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Climate Smart Agricultural policy in South Africa. A case study of Ngaka Modiri Molema District Municipality of North West Province, South Africa

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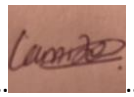
DECLARATION

I, Oladele Olamide John, declare that the dissertation, which I submit for the fulfilment for the degree of Master of Science in Geography, Archaeology, and Environmental Studies at the University of Witwatersrand, is my own work and has not been submitted before for a degree at any institutions or this institution.

SIGNATURE:…  … DATE:…16/09/2022….

ABSTRACT

This study analysed Climate Smart Agricultural policies and strategies in Ngaka Modiri Molema District Municipality (NMMDM), North West Province, South Africa. This is predicated on the fact that coherent policy development and implementation is one of the major approaches to proffer effective responses to adaptation as well as mitigation of the influences of changing climate. The study objectives include examining the existing institutions and legal frameworks for CSA at the national, provincial, and local levels, assessing policy problems affecting CSA in North West Province, and proposing relevant strategies and references that can facilitate CSA policy in NMMDM. The descriptive research design was applied, and the population for this study include the staff of the Department of Agriculture, Department of Forestry, Fisheries, and Environment (DFFE), Non-Governmental Organisations (NGOs) whose mandate and activities cover climate change, and farmers, as well as the people living in the community of the NMMDM.

A stratified random sampling method was used to select participants from the population to give a sample size of 10 experts each from the NGOs and Governmental organisations, 10 Farmers, and 10 Citizens of NMMDM. Data for the study were collected through an interview schedule based on structured questions on demographics, sources of information, awareness, knowledge and implementation of CSA policies and strategies, and policy problems associated with CSA. The data obtained was analysed with the Statistical Package for Social Sciences (SPSS) using frequency counts and percentages. The study revealed that there were many respondents with a low knowledge of CSA practices and policies. The study concludes there is a need for more awareness to increase knowledge among various stakeholders in NMMDM, North West Province, South Africa, in order to enhance the effectiveness of adaptations to climate change.

Key words: *Climate Smart Agriculture, Policy, Agriculture, Ngaka Modiri Molema District Municipality*

DEDICATIONS

This dissertation is dedicated to my parents, Prof. Oladele Idowu and Dr Oladele Folasade, as well as my siblings (Williams, Emmanuel, and Esther) for all the encouragement and support that they provided for me during my education.

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LIST OF ABBREVIATIONS

ARC: Agricultural Research Council
CA: Conservation Agriculture
CSA: Climate Smart Agriculture
DEFF: Department of Environment, Forestry and Fisheries
DFFE: Department of Forestry, Fisheries, and Environment
FANRPAN: Food, Agriculture, and Natural Resources Policy Analysis Network
FAO: Food and Agriculture Organization
GDP: Gross Domestic Product
HRLM: Holistic rangeland livestock management
ISFM: Integrated Soil Fertility Management
ISPAAD: Integrated Support Programme for Arable Agriculture Development
LIMID: Livestock Management and Infrastructure Development
NAMPAADD: National Master Plan for Arable Agriculture and Dairy Development
NCCRP: National Climate Change Response Policy
NDP: National Development Plan
NDP4: Fourth National Development Program
NGO: Non-Governmental Organisations
NMMDM: Ngaka Modiri Molema District Municipality
SASRI: South African Sugar Research Institute
SPSS: Statistical Package for the Social Sciences
VAT: Value Added Tax
WB: World Bank
WBG: World Bank Group

CHAPTER ONE: GENERAL INTRODUCTION

1.1 Background of Study

Changing climate impacts both developing and developed countries. It also has adverse effects on industries and communities, and according to Van der Bank and Karsten (2020), these effects are felt most strongly in developing countries. Changing climate is viewed as one of the key issues affecting the pace of development in South Africa, especially in the agricultural industry (Van der Bank & Karsten, 2020). Ziervogel et al. (2014) stated that annual average temperatures have increased by at least 1.5 times over the last five decades and severe weather events have become more frequent. Climate change has, therefore, reduced the potential production of food crops in many developing countries' agricultural sector, including South Africa, such that food production as well as pasture quality continue to decline as atmospheric CO_2 concentrations increase, due to the negative influences of climate (Steenwerth et al., 2014). The continuing incidences of harsh weather, such as drought and high temperatures, are leading to worsening prices and yield volatility (Steenwerth et al., 2014). This further undermines food security in South Africa (Mthethwa & Wale, 2022), in addition to disrupting the wellbeing of individuals in rural areas, such as farmers, by lowering their living standards, and in the process perpetuating the poverty cycle (Makate, 2019).

Climate Smart Agriculture (CSA) involves practices that have been seen as a way to solve environmental problems and is being adopted by many nations around the world as a way to combat the negative influences of changing climate on agricultural production (Ngcobo & Chitakira, 2021). Sullivan et al. (2012) referred to CSA as farming practices that reasonably increase profitability and enhance ecological framework versatility while decreasing the outflows of ozone-harming substances. CSA guarantees that environmental change variation and moderation are straightforwardly fused into agricultural advancement planning and investment policies (FAO, 2013).

For the vast majority of the world's poor, agriculture is their primary means of financial support, and research has revealed that expanding agriculture is often the most effective option for decreasing poverty, building resilience as well as enhancing

food security, but changing climate makes it challenging to achieve these goals (Recha, 2020). In this context, CSA can serve as a holistic and effective way to address these interconnected concerns by guiding agricultural systems reform and realignment initiatives to effectively and continuously promote growth and food abundance as climate change exists (Recha, 2020). CSA includes systems and practices that farmers can use to respond to changing climate while also increasing productivity and lowering GHG emissions. CSA could also aid various governments achieve food security in their own countries in addition to poverty reduction (Barnard et al., 2015).

According to Makate (2019), there are various obstructions to the effective enactment of CSA in the South African agricultural sector; these include the lack of availability of seeds, pesticides, and herbicides, which ensure that crops are less impacted by climate change. In addition, South Africa lacks analytical capacity and skills to scale down global patterns of agriculture-related adaptation practices for climate change, at national as well as provincial levels (Zhou, Kori, Sibanda & Nhundu, 2022). Thus, there is poor understanding or knowledge about the current as well as the potential effects of changing climate in South Africa, and what this implies for agricultural production and food security (Thornton et al., 2018). Due to the little knowledge concerning changing climate in South Africa, and the lack of guidelines for CSA policies, the intended outcome is not usually achieved (Thornton et al., 2018).

Different approaches that propose solutions to combat environmental problems have highlighted the need for public participation, awareness, the adoption of environmental protection programmes, enactment of environmental management practices, and the adoption of environmental management policies (Khalil et al., 2011). For the success of CSA, policy analysis is one of the methods that can be employed to understand how and why countries are implementing specific policies such as integrated soil fertility management, as well as their ramifications (Browne et al., 2019). As part of this research, policy analysis serves as a comprehensive assessment of the effect and implementation of existing changing climate policy, such as CSA, in addition to opportunities for implementing new climate policies (Milovanovitch, 2018). According to Mnkeni et al. (2019a), the limitations that these

policies, such as soil and water management and agro-processing, have in common in South Africa are that there are no practical guidelines for their implementation. In 2019, the Department of Environment, Forestry and Fisheries, of South Africa released compilations of “Actionable guidelines for the implementation of climate smart agriculture in South Africa” in two volumes (Mnkeni, Mutengwa, Chiduza, Beyene, Araya, Mnkeni, Eiasu & Hadebe, 2019). Thus, this study conducted a policy investigation of CSA strategies in South Africa in a case study of NMMDM which is located in the North West Province.

1.2. Research Problem

The position of the agricultural industry as a main supplier of income to various households, especially in rural areas like Mahikeng, which is located in the North West Province of South Africa, is in jeopardy due to effects of climate change (Naude & Rivett-Carnac, 2018). These include, but are not limited to, inefficient water supply and use of water-related practices in the province, and implications related to changing climate, e.g. variable weather patterns, lack of rainfall, and severe climatic phenomena (Naude & Rivett-Carnac, 2018). These ecological effects are felt within the economic system of the sector (Naude & Rivett-Carnac, 2018). Farming systems in the North West Province are not built to withstand climate change, as farming practices promote water stress, environmental degradation, and climate change, which is unsustainable with regard to food security, and the creation and sustainability of decent jobs (FANRPAN, 2017). The implications of climatic change and unpredictability decreases agricultural production, thereby increasing poverty and unemployment (Oduniyi, 2018). As a result, there is a compelling need to examine the influence of changing climate in the study area and then conduct a policy analysis of CSA as an adaptation strategy that has been adopted in the study area in order to adapt to the changing climate.

