the conservation agriculture policy is successfully implemented, it can potentially help bring an alignment of CARA and other policies.

#### **5.5.12 Invasive alien species policy (NEMBA Regulations)**

This policy has the potential to aid the uptake of conservation agriculture by farmers in South Africa. Invasive alien plants cause important conservation and economic problems, such as changes in plant community composition, reduced productivity of agricultural lands, excessive water loss from watercourses and catchments, reduced regeneration rates of native species and alteration in landscape structures. While some species result in excessive loss of nutrients others like *Acacia* species actually elevate the levels of soil nitrogen and secrete allelopathic substances into the soil thereby discouraging the germination and establishment or even causing extinction of native indigenous species. The displacement of fynbos vegetation by populations of invasive Australian *Acacia* species has been attributed mainly to habitat modification by the *Acacia* species themselves. This includes the mineral enrichment of soils whereby levels of nitrogen are elevated beyond that which the nutrient poor soil adapted native fynbos can tolerate (Musil and Midgley, 1990 and Low, 1988) associated with an increased litter fall mass (Milton, 1981) and litter decomposition rate (Witkowski, 1991) under *Acacia* species, solar radiation attenuation by the overtopping *Acacia* plant canopy, and reduced soil water availability (Rutherford and Bosenberg, 1988). CA can help restore fertility in land that have been degraded by invasive and alien plants since it yields benefits of increased soil fertility and the organic content within the soils (Jat *et al.*, 2014).

As for the unintended consequences and the cost criteria, the same scenario as that experience in CARA applies under this policy as well. Farmers that own land infested by invasive plant species are now required by law (NEMBA) to control these plants and to avoid their spread

outside their area of confinement. This is likely to cause extra cost for farmers, since they will have to use their own money and resources to control invasive plant species.

In terms of the feasibility criterion, this policy is technically feasible since the government has set a budget for research and implementation of biological control as part of the integrated management of alien invasive plant species through the Working for Water funding programme under the auspices of the DEA. Reports from post release impact evaluation studies indicate that the combined use of biocontrol and clearing efforts has prevented the spread and densification of several alien species for example certain *Acacia* species (Impson *et al.*, 2011) and invasive cactus species (Paterson *et al.*, 2011).

As for the equity criterion, this policy has positive effects for farmers in general and society as whole to a large extent since the control of these species brings restoration of natural ecosystems and agricultural lands as well as restoration of soil nutrient balance which implies enhanced productivity of the land. While several alien species have now been declared important invaders, there have been conflicts of interest between those wanting them eradicated and those that benefit from their economic or aesthetic value. For example *Eucalyptus* species are important to bee farmers and the South African deciduous fruit industry as bees utilize them as overwintering sites and an important source of pollen whereas the bees themselves are important pollinators of fruit trees in the horticulture sector (SANBI, 2015). The *Acacia* species on the other hand despite being extremely invasive in some areas, they are also valuable sources of timber, tannins and pulp in South Africa.

In terms of the acceptability criterion, the NEMBA Act has been welcomed as the benefits derived from the management of invasive species far outweigh the negatives of the act. In addition, the management efforts implemented against some of the beneficial invasive species such as biological control of Australian acacias, target the reduction of their reproductive capacity while not interfering with beneficial attributes of the species so that they can continue to be exploited commercially (Impson *et al.*, 2011). It can therefore be concluded that invasive alien species control policy (NEMBA) will align very well with the conservation agriculture policy and other pro conservation policies.

## **5.6 Conclusion**

In the analysis, twelve economic policies and instruments with a major potential impact on conservation agriculture uptake in South Africa were identified namely; the climate change

policy, land reform policy, carbon tax policy, trade policy, environmental policy, policy on organic production, water policy, policy on agriculture in sustainable development, food and nutritional security policy, the comprehensive rural development programme (CRDP and the Invasive Alien species policy (NEMBA regulations). The findings indicate that the aforementioned policies have potential to enhance the uptake of conservation agriculture. However this has not happened due to the overlap, contradictions and discord between the policies (Midgley *et al.*, 2015). This therefore necessitates the alignment of all the policies in a manner such that they complement each other achieve their intended goals and objectives. Furthermore conflict of interest between the various stakeholders as well as scepticism with regards to unintended effect may be a source of delay.