One of the conditions for the success of CSA policies is based on their assimilation and implementation in current policy (Zougmoré et al., 2015). An example of current CSA policies employed in South Africa are those of the Food and Agriculture Organization of the United Nations, which supports the government in developing CSA approaches. However, some of the farmers in South Africa face challenges

when it comes to using CSA strategies to address environmental issues caused by climate change due to having little knowledge about the techniques (Abegunde & Obi, 2022).

Zokwana (2018) noted that many project participants and other stakeholders in North West Province of South Africa involved in CSA mainstreaming lack the capacities to implement CSA, and that there is poor budgeting when it comes to implementing planned climate change adaptation response options (Zwane & Montmasson-Clair, 2016). The shortage of skills is another policy problem, because relatively appropriate planning procedures for CSA-related initiatives have not always achieved the desired results (Zokwana, 2018). Furthermore, while South Africa might have a lot of knowledge on CSA practices, it has difficulty putting this knowledge into practice (FANRPAN et al., 2017). With the exception of the Western Cape, national initiatives on changing climate such as CSA have not been sufficiently assimilated or incorporated into specific provincial strategies and plans. The same is true at the municipal level, in the NMMDM (Zwane & Montmasson-Clair, 2016).

Despite a strong policy framework at the national level, integrated strategic and comprehensive CSA planning is lacking in the North West Province of South Africa (FANRPAN, 2017). The following research questions emanate from the study:

I. What are the institutions or authorised policies impacting the enactment of CSA in the agricultural sector of NMMDM in the North West Province of South Africa?
II. How do implemented CSA strategies affect the agricultural situation of NMMDM?
III. What are the recommended policies that have been implemented in the agricultural sector of NMMDM in the North West Province of South Africa that facilitate CSA?

1.3 Aim and Objectives

This study aims to conduct a policy analysis of CSA strategies in NMMDM in the North West Province of South Africa. This analysis will examine the existing CSA policies and strategies, evidence of cross-sectoral synergy, and incentives for adoption in terms of context, coherence, and governance of this policy. The objectives are to:

I. Examine the current agricultural practise and existing legal frameworks for CSA in the study area at the national, provincial, and local levels.
II. Assess policy problems affecting CSA in the agricultural sector of the North West Province.
III. Propose relevant strategies and references that can facilitate CSA policy in the agricultural sector, in the study area.

1.4 Justification of the Study

This study has significant importance concerning how policies are responsive to changing climate, informed guidelines, and programmes, as well as projects, taking into account climate change, and which are aimed at lowering GHG emissions. Thus they may alleviate the impacts of changing climate and implement the necessary incentives for individuals and social systems to adapt to changing climate and threats (Corbera et al., 2019). This study will identify respective policy, technical, and institutional interventions that have been proposed by experts to aid agriculturalists to acclimatize to future as well as the present changing climate (Aggarwal et al., 2018). Additionally, this study is of importance because the implications of environmental policies, the source of energy constraints they entail, and how climate change policies and measures correspond to the development policies and procedures are, in general, still inadequately understood (Corbera et al., 2019).

1.5 Study Organisation

This study is made up of five chapters. The first chapter comprises of the introduction which establishes the background in addition to the research problem of the study, and the aims as well as objectives of the study. It briefly identifies the relationship between changing climate as well as food production, the adverse effects that changing climate has on agricultural production, and it identifies CSA as a strategy which can be utilised to decrease the adverse influence of changing climate on agricultural practices and, in the process, promote food production. The barrier facing CSA is briefly discussed and the strategies that can be used to promote CSA are also discussed. The introduction ends by identifying the research questions as well as the aims and objectives of the study. Chapter two, which is the literature review, draws from a large variety of studies that are related to CSA. The third chapter describes the methodology utilized in the study. The fourth chapter presents the findings of this study, and the last chapter entails discussion of the findings and the conclusions, which provides suggestions and strategies that can promote CSA policy applications.

CHAPTER TWO:
LITERATURE REVIEW

2.1 Conceptual Framework and Literature Review

This section encompasses four areas; the first section defines the frameworks for this study namely CSA, policy analysis, and agriculture. The second section reviews the policy analysis of Climate Smart Agricultural strategies from a global perspective, the third section deals with the existing policy of CSA in sub-Saharan Africa from a regional perspective, and the last section deals with the existing policy of CSA from the perspective of South Africa.

2.2 Defining the concepts

Lipper et al. (2014) define Climate Smart Agriculture as a tactic for reforming as well as facilitating agricultural growth. CSA is defined by the United Nations FAO as agricultural practices that enhance productivity in a sustainable manner, improve adaptability, mitigate greenhouse gases where feasible, and facilitate development and reduce food insecurity (FAO, 2013). The process of tackling food insecurity and promoting development is described as the principal goal of CSA (FAO, 2013; Lipper et al., 2014); adaptation, productivity, as well as mitigation are recognized as the three interconnected sustainability pillars required to achieve this goal.

In the context of this research, policy analysis refers to the review as well as study of the creation of a concept or scheme (CSA)(Patton, Sawicki & Clark, 2015), which will then be adopted and executed to alleviate the impact of changing climate on agriculture in the study area (Simon, 2016). Policy analysis also entails the gathering and evaluation of data that clarifies the causes and effects of public problems, such as climate change affecting agricultural development in this context, as well as the repercussions of selecting one policy over another to solve them (Kraft & Furlong, 2018).

Harris and Fuller (2014) define agriculture as the various methods wherein crop plants and domestic animals provide food and other products to the worldwide human population. The cornerstone of developing economies is sometimes referred to as agriculture (Mnkeni et al., 2019b). While contributing value to raw materials, a

thriving agricultural sector promotes a country's GDP, social welfare, food security, and job development, as well as ecotourism. Due to its backward and forward links to the economy, it is regarded as a vital driver for development. It has also been highlighted as one of the main areas that could promote the greening of the economy, which in this case means helping with climate change mitigation and adaptation (Mnkeni et al., 2019b).

2.3 Policy analysis of Climate Smart Agricultural strategies: a global perspective

The World Bank Group (WBG) is increasingly promoting and supporting CSA strategies on a worldwide basis. The World Bank has pledged to work alongside nations to produce CSA that attains the triple goals of greater production, reduced emissions, as well as improved adaptive capacity (The World Bank, 2021). The WBG places a greater emphasis on adaptability and resilience towards climate change. The WBG also funds research initiatives such as the Consultative Group on International Agricultural Research, which creates climate-smart technology and management approaches, as well as early warning systems, risk insurance, and other technologies that build adaptability and tackle climate change (The World Bank, 2021). With assistance from the World Bank, countries in Eastern and Southern Africa are putting a variety of short, medium, and long-term plans into action (such as smallholder agriculture development project) in response to climate change in an effort to lessen its impact on the world's poorest households and put the continent's food systems on a more resilient and productive course (The World Bank, 2022). In practice, nowadays, many situations necessitate trade-offs between these three goals. The difficulty, on the other hand, is prioritizing or reconciling the three objectives, as well as executing those objectives through policy planning and decisions (Lewis & Rudnick, 2019). Furthermore, policymakers are frequently constrained to addressing only one issue at a time, ensuing in the absence of a systematic tactic that takes into consideration the interconnectedness of the various factors of CSA (Lewis & Rudnick, 2019).

The FAO's description of CSA is still a favourite among international policymakers and agricultural stakeholders. However, there are still questions over what techniques as well as technologies ought to be included in the CSA category, in

addition to which of the three foundational principles – adaptation, productivity, and mitigation – should take precedence in a particular situation (Partey et al., 2018). Furthermore, as per Williams et al. (2015), it is questionable whether a specific approach designated as CSA would remain so in all agro-ecologies with the same level of effectiveness in developing nations, due to the diversity of farming techniques and systems as well as the differences in agroecological zones.

Partey et al. (2018) state that whether the practices and technologies that constitute CSA are having remarkable success in developing nations is yet unknown (Steenwerth et al., 2014). Furthermore, a lack of documentation of effective CSA procedures is another issue. To date, agroforestry and conservation agriculture have garnered the greatest attention as practices that adhere to CSA's goals. The economic effects of these CSA practices have not yet received much research. The commercial case for investing in these CSA practices is also indeterminate because of the policy problems that agroforestry and conservation agriculture confront (Sylla et al., 2012).

Examples of CSA strategies being utilised by developing countries include drip irrigation and agroforestry (Partey et al., 2018). According to Wanvoeke et al. (2016), the developments in enhancing the availability of water on farms are noticed in drip irrigation systems investments and are considered a climate-smart choice in developing nations, especially for generating quality vegetables like spinach. Due to its affordability and strong link to rising household income as well as dietary intake in the Sudano-Sahel regions in West Africa, solar-powered drip irrigation systems are being promoted there in particular (Partey et al., 2018). Solar-powered drip irrigation systems also promotes water conservation, which benefits farmers' investments by increasing profits (Balana et al., 2017). Partey et al. (2018) found that farmlands with drip irrigation could have increases in yield of up to 100%. Additionally, compared to traditional irrigation methods, there could be significant water savings of up to roughly 80% (Partey et al., 2018).

Agroforestry is another climate-smart agricultural strategy utilised by developing countries. Partey et al. (2018) claim that agroecosystems with integrated methods, like agroforestry, which combine trees with livestock and/or crops, may increase

resilience to hazards associated with changing climate (Sinare & Gordon, 2015). These farming practices have the capability to promote resilience, lessen the severity of changing climate, as well as increase food security (Bayala et al., 2012). Agroforestry is a commonly-used land-use system that is becoming more and more recognized as a part of CSA (FAO, 2013).

Regardless of the capability of CSA to increase adaptability, enhance agricultural productivity, improve rural livelihoods, as well as the ability of developing countries to systematically respond to changing climate through the incorporation of CSA practices and technologies, Kaptymer et al. (2019) state that it is still very restricted due to a variety of policy problems. Examples of these policy problems include Inadequate integrated, enabling, and supportive policy frameworks; a absence of information and sufficient analytical equipment at local as well as national levels; socio-economic restrictions at the farm level; and poor accessibility to suitable agricultural equipment, credit, inputs, tools, and money (Kaptymer et al., 2019).

Policy-makers may be unable to analyse the benefits as well as the risks of CSA (Kaptymer et al., 2019). They make inaccurate investment choices due to a lack of timely and accurate data, and technical advisory services (Kaptymer et al., 2019), in addition to the unavailability and inaccessibility of inputs, especially on appropriate crop types. Regarding the size of agriculture, competition for resource use and inaccessibility to CSA-specific agricultural tools and equipment have been a major constraint to CSA expansion (Kaptymer et al., 2019).

2.4 Policy analysis of Climate Smart Agricultural strategies: A Regional perspective

Several factors play a part in increasing the negative influences of changing climate in sub-Saharan Africa and limiting the ability to achieve food security (Steenwerth et al., 2014). These are lower earnings, increased dependence on climate-susceptible industries like farming, and a lack of capability to easily adapt to changing climate (Chepkoech et al., 2018). Agricultural adaptation techniques such as CSA, particularly in sub-Saharan Africa, can bring about assurance for increasing food security, poverty reduction, and individual well-being in a fluctuating and unpredictable climate. Strengthening the adaptability of smallholder farmers (the region's main food producers) is gradually becoming a policy priority in sub-Saharan Africa (Zseleczky & Yosef, 2014), and several nations such as Nigeria and Ghana are already integrating climate mitigation and adaptation techniques (e.g. CSA) into their national policy frameworks (Zseleczky & Yosef, 2014).

To assist in changing-climate-related policy as well as decision-making, the CSA practice proposes integrating climate change into the planning as well as the implementation of sustainable agricultural techniques, thereby highlighting trade-offs as well as synergies amongst the three key pillars of CSA (Nagothu & Kolberg, 2016). The majority of the CSA principles and practices have been implemented and advocated in several sub-Saharan African countries. For instance, in Zimbabwe, Nigeria, Ethiopia, South Africa, Ghana, and Mozambique, the implementation of CSA practices such as soil conservation along with diverse stress-crop methods resulted in a considerable rise in yields of drought-tolerant maize varieties (Barasa et al., 2021; Nagothu & Kolberg, 2016). There has been an overall increase in the household income of the farmers from these countries who have been utilising the CSA. Furthermore, CSA has increased agricultural productivity in addition to reducing farm losses in these countries (Adoghe et al., 2017).

Many climate-smart farming methods have potential in sub-Saharan African nations (Lima, 2014). Lesotho's *machobane* farming system, a type of cultivation that makes use of relay cropping, crop rotation, and intercropping techniques, together with the use of fertilizer as well as plant ash, is an example of the climate-smart farming

(Mekbib et al., 2011). Minimum tillage and the research and development of drought-tolerant, high-yield crop varieties are examples of CSA practices used in Botswana.

According to Lima (2014), a third of the farmers in the Pandamatenga dryland area specialize in the use of drought-tolerant varieties. In turn, crop research and development concentrates on maize, peanut, millet, and cowpeas and their products. It emphasizes large yields, early maturity, pest (witchweed) resistance, and drought tolerance (Lima, 2014). The method gives poor farmers access to resources through a sustainable procedure that does not need costly external inputs, is simple to use, in addition to providing them with food all year long (McIntosh, Sarris & Papadopoulos, 2013). The use of organic fertilizers to increase and maintain soil fertility, permanent vegetation cover, natural insect management, relay harvesting, and the use of varied crops adapted to various climates are its key components (Mekbib et al., 2011). It is justified by the farmer's self-reliance, which is founded on hard work, appreciation of the resources at hand, and group practical learning (Mekbib et al., 2011).

Tanzania uses CSA techniques similar to those used in many other developing nations, such as community-based irrigation systems, traditional rainwater harvesting, mixed farming systems, rice cultivation intensification, and agroforestry, in addition to the use of livestock and drought-tolerant crop varieties (Lima, 2014). Other CSA practices include agroforestry systems with crops like cassava, beans, vegetables, yams, legumes, and fruit trees, as well as terrace cultivation, which uses organic material to decrease erosion and increase soil fertility (McCarthy & Brubaker, 2014).

Some of the policies related to CSA in most of the sub-Saharan African countries include the Livestock Management and Infrastructure Development (LIMID), the Integrated Support Programme for Arable Agriculture Development (ISPAAD), and the National Master Plan for Arable Agriculture and Dairy Development (NAMPAADD) initiatives (FANRPAN & Earth System Governance Project, 2017). Furthermore, the Fourth National Development Program (NDP4) and Vision 2030 both have goals of gradually diversifying crop production and adaptation to changing climate in agriculture (Lima, 2014).

Using public extension services, these policies have encouraged agricultural R&D and the advancement of farming techniques. According to Flora (2019), the main goal of the Master Plan is to increase the competitiveness of the agricultural sector and lessen the nation's dependency on the importation of agricultural goods that may be profitably produced domestically. Programmes that help traditional methods will accomplish this goal and allow subsistence farmers to modernize their operations to a commercial level, while also assisting commercial farmers to raise their management standards and use of technology (Temoso et al., 2015). The policy objective should include reducing vulnerability through higher production, soil and water conservation, and rainfed farming, with a concentration on dairy, horticulture, and agriculture. The policies should also include an economic incentive in the form of a Value Added Tax (VAT) exemption for agricultural goods and farming inputs, in addition to investments in management and capacity enhancement (Lima, 2014).

The policy challenges for sub-Saharan African countries when it comes to achieving climate-smart agriculture goals involve bringing together diverse financial flows for investment. Long-term lucrative and self-sustaining practices may require upfront funding to get off the ground (World Bank, 2013). There are no long-term climate and landscape-level statistics in many African countries (Kaptymer et al., 2019). Most countries lack the ability, along with the analytical resources, to rationalize the conclusions of global models to national, regional, and provincial scales (Kaptymer et al., 2019). Therefore, policy-makers are unaware of the existing and apparent impacts of the changing climate in their country, as well as the repercussions for agricultural practices like CSA, on their food security, and natural resources management (Kaptymer et al., 2019).

Other policy problems that are negatively influencing CS, include the lack of a coherent, overarching strategy, and the actors and programmes possess poor coordination (Kombat et al., 2021). Additionally, top-down policymaking and a lack of appropriate two-way communication with smallholders continue to be major obstacles to the promotion of CSA (Liu et al., 2011). According to Lima (2014), most CSA projects force socially unfavourable techniques on farmers while ignoring their preferences and local knowledge. Furthermore, the bulk of small-scale farmers

continue to lack access to expensive CSA technology that requires the purchase of inputs, and face obstacles to CSA adoption due to gender issues (Lima, 2014; Abegunde et al., 2019).