## **Chapter 6: General discussion and conclusions**

### **6.1 Introduction**

This study has offered critical and detailed information about economic policies and instruments that can potentially influence the uptake and adoption of conservation agriculture in South Africa. It is apparent that there seems to be some discord amongst policies. Therefore it is imperative that an alignment of various policies is done in order that they complement and not conflict against each other. The success of conservation agriculture uptake and adoption in South Africa will likely succeed with greater alignment given the multi policy, multi-institutional and system-wide framework affecting conservation agriculture promotion within South Africa. The implementation of a conservation agriculture policy is of additional importance in order to enhance the effects and implementation dimensions of these policies. This chapter presents an overview of the study with a brief summary and outline of each aspect of the analysis, as well as a detailed discussion of implications and recommendations of the respective policies.

### **6.2 Thesis overview**

In this dissertation the impact of economic policies and instruments on conservation agriculture in South Africa was investigated. A detailed background and a review of conservation agriculture and policies from both a global and South African context was conducted. It has emerged that few countries have successfully promoted conservation agriculture using policy and the rest of the uptake has mainly been farmer and NGO driven. It was also noted that there has been a significant shift of policy in South Africa. Most of the adoption and uptake of conservation agriculture has therefore been market driven without the support of policy. However, there are policies in place that can potentially enhance the uptake of conservation agriculture in South Africa.

The history and progression of conservation agriculture from both a global and South African perspective was reviewed in order to establish whether the case of South Africa can be

compared to that of other countries as well as draw lessons from the experience of other countries. The origins of CA were found to have started in the 1930's as a result of the dust bowls in the USA due to extensive soil wind erosion as a result of conventional farming practices (Jat *et al.*, 2014). It was noted that policy has played a pivotal role in the adoption of conservation agriculture in the USA. In the case of Brazil, it was noted that, for all its efforts, it has come to be regarded as the cradle of the conservation agriculture revolution, which saw the spread of the concept from Brazil to other South American countries (Jat *et al.*, 2014). In Australia conservation agriculture started as a result of soil erosion problems and its adoption and uptake was inspired through visits to Europe to gain more information about the conservation agriculture technique and most of the uptake has been widely supported by policy (Jat *et al.*, 2014). As for the EU, not much conservation agriculture adoption has taken place due to policy constraints and the fact that the EU Common Agricultural Policy is built upon principles of conventional farming practices. The African continent, adoption and uptake of conservation agriculture is still very low and has mostly been driven by other factors other than policy. In the case of South Africa, the origins of conservation agriculture can be traced back to the late 1970's when the Small grains institute of the ARC initiated conservation agriculture trials (Berry *et al.*, 2001). However due to a policy shift that saw the agricultural sector losing all state support as a result of trade reforms implemented during the period 1980-1994. Wheat and maize commercial farmers adopted conservation agriculture for economic reasons to avoid bankruptcy and going out of business (Tregurtha and Vink, 2008 and Tregurtha *et al.*, 2010). Currently conservation agriculture has been widely adopted by commercial farmers and more work needs to be done to promote its uptake and adoption by small scale and emerging farmers within South Africa.

The methodological approach and analytical framework used in this research was outlined. The knowledge synthesis method was used in this study to analyse the various policies that can potentially influence the uptake of conservation agriculture in South Africa. This method was adopted from those used by Salamon (2002) and Morestin *et al* (2010). The analytical framework for the afore-mentioned methodological approach was two pronged focussing on two dimension of effects and implementation of the policies and instruments which were further broken down into six analysis criterion. The relationship between the six analysis criteria was also analysed and it has been shown that all the criteria are interrelated. The analytical framework was then formulated in the form of matrices on excel spreadsheets for

the purpose of this thesis and conducted in text format. The excel matrices are shown in the Annexure section (i.e. Annexure 1-3).

The research results and findings applied to the methodological approach and analytical framework were also presented with a detailed discussion of the various policies and instruments with possible impacts on conservation agriculture. Other legislation relevant to conservation in agriculture were also discussed. Twelve policies and instruments that have a higher chance of influencing conservation agriculture were analysed using the afore-mentioned framework. Of these twelve policies, only the land reform policy posed negative effects to the adoption of conservation agriculture. An alignment of policies and instruments was found to be imperative to make the policies politically and administratively feasible and effective. The implementation of a conservation agriculture policy was also determined to be of paramount importance in strengthening the feasibility of the policies in a mutually beneficial way. It follows that should a conservation agriculture policy be promulgated, it would assist other policies in achieving their goals whilst at the same time the other policies would promote the uptake of conservation agriculture.