In the majority of sub-Saharan countries, funding and aid are mostly foreign-based, linked to transient projects, and programs are scattered. Typically, there is no post-project evaluation, and farmers typically stop using CSA because they are unable to make ends meet (Pretty et al., 2011). The majority of the sub-Saharan nations are lacking a broad, all-encompassing strategy, a CSA investment structure, as well as legislative and financial incentives. There is no direction, let alone incentives, at the policy level for methods appropriate to sub-Saharan nations' varied agro-ecological zones (Bamanyaki, 2020).

As per Lebel et al. (2011), inadequate financial resources and poor coordination between different sectors (with a clear definition of stakeholders' roles and duties) or amongst the central government as well as the local level entities are also problems. Finally, the perks of new technology or techniques are not usually approved for the local environment, nor are they adequately explained to farmers, and there are no regulatory incentives for the implementation of CSA practices, which limits the uptake of CSA (Bamanyaki, 2020).

The fundamental policy issue with CSA in sub-Saharan African countries is that it is too technically oriented, failing to address issues such as advances in the labour force, and consumption patterns, as well as land tenure issues (Taylor, 2018). Additionally, CSA also faces misinterpretation in the research community as well as opposition from civil society actors (Saj et al., 2017). Farmers' access to training, agricultural inputs, climate information technology, markets, and credit, in addition to resource challenges, were cited as significant challenges in adopting CSA technologies in sub-Saharan African countries, specifically for female farmers (World Bank, 2015).

2.5 Policy analysis of Climate Smart Agricultural strategies: A Local Perspective

The agricultural sector contributes just around two percent (2%) gross domestic product to South Africa (Mnkeni et al., 2019a). It is seen as a vital catalyst for the rest of the nation's progress. Agriculture is also a contributor to as well as a beneficiary of the influences of changing climate; therefore, initiatives to green the country through this division must address both (Mnkeni et al., 2019a). In this context, CSA is suitable because it incorporates both adaptation and mitigation strategies. Water and soil management, agricultural development, rangeland management, urban agriculture, and agro-processing are all CSA practices that can be utilized to tackle climate change (Matteoli, Schnetzer & Jacobs, 2020). CSA is particularly beneficial for farmers in rural South Africa, as they are more susceptible to adverse climate and weather effects (Barasa et al., 2021). In South Africa, a variety of CSA practices are being explored and implemented (Mnkeni et al., 2019b).

The South African Sugar Research Institute (SASRI), for example, is responsible for the majority of the research into adaptation and mitigation techniques used by sugarcane growers (Mnkeni et al., 2019a). The research initiatives focus on long-term sugarcane agricultural production and have been designed to meet farmers' needs as well as reduce sugarcane farming risks (Mnkeni et al., 2019b). The deteriorated state of communally-used rangelands in South Africa, which are subjected to continual grazing, makes them less resilient and adaptive to the impacts of changing climate. The Holistic Rangeland Livestock Management (HRLM) plan is an example of a CSA practice whose enactment in communal rangelands in South Africa is projected to result in soil regeneration and increased pasture productivity (Mnkeni et al., 2019a; Gosnell et al., 2020).

The problem with the CSA policy in South Africa is that smallholder farmers who want to implement CSA practices are frequently limited by a lack of funds to spend on land, machinery, manpower, seedlings, and other agricultural inputs (Kaptymer et al., 2019). In addition, there is poor practical comprehension of the use of the CSA approach, and lack of data, along with information, and suitable analytical instruments at national and provincial levels, as well as insufficient coordinated,

supportive and facilitating policy frameworks, and the unavailability of appropriate tools and innovative sources of funding (Rakgase & Norris, 2015).

In South Africa, other CSA practices are being explored and implemented due to the semi-arid nature of a vast area of the region, as well as the region's high susceptibility to the effects of changing climate on rainfall (Lima, 2014). CSA procedures have comprised conservation agricultural methods (including minimal tillage, crop rotation, and intercropping), field rainwater harvesting methods, as well as the creation of drought-tolerant crop types (e.g. open-pollinated and maize hybrids varieties). Also, the livestock industry has seen exploitation of animal breeding and feeding techniques (such as nutrient content) to lower the emission of methane from cattle (Campbell et al., 2011). A wide range of CSA-related policies are in place in South Africa. These include the National Climate Change Response Policy (NCCRP) (Lima, 2014), which outlines approaches for responding to climate change in various districts, including rural development, and agriculture initiatives that incorporate righting historical wrongs and securing land rights mostly for black populations, as well as a forthcoming national strategy on agroecology.

According to Mnkeni et al. (2019b), to enhance the effectiveness of fertilizer and water utilization and boost agricultural productivity, integrated soil fertility management (ISFM), which is also a CSA practice, has been adapted to South African local conditions. ISFM techniques focus on using organic matter (such as crop wastes, compost, and green manure) to rejuvenate soil depleted of nutrients, in addition to mineral fertilizers that are locally accessible. This enhances the effectiveness of fertilizers and other agro-inputs while also improving soil quality. Additionally, ISFM encourages the use of agroforestry, intercropping, and/or crop rotation with legumes (a crop that also enhances soil fertility) (Vanlauwe et al., 2015).

Crop yields are significantly impacted by the inadequate nutrient availability in arable areas, particularly among smallholder farmers in South Africa (Mnkeni et al., 2019b). CSA practices, such as soil fertility management techniques, aim to improve the situation; however, according to Stewart and Roberts (2012), the utilization of mineral fertilizers as a supplier of nutrients for plant growth is still essential for

boosting productivity. As a result, their use needs to be gradually replaced by integrated soil fertility management (ISFM) strategies that incorporate organic resources and fertilizers that are applied in the best possible way. The restoration of soil health and production while reducing GHG emissions has been proven highly successful when conservation agriculture (CA) and ISFM are combined (Smith & Trytsman, 2017).

The South African government has developed several CSA-related policies, initiatives, and plans that support its objectives (Zwane & Montmasson-Clair, 2016). In terms of imagining food security measures, the effects of changing climate, and the establishment of a centralized food security management, the national food, and nutrition security policy is relatively strong. Another programme that aims for increasing irrigated agriculture through the utilization of current water resources and the creation of new water schemes is the National Development Plan (2012) (Zwane & Montmasson-Clair, 2016). As stated by Lima (2014), there are many challenges to CSA implementation, such as the problem of inconsistent policies. That being said, there are not many incentives for farmers to implement the recommended measures. Furthermore, there are certain inconsistencies in South Africa's agriculture policy.

For instance, government initiatives to encourage conventional agriculture, which are based on external inputs – machinery for soil tillage among others – contrast with efforts to promote agroecological methods (Chitakira & Ngcobo, 2021). In addition to causing tensions amongst the parties involved, the lack of coordination also confuses farmers and investors (Lima, 2014). According to Zwane and Montmasson-Clair (2016), the majority of CSA-related policies recommend irrigation methods that are inappropriate for various agroclimatic areas. They do not understand how these systems are to be devised and implemented. Some of the strategies generally disregard the study and development of technology solutions for coping with climate change, producing crops and animal varieties that are susceptible to extreme weather. The policies avoid addressing the failure to translate research and development into technologies and products that are ready for the market (Zwane & Montmasson-Clair, 2016).

2.6 Gap of this Study

The gap to be filled by this study is that there is no common archive or framework for climate smart agriculture-related information that is being shared among various agencies (DEFF, 2019). Significant knowledge gaps persist despite two decades of changing climate in South Africa (Ziervogel et al., 2014). There is poor linkage between climatic impacts and the evaluation of these impacts. According to Ziervogel et al. (2014), the evaluation of the impact and the adaptation does not have a cross-sectoral assimilation, which is not beneficial towards CSA.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter describes the study area, research design, study population and sampling technique, data collection and analysis, and ethics principles applied in this research.

3.2 Study Area

The study was conducted in NMMDM which is based in the North West Province of South Africa, bordering Botswana to the north. The province's capital, Mahikeng (formerly Mafeking), is located in the heart of the province, with Potchefstroom, Klerksdorp, and Rustenburg accounting for more than 80 percent of the province's GDP (Oduniyi, 2018). Mahikeng, Ramotshere Moiloa, Ratlou, Ditsobotla, and Tswaing municipalities make up the district. The area covers 28 114km² and has a population of 961 960 people (Municipality, 2020).

Ngaka Modiri Molema District Municipality has been chosen as the study area for this research because the negative consequences of climate change have sparked widespread concern, particularly among poor villages' proneness in the face of uncertain and frequent environmental change (Oduniyi, 2018). Maize and sunflower are the main crops grown in this region on a large scale. On a smaller scale, other crops are also planted, including groundnuts, soybeans, cotton, dry beans, wheat, green mealies, grain sorghum, and Cucurbitaceae (squash, butternut, pumpkin, watermelon, etc.) (Profile, 2020). Maize in the study area is more commercialised than it is sustenance, this is based on the fact that the major source of income in the province is agriculture (derived from large scale farming of maize), and the study area is the second largest producer of maize in South Africa (Oduniyi, 2018). Around 20% and 15% of maize and sunflower farmers, respectively, followed non-market participation and formal markets for the distribution of their products, while about 65% of these farmers used informal markets (Nxumalo, Oduniyi, Antwi & Tekana, 2019).

Agriculture from the study area adds about 5 percent of GDP to the South African economy, greatly contributing to the advancement of food security in various households (Oduniyi, 2018). But changing climate has had an adverse influence on the productivity of various crops such as spinach, sunflower, wheat, and maize in the research area, resulting in low yields, food scarcity, and low income (Oduniyi et al., 2019). For instance, Taung near Vryburg in the North West Province experienced flooding in January 2010 (Kabanda & Palamuleni, 2011). Other areas of the region have also experienced extreme weather conditions like years with exceptionally heavy rains, strong winds, and high temperatures. Due to this, some farmers now use irrigation techniques like sprinkler irrigation and drip irrigation to safeguard their crops from severe weather conditions (Oduniyi, 2018). In the South African North West Province, higher temperatures are anticipated to cause more crop heat stress and an increase in the need for evapotranspiration. The effects are then anticipated to have an impact on natural resources like air and water, which are thought to be the most important aspect of climate change. Changing climate not only affects crops but also domestic animals such as chickens and cows. For instance, when there is little or no rainfall there is no water available for these animals, and in the case of high temperatures there is a reduction in grazing in fields to support these animals. These factors will adversely impact the domestic animals and in the long run the study areas' economic and food security (Campbell et al., 2016).

The study area is located in a semi-arid environment, with annual rainfall ranging from 300 to 700 mm (MacFadyen, Zambatis, Van Teeffelen & Hui, 2018). The core geology of the NMMDM is limestone, dacite, and granite, and this makes the area susceptible to waterlogging when there is heavy rainfall (Kabanda & Palamuleni, 2011). The average minimum and maximum monthly temperatures range from 4.0 °C in July to 17.1 °C in January and from 20.4 °C in July to 29.7 °C in February, respectively (Materechera, 2018).

Figure 1. Map of Ngaka Modiri Molema District Municipality (Phillips, 2022).

3.3 Research Design

The research design for this study is meant to give a suitable framework for the aims and objectives of this study. The selection of the research approach is a vital step in the research design process since it specifies how important data for this study will be collected (Sileyew, 2019). The descriptive research design was utilized in this study. The descriptive method is a type of research design that aims to acquire information for enhancing deep understanding of study facts to methodically define a phenomenon, condition, or population, and thus proffer answers to exploration and expressiveness of a concept rather than answer the 'why' question (Doyle, McCabe, Keogh, Brady & McCann, 2020). The quantitative component enables information to be gathered from a large sample of participants, increasing the possibility of generalizing the discoveries onto a larger group of respondents, while

the qualitative component, in contrast, allows for a more in-depth grasp of the subject under investigation while also honouring the participants' opinions (Doyle, Brady & Byrne, 2016).

This type of research design was operationalised to examine the policy analysis of CSA strategies in the study area, by examining the existing institutions and legal frameworks of CSA at the national level. The research design also assesses policy problems affecting CSA in the study area such as policies from the Intergovernmental Panel on Climate Change, the United Nations Framework Convention on Climate Change, the National Climate Change Response Policy White Paper, the National Development Plan, and the Nationally Determined Contribution under the Paris Agreement.

3.4 Study Population and Sampling Procedure

The population of this research includes the staff of the Department of Agriculture and the Department of Forestry, Fisheries, and Environment (DFFE), Non-Governmental Organisations (NGOs) that specialise in climate change and are in charge of agriculture, and farmers, as well as the people living in the community of the NMMDM. A list of the population of study was compiled and divided into strata using a stratified random sampling approach, with a random sample drawn from each stratum (Oduniyi & Tekana, 2020); this strategy was employed because of the homogeneous subgroup inside the district municipality. This method made sure that the major participants in the sample were precisely represented, in addition to reducing sampling error (Oduniyi & Tekana, 2020). The sample size of 10 participants per stratum was purposively selected due to observance of practice of CSA or mandates related to CSA across the strata.

3.5 Data Collection Techniques

In this research, data was collected using interviews and literature reviews. Both closed- and open-ended questions were used to solicit responses from participants. The interviews were organized and included a logical flow of inquiries about demographics of the farmers, socio-economic features, and existing institutions and legal frameworks of CSA at the national level, policy problems affecting CSA in the North West Province, and relevant strategies and references that can facilitate CSA policy in the study area. The interview was conducted in English, and there was no need for a translator due to the fact that most of the participants were literate and all the participants had a good understanding of the English language. The interviews were audio recorded and spanned over 20 minutes. The interview took place in the participants' place of work, and for some participants the interview took place in their homes, furthermore participants provided information using their own descriptions for the open-ended questions and selected the options for the close ended questions. Similarly, the qualitative interview was transcribed through Intelligent verbatim transcription, wherein every word aside from those that were irrelevant was written down in order to increase readability, fix errant grammar, and shorten lengthy paragraphs.

In each local municipality namely Mahikeng, Ratlou, Ramotshere Moiloa, Ditsobotla, and Tswaing in NMMDM, before face-to-face interviews was conducted, participation information sheet which indicates the purpose and objectives in addition to the nature of participant involvement in the study was explained to the participants (see Appendix I). The participants were then given consent forms which emphasizes on what they are agreeing to when they participate in the research such as agreeing to be interviewed, complete a questionnaire, or being recorded if audio recording is involved before partaking in the study (see Appendix H). The participants who are experts were required to give accurate responses on whether the CSA policies that have already been enacted are serving their roles, and whether more CSA policies will be implemented in the future in the study area to further promote agriculture.

3.6 Data Analysis

SPSS enabled the data to be analysed using descriptive statistics such as frequency counts, percentages, while the Excel program was used to create graphs and histograms. All interviews were recorded, and the information gathered from the interviewees was analysed using thematic analysis methodologies. Thematic analysis in the context of this research and as a qualitative analytic system enabled the extraction or identification of important patterns and themes from the data that have been obtained from the respondents during interviews, while also interpreting and making sense of the data.

3.7 Ethical Considerations

The ethical considerations in this study are premised on the fact that this study involved human subjects; therefore ethics approval from the University of the Witwatersrand Human Research Ethics committee (Non-medical) was obtained (Certificate - H22/07/33) prior to data collection. Informed consent for all respondents was obtained through an information sheet outlining the study's objectives and guaranteeing them anonymity. The respondents' identities were protected by ensuring that the information provided remain confidential and anonymous, as no names or other personal details were requested, and the information contributed has been retained securely on my hard drive and not disclosed to others.

CHAPTER FOUR:
DATA PRESENTATION, ANALYSIS, AND DISCUSSION

4.1 Introduction

This chapter concentrates on the results, analyses and discussions and what they portend for interviewees, and their perceptions of the policy analysis of CSA strategies in NMMDM of North West Province, South Africa. It is divided into sections and sub-sections based on the objectives of the study. The study's major goal was to investigate the policy analysis of CSA strategies in the study area, by examining the existing institutions and legal frameworks of CSA at the national level and assessing policy problems affecting CSA in the study area. The chapter is organised into the following sections: demographic information of the participants, their knowledge of CSA, and the strategies that can be used to promote CSA in the NMMDM.

The participants consisted of four groups, namely, experts such as staff members from government organisations such as the Department of Agriculture, Land Reform and Rural Development, NGOs such as the Farm Union, farmers, and community citizens who are agriculture-related professionals such as students, professors, and researchers. The demographic findings concerning the experts from government organisations indicated that the participants consisted of extension workers (10%), Chief Executive Officers (CEO) (10%), office administrators (40%), agricultural advisors (20%), managers (20%). The experts from the NGOs consisted of extension workers (50%), CEOs (20%), agricultural advisors (20%), and managers (10%). The participants from the community consisted of agriculture-related professionals in terms of students (50%), professors or lecturers (30%), and researchers (20%), and the last participant group consisted of farmers (100%) (see Table 1).

The equation that is utilized in this research is $\boxed{N = F \div 10 \times 100}$. F represents the frequencies of the different variables in this research study that have been presented to the participants, **10** is the total amount of respondents in each group (farmers, community citizens, government organisations, and NGOs), and N will be the percentage of the variables.