### **6.3 Policy implications, recommendations and further studies**

Various policy recommendations can be drawn from this study. One of the most important recommendation is to create awareness of conservation agriculture and implement a policy specifically for conservation agriculture. This is important as knowledge of conservation agriculture at all levels of farming (i.e. small scale, emerging and commercial), governmental departments, and other relevant stakeholders needs to be increased. This can be achieved by producing and distributing relevant literature by means of published data, posters, pamphlets and videos about conservation agriculture practices as well as the inclusion of conservation agriculture topics in relevant radio and television programmes. Conservation agriculture should further be promoted at stakeholder meetings, workshops, field days and seminars. Study tours can also be organised at established demonstration sites within South Africa where conservation agriculture has been a success, for example in the wheat regions of the Western Cape, maize production sites in the interior provinces of the country as well as in the KwaZulu-Natal Karkloof valley where all farmers have adopted conservation agriculture (ACT, 2011 and FAO, 2007). Conservation agriculture concepts should also be included in primary, secondary

and tertiary education curriculum to mitigate information asymmetries and myths regarding the concept and to develop the skills needed in its implementation. The activities regarding conservation agriculture by DAFF and other relevant stakeholders should be more coordinated. This can be achieved via by the means of institution-coordinated programmes such as the Land Care Programme and Agricultural Production Action Plan (APAP). Comprehensive support should be given to small scale and emerging farmers who lack capital and are faced with other resource constraints. It is important to note that, farmers are the major stakeholders being the ones at the forefront conservation agriculture adoption and implementation. Therefore, they should be consulted and allowed to participate and lead the policy formulation process.

Standards for monitoring and evaluating conservation agriculture should be enacted. Conservation agriculture needs to be implemented in accordance with South Africa's conditions and this can only be done through a clear outline of guidelines for the implementation and monitoring of conservation agriculture. Compliance and punitive measures should be enacted to enforce as well as promote pro-conservation behaviour amongst all famers in South Africa. Conservation agriculture technologies and practices within South Africa should be elucidated and communicated clearly to ensure success in their implementation and to avoid possible misunderstandings or conflicts that may arise. The evaluation and monitoring methods of conservation agriculture should additionally be standardized to bring about a novel, robust and holistic approach. A baseline should be launched through quantifying and mapping present conservation agriculture activities within South Africa. This should typically include the number of conservation agriculture farmers, areas under conservation agriculture, yields and other relevant parameters in DAFF's regular data collection and reporting system.

The current extension workers in South Africa are more proficient with conventional farming. Capacity building of Extension services has to be increased to adequately establish and promote the adoption and uptake of conservation agriculture. This can be done through the creation and decentralization of conservation agriculture training and exposing them to successful conservation agriculture initiatives in SADC, AU and other intercontinental case (like North America, Australia and Asia). In-service training centres which are easily accessible to extension workers should additionally be provided. Modules and refresher courses should be developed and provided for the extension workers, focusing mainly on skills and technologies relevant to conservation agriculture. This is imperative because the various conservation agriculture practices are specifically applicable in certain farming systems and agro ecological

zones. This therefore necessitates the implementation this agro-ecological farming practice in regions with the most suitable farming conditions. Most importantly, conservation agriculture practices should be analysed, verified and adapted to the various farming types (i.e. small scale, emerging and commercial farmers) and farming conditions in South Africa.

The government of South Africa must make conservation agriculture equipment (such as no till planters), inputs and services more readily available to all the farmers (i.e. small scale, emerging and commercial) since these are not always locally available. This can be done through the subsidisation of conservation agriculture equipment purchase or replacement schemes. Another incentive schemes to promote the uptake and adoption of conservation agriculture in South Africa can be achieved through the trade policy, by eliminating import taxes and duties on imported conservation agriculture equipment. Institutional arrangements can also enacted through the establishment of community based service providers which will respond quickly to the needs of each farmer and farming environment. Conservation agriculture equipment dealerships should also be established in all provinces to provide the conservation agriculture equipment and also render service to farmers on how to use the equipment.

It is recommended that markets that offer favourable buying prices for the rotational crops be established for farmers practicing conservation agriculture. This is specifically relevant in the case where new or relatively unknown rotational and cover crops are used. The feasibility of processing these rotational crops into value added products should be assessed and re-examined in the context of conservation agriculture.

The issue of land tenure should be addressed in order to make the adoption and uptake of conservation agriculture by small scale and emerging farmers more effective. The tenure system under which this group of farmers operates is invariably inferior to that of commercial farmers due to lack of clearly defined property rights. It does not encourage any pro-conservation behaviour due to the lack of clarity with respect to property rights. Adjustments with regards to this issue that favour the communal farmers would likely promote conservation agriculture within this sector.

It is recommended that the formulation of a conservation agriculture policy be expedited in view of the evidence presented with respect to the myriad of benefits likely to be encountered. A conservation agriculture policy that reconciles all the objectives of the policies analysed in this study will help bring an alignment between the various policies and help eliminate the current discord and potential conflicts amongst them. This should also be accompanied by an

update of legislation governing the conservation of agricultural resources (CARA). CARA (Act 43 of 1983) is now outdated and needs to be reviewed and updated to make it effective and this process needs to be done as a matter of emergency.