4.2 Demographic Information

The first section of the interviews, which is based on the demographic information, consisted of variables such as gender, marital status, highest level of education achieved, the organisation at which participants work, and the numbers of years they have spent in the organisation. Basically the demographic information serve as an introduction into the socio-economic characteristics of the participants as well as their knowledge on the present agricultural sector in Ngaka Modiri Molema. The findings on the gender distribution of participants indicated that there were more male participants than female participants in three of the groups that participated in this study, with farmers represented by 60% male, community citizens 70%, and NGOs 60%. The exception was the government organisations, where the number of male participant was the same as females (50%) (Table 1). It can be deduced from the findings that more males partake in agricultural-related activities than females in the study area. This can be linked to the fact that the recruitment process favours more males than females. Furthermore, there exists the bias that when it comes to agricultural activities, male employees are preferred to female employees, especially amongst farmers. This result concurs with that of Oduniyi (2018), who claimed that men in the Ngaka Modiri Molema District are more likely than women to be employed in agriculture-related activities.

Regarding farmers, there are more males than females. One of the interviewees stated that this situation could be attributed “to the access and ownership of land since this factor has a significant impact on agricultural productivity and income earnings, the severity of gender discrepancies in land holding and ownership has negatively influenced female farmers.” This finding agrees with Oduniyi (2018), who stated that there are more male farmers than female farmers in Ngaka Modiri Molema district.

With regard to marital status of the participants, a large number of the participants are married, with farmers 70%, community citizens 70%, government organisations 90%, and NGOs 50% (see Table 1). This can be due to the fact that most of these participants take on paid employment because the jobs serve as a source of income for sustaining their livelihood. This finding agrees with the Department of Social Development (Republic of South Africa, 2021), which stated that employment is

common among married people/families because it serves as a support for promoting a positive lifestyle in addition to providing support and comfort for the family members. This result supports Modirwa's (2019) assertion that most farmers are married, with only a small percentage being either single, divorced, or widowed. Furthermore, it was suggested that most farmers are married because they are frequently seen working together on farming projects.

With regard to the educational level of the participants, the highest educational qualification amongst the farmers was a BSc, representing (40%), community citizens was a PhD (50%), for the governmental officials it was a BSc (60%), and for the NGOs it was a PhD (30%). It can be deduced from the findings (Table 1) that the participants are knowledgeable in their field of work (agricultural-related activities) due to their high educational qualifications. The findings concur with those of Makolomakwa and Losaba (2020), who stated that there has been an increase in the literacy rate in NMMDM since 2018. The findings disagree with Nxumalo et al. (2019), whose findings indicated that many farmers in the NMMDM do not have tertiary educational qualification. In relation to the highest educational level of the government officials, the findings above disagree with Oladele (2015), who stated that a diploma was the most common educational qualification among government officials, particularly the extension officers.

In terms of the years participants spent in their organisations, the findings (see Table 1) showed that 80% of NGO participants spent six to ten years in their organisations, 60% of government officials spent between eleven to twenty years in their organisations, while 60% of the community citizens and farmers have spent between one and ten years working in their organisations. Most of the participants have spent more than four years in farming-related activities due to the fact that Ngaka Modiri Molema consist of many villages (rural areas) where agriculture is much practiced to promote livelihood, and it is also recognised as one of the drivers of the economy in NMMDM.

The results support Oduniyi's (2018) assertion that the Ngaka Modiri Molema district is highly involved in agriculture. Additionally, the Ngaka Modiri Molema district is one of South Africa's top-producing regions for maize and other grains, such that the

agricultural sector contributes roughly five percent of the nation's GDP. Since the vast majority of individuals in the province depend on agriculture for their livelihood, there is a large number of individuals who have spent years in jobs that are related to farming activities and in the process, the region makes a substantial contribution to the promotion of household food security.

Table 1. Demographic findings

Variables	**Farmers**	**Community Citizens**	**Government Officials**	**NGOs**
Gender				
Male	6 (60%)	7 (70%)	5 (50%)	6 (60%)
Female	4 (40%)	3 (30%)	5 (50%)	4 (40%)
Marital status				
Single	2 (20%)	3 (30%)	0 (0%)	4 (40%)
Married	7 (70%)	7 (70%)	9 (90%)	5 (50%)
Widowed	0(0%)	0(0%)	1 (10%)	1 (10%)
Divorced	1 (10%)	0(0%)	0 (0%)	0(0%)
Educational level				
No formal education	0(0%)	0(0%)	1 (10)	0(0%)
BSc	4 (40%)	1 (10%)	6 (60%)	2 (20%)
MSc	0(0%)	3 (30%)	0 (0%)	2 (20%)
PhD	2 (20%)	5 (50%)	1 (10%)	3 (30%)
College	3 (30%)	0(0%)	2 (20%)	2 (20%)
High School	1 (10%)	1 (10%)	0 (0%)	1 (10%)
Years spent in Organization				
1 -10	6 (60%)	6 (60%)	4 (40%)	8 (80%)
11 – 20	2 (20%)	4 (40%)	6 (60%)	2 (20%)
30 – 40	1 (10%)	0(0%)	0(0%)	0(0%)
41 – 50	1 (10%)	0(0%)	0(0%)	0(0%)
Position at work place				
Extension Worker	0(0%)	0(0%)	1 (10%)	5 (50%)
Chief Executive Officer (CEO)	0(0%)	0(0%)	1 (10%)	2 (20%)

Office Administrator	0(0%)	0(0%)	4 (40%)	0(0%)
Agriculture Advisor	0(0%)	0(0%)	2 (20%)	2 (20%)
Manager	0(0%)	0(0%)	2 (20%)	1 (10%)
Student	0(0%)	5 (50%)	0(0%)	0(0%)
Lecturer/Professor	0(0%)	3 (30%)	0(0%)	0(0%)
Researcher	0(0%)	2 (20%)	0(0%)	0(0%)
Farmer	10 (100%)	0(0%)	0(0%)	0(0%)

4.3 Information related to Climate-Smart Agriculture

The results on the information related to CSA show that 40% of the participants from government organisations knew what CSA was, and the remaining 60% did not know (Figure 2). The knowledge of CSA among participants from government organisations is low, even despite the high educational qualifications reported in Table 1. One of the interviewees stated that “the staff only knew the basics regarding agriculture and when it comes to advanced topics like CSA, only a handful of the staff members had proper knowledge on the topic.”

The knowledge of the farmers who participated in this study (see Figure 2) indicated that only 30% knew what CSA was and 70% had no knowledge of CSA. The reason can be based on the fact that agricultural officers and extension officers who train farmers also have low knowledge of CSA. The result of Setshedi and Modirwa (2020), who stated that there is a significant knowledge gap regarding Climate-smart agriculture in the Mahikeng Local Municipality, supports this finding. Participants from non-governmental organizations, as seen in Figure 2, had an equal proportion of 50% each of those who knew about CSA and those who did not. The reason for this result, according to one of the participants, can be linked to the fact that "agriculture is at the epicentre of changing climate concerns, which in this sense means that agricultural production is a target of the adverse effects of climate change," thus these NGOs want to acquire knowledge to stem these harmful effects. Similarly, the need for NGO staff to ensure the adoption of CSA practices by the beneficiaries of their services has improved learning about CSA.

The community citizens are the only participants with a high knowledge of CSA, with 70% of community member participants knowledgeable about CSA, and only 30% lacking knowledge of CSA (Figure 2). The reason for the high knowledge of CSA can be attributed to the fact that 70% of these participants are professionals in the agricultural sector and have a thorough knowledge of CSA (see Table 1).

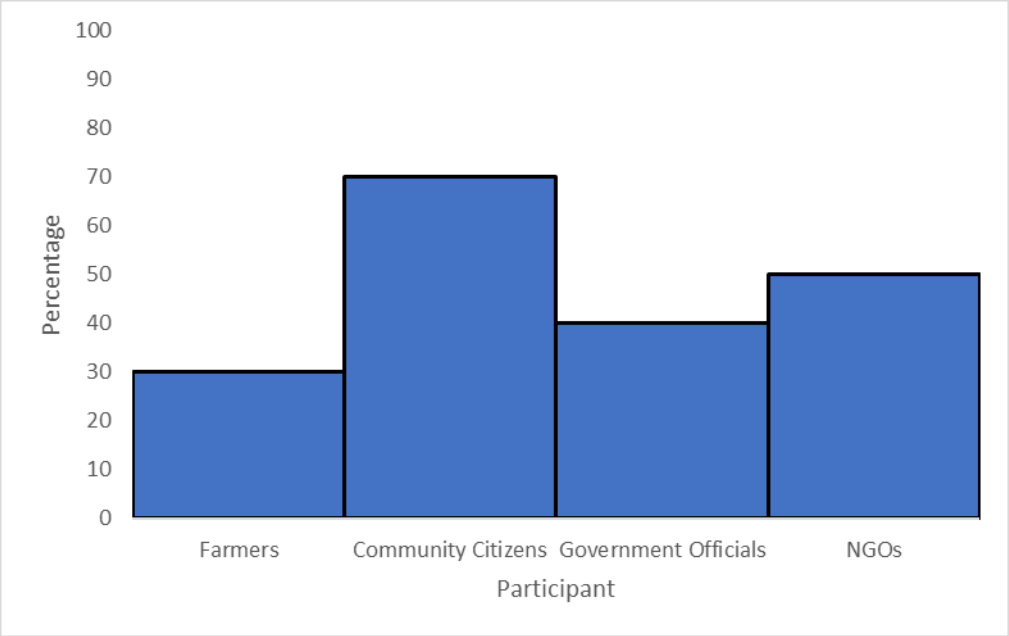

Figure 2. Knowledge on CSA

The participants were then asked to give a description of CSA (see Figure 3). Among the farmers, the most used definitions were that CSA is techniques that ensure the effective and efficient practice of agriculture, and also curb GHGs, which cause climate change such as high temperature and little to no rainfall (30%). CSA is also described by the farmers as a combined approach to manage landscape, livestock, cropland, fisheries, and forests that tackle the interconnected challenge of food security and changing climate (30%). These definitions were utilized the most by the farmers based on their years of experience, according to most of the farmers they stated that “high temperature and little to no rainfall in Summer has forced them to look for alternative options that will improve their agricultural practices”.

Ten percent of the farmers also stated that CSA refers to farming procedures that utilise resources that will not harm the environment, while 20% defined CSA as a

pathway towards development and food security, and the process of forecasting the weather in relation to farming, as well as a climatic tool for agricultural cultivation and a technological tool to enhance agricultural practices. It can be deduced that the definitions given by the participants can be linked to their high educational levels as well farming experience. This is supported by (Ariom, Dimon, Nambeye, Diouf, Adelusi & Boudalia, 2022), who stated that education and farming experience has an impact on how farmers perceived changing climate on agriculture.

The community citizens had the highest number of participants who knew what CSA was in this study, and they defined CSA as the process of forecasting the weather in relation to farming as well as a climatic tool for agricultural cultivation, and a technological tool to enhance agricultural practice (representing 60%). They also added about CSA being a technique that ensures the effective and efficient practice of agriculture and also curbs GHGs which produce climate change such as high temperature and little to no rainfall (50%), as well as a cohesive approach to manage livestock, landscape, cropland, forests, as well as fisheries that tackles the intertwined challenge of climate change and food security (50%). The reasons for the answers can be ascribed to the fact the community citizens consist of researchers and professors who specialise in agricultural science. Furthermore, one of the participants stated that “the word “smart” from the definition was hinting at better practices for agriculture against climate change.”

When the participants from the government departments were asked to provide descriptions for CSA, 30% of the participants from this group stated that CSA is a pathway towards food security and development, and 20% indicated that CSA is a procedure of farming with resources that will not harm the environment. An additional 20% defined CSA as a technique that ensures the effective and efficient practice of agriculture and also curb GHGs which produce climate change such as high temperature and little to no rainfall. CSA was also described as an integrated method to manage cropland, landscape, forests, livestock’s, and fisheries that deals with the interconnected challenge of climate change and food security by another 20%. Very few participants from the government organisation provided descriptions of CSA. This can be linked to the fact that most of the staff working in these government organisations had little to no knowledge about CSA. This is supported by the

statement given by one of the staff respondents who stated that “most of the staff members have little knowledge about CSA and only staff members who have completed their Bachelors, Masters and PhD tend to be knowledgeable on CSA, furthermore she went to state that the staff training was lacking and no one has taken actions to promote CSA knowledge”. The findings of the study are supported by the results of Setshedi and Modirwa (2020), who stated that there is little knowledge regarding CSA in the Mahikeng Local Municipality, and this resulted in very few of the respondents being able to define CSA.

The NGO participants’ definition of CSA consisted of 40% stating that CSA is techniques that ensure the effective and efficient practice of agriculture and also curb GHGs which produce climate change such as high temperature and little/no rainfall. Fifty percent, of the participants stated CSA was a pathway towards sustainable development and food security, and another fifty percent stated that it was an integrated approach to manage landscape, cropland, livestock’s, forests, and fisheries that address the interlinked challenge of food security and changing climate. Awareness of the definitions of CSA by NGOs according to a few of the participants “is something all NGOs should be aware of and be capable of utilising because CSA can serve when utilized by farmers, becomes a strong ally in protecting water resources, fostering the development of healthy soils, and ensuring food and nutrition security. It improves biodiversity and crop diversity while raising farmers' incomes and resiliency against climate change. Therefore, it is essential for all initiatives to realise the human right to adequate nutrition to be successful.”

There were more participants from NGOs who provided a more detailed description of CSA compared to participants from government organisations, and this can be attributed to the purpose that NGOs serve, which is to promote the agricultural sector in the study area, developing plans and policies that are more systematic, better structured, and better organised. This finding disagrees with Setshedi and Modirwa, (2020), who asserted that only a few of the participants believe that CSA in addition to encouraging the management of natural resources as well as the agricultural features they provide, CSA also advances developmental goals and national food security.

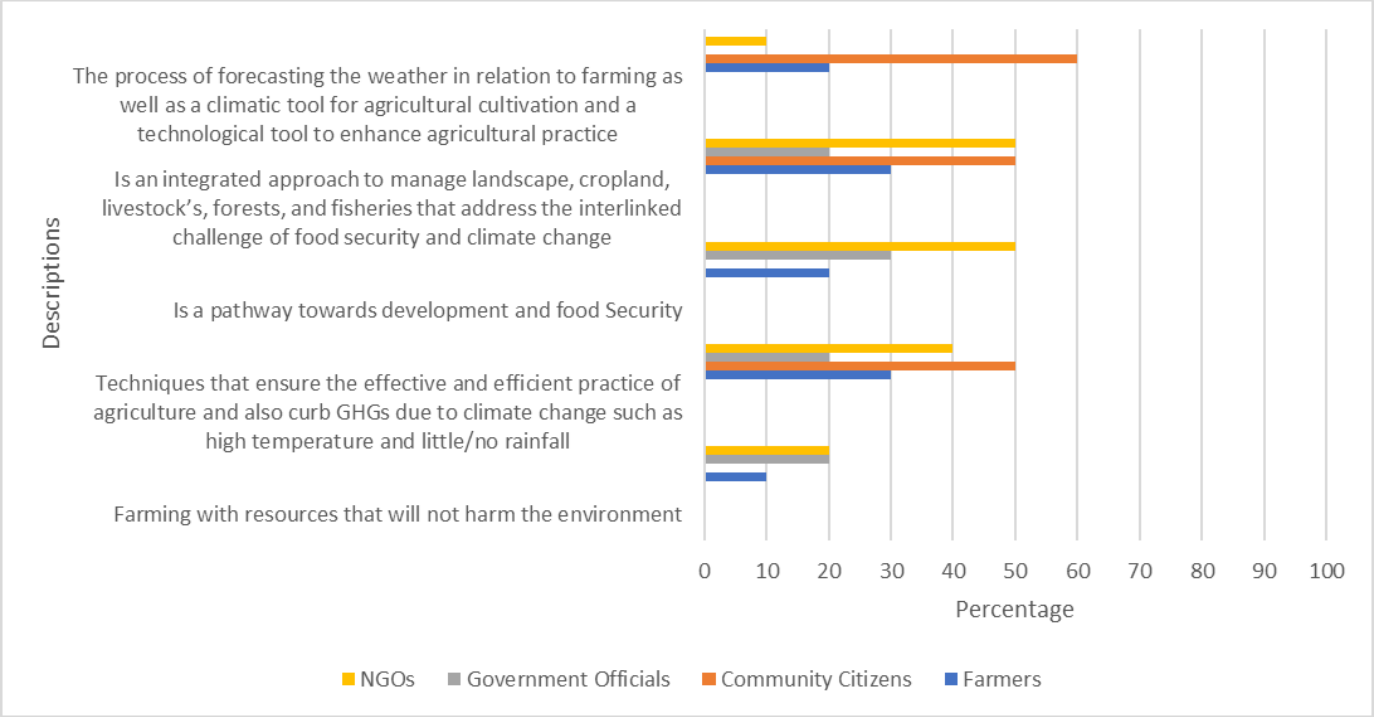

Figure 3. Descriptions of CSA by the respondents

According to the findings of this study (see Figure 4), when it comes to CSA training, the group of participants with the highest CSA training are government organisations (40%), followed by NGOs (20%), farmers (10%), and community citizens (10%).