A way to accurately measure the greenhouse gas emissions from the agricultural sector should be put in place to allow for the feasibility of the climate change policy and carbon tax implementation within the agricultural sector. The agricultural sector is exempted from paying carbon tax in the first five years due to the anthropogenic nature of emissions within this sector (NT, 2014 and DEA, 2011). Further research is necessary to measure and determine the accurate estimates of emission in the agricultural sector, bearing in mind that it's one of the contributors of greenhouse gas emissions (NT, 2013). To lower emission from combustion of fossil fuels, for example dung from the livestock sector can be utilized as a source of bio gas energy.

Van der Linde (2006) states that the judicial system of South Africa is currently inadequate to deal with issues surrounding environmental law and sustainability. It is therefore recommended that an environmental court be established as it would make the prosecution of environmental degradation offenders easier and more successful.

Last but not least, the South African government can consider taking out irrigated maize and wheat out of production (since South Africa is a water scarce country) and shift production to countries like Zambia, Zimbabwe and Malawi which are water abundant (and have more yields than South Africa) and then import from these countries.. The adoption of conservation agriculture in dry land crop production systems will further enhance water conservation by the South African agricultural sector.

It is important to note that policy is not the only means that will see farmers in South Africa adopting conservation agriculture. It should be integrated with other factors such as the market and farmer driven factors, and promotional efforts by the NGO community. It should also be noted that conservation agriculture is not the best environmentally friendly alternative farming method. This is because the success of conservation agriculture is dependent upon the availability of effective herbicides which will cause negative environmental effects, such as the killing of non-targeted plants and environmental contamination. More research is needed so that environmentally benign herbicides that are biodegradable can be manufactured in contrast to the current synthetic chemical herbicides.

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## Annexure

### Annexure 1 Description of policy environment

Description of policy environment	Effectiveness (What effects does policy have on conservation agriculture?)	Unintended effects (What are the unintended effects of this policy?)	Equity (What are the effects of this policy on different groups?)	Cost (What is the financial cost of this policy?)	Feasibility (Is this policy technically feasible?)	Acceptability (Do the relevant stakeholders view the policy as acceptable?)
Policy 1						
Policy 2						
Policy 3						
Policy 4						
Policy 5						
Policy 6						
Policy 7						
Policy 8						
Policy 9						
Policy 10						
Policy 11						
Policy 12						
Policy n.....						

**Annexure 2 Analysis of policies on agriculture**

Analysis of policy on Agriculture	Dryland maize						Extensive beef production		
	Commercial		Emerging	Smallholder			Commercial	Emerging	Smallholder
<b>Policy 1</b>									
Effectiveness (What effects does policy have on CA?)									
Unintended effects (What are the unintended effects of this policy?)									
Equity (What are the effects of this policy on different groups?)									
Cost (What is the financial cost of this policy?)									
Feasibility (Is this policy technically feasible?)									
Acceptability (Do the relevant stakeholders view the policy as acceptable?)									

<b>Policy 2</b>			
Effectiveness (What effects does policy have on conservation agriculture?)			
Unintended effects (What are the unintended effects of this policy?)			
Equity (What are the effects of this policy on different groups?)			
Cost (What is the financial cost of this policy?)			
Feasibility (Is this policy technically feasible?)			
Acceptability (Do the relevant stakeholders view the policy as acceptable?)			

Policy n.....			
Effectiveness (What effects does policy have on conservation agriculture?)			
Unintended effects (What are the unintended effects of this policy?)			
Equity (What are the effects of this policy on different groups?)			
Cost (What is the financial cost of this policy?)			
Feasibility (Is this policy technically feasible?)			
Acceptability (Do the relevant stakeholders view the policy as acceptable?)			

**Annexure 3 Recommendations for policy on agriculture**

recommendations for policy on Agriculture						
	Dryland maize			Extensive Beef production		
	Commercial	Emerging	Smallholder	Commercial	Emerging	Smallholder
<b>Policy 1</b>						
- Recommendation 1						
- Recommendation 2						
- Recommendation 3						
- Recommendation 4						
- Recommendation 5						
- Recommendation 6						
- Recommendation n.....						
<b>Policy 2</b>						
- Recommendation 1						
- Recommendation 2						
- Recommendation 3						
- Recommendation 4						
-Recommendation n....						
<b>Policy n.....</b>						
- Recommendation 1						
- Recommendation 2						
- Recommendation 3						
- Recommendation 4						
-Recommendation n...						