One of the interviewees from the governmental organisations stated: "there is not enough of CSA training in Ngaka Modiri Molema, and that in a year there could be only four CSA trainings which is not enough to build CSA knowledge and skills amongst farmers as well as the staff members of the governmental organisations and NGOs." According to Maka (2021), very few extension officers received formal training and education for changing climate, when it was not considered an immediate dilemma or even in the curriculum or skills required of extension officers. Therefore, training was provided to the extension officers participating in the study to increase their understanding of and sensitivity to changing climate. This is in line with the finding of this study, that most of the participants from the governmental officials group have undergone CSA training. Furthermore, Zikhali et al. (2020) stated that although training is provided, attendance is low.

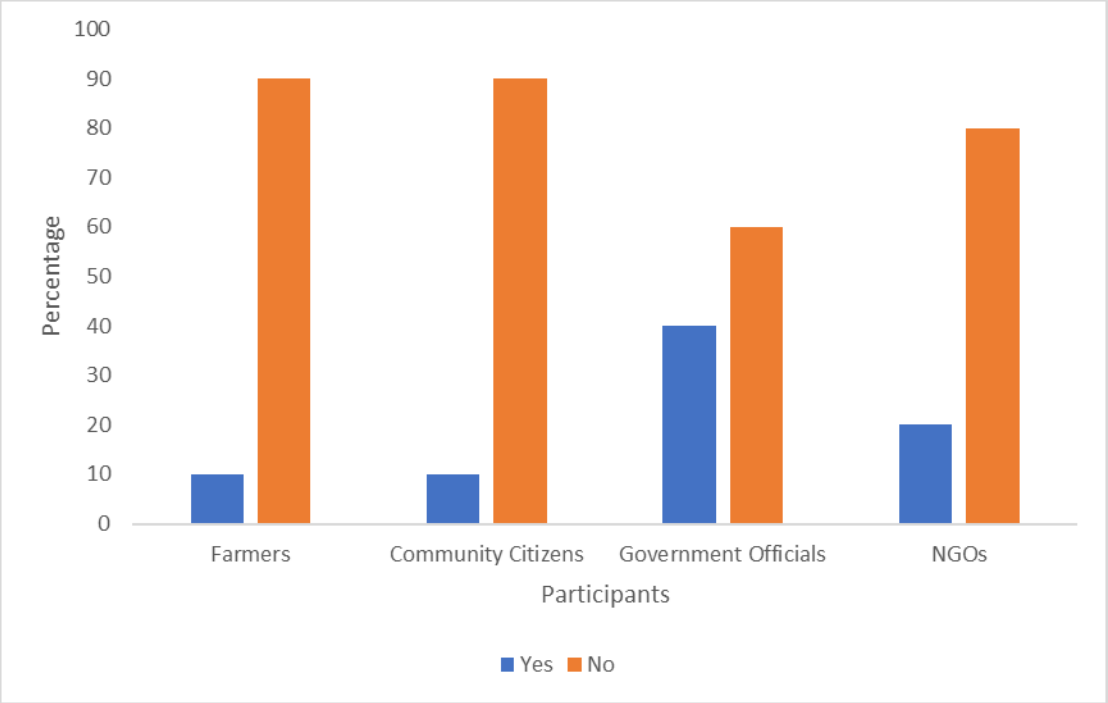

Figure 4. Have you ever participated in CSA training?

Furthermore, the participants were asked to describe what CSA training entailed (Figure 5). Ten percent of the farmers who undertook CSA training stated that the training helped raise awareness about CSA. As to how it applied to farmers, there was teaching on the techniques surrounding CSA. There were practicals on the mitigation of climate change effects on crops and livestock, and the process of taking care of the environment. Ten percent of the community citizens stated that the training entailed describing the relationship between CSA technologies and the GIS systems.

Among the 20% of the participants from NGOs who stated that they have undergone CSA training, all of them stated that the training entailed raising awareness regarding CSA, obtaining information on the techniques surrounding CSA, emphasising the process of taking care of the environment when conducting agricultural practices, and the importance of knowledge on climate change and how to adapt to it. In contrast to the practicals for the mitigation of climate change effects on crops and livestock, only 10% undertook these practicals.

Thirty percent of participants from the government organisations stated that the training entailed raising awareness of CSA, 20% of them stated that the training involved seminars on CSA techniques and how to utilise them. Forty percent undertook the practical on the mitigation of climate change effects on crops and livestock, 30% stated the training placed emphasis on the process of taking care of the environment when conducting agricultural practices, and 30% spoke on how the training emphasised the importance of knowledge on climate change and how to adapt to it.

According to one participant, the various activities participants reported experiencing during the CSA training can be linked to the fact that "managers in government organizations like the DFFE are trying to bridge the gap in understanding the CSA and its implementation among farmers and staff of government organisations." The findings of this study are in line with those of Masukela et al. (2013), who stated that the CSA training entailed the coverage of CSA techniques, the connection between climate change and CSA, raising awareness on CSA, and the process of spreading and transferring climate information from extension officers to farmers.

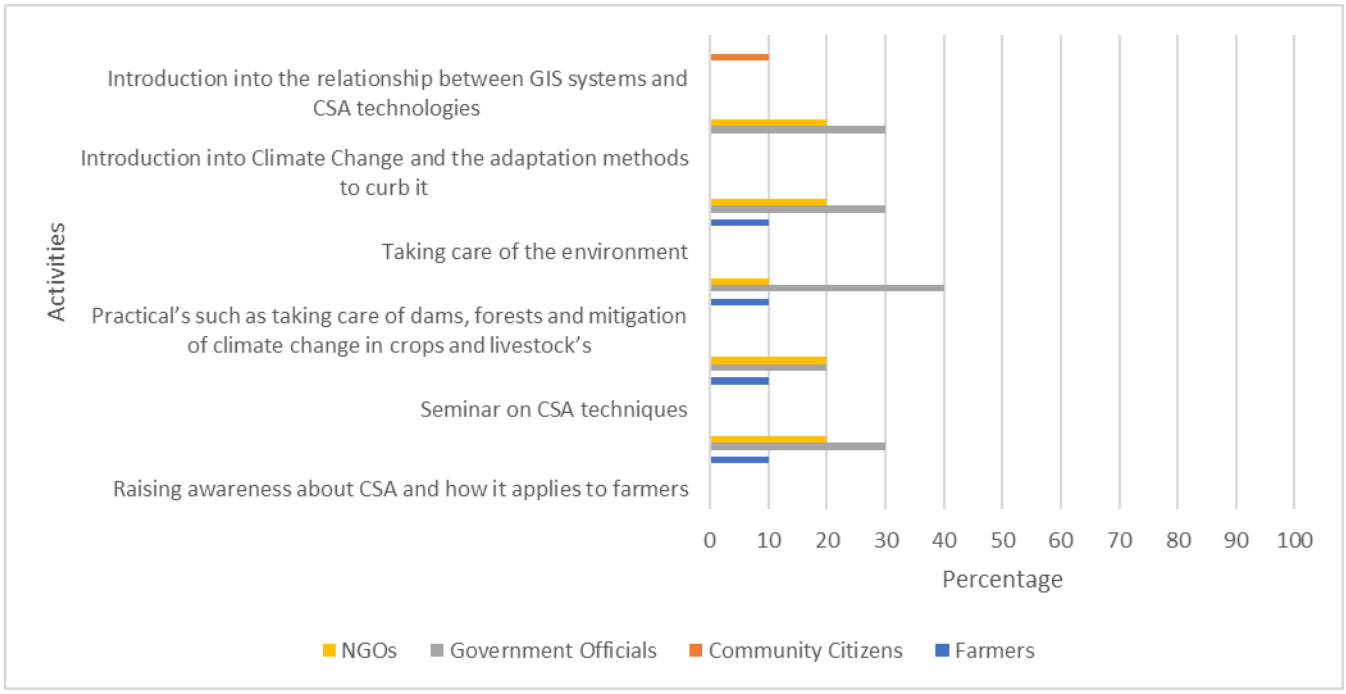

Figure 5. Description of the activities that the participants encountered in the CSA training.

The participants were then asked to state if the knowledge that they have gained from the CSA training was important and whether it had a positive impact on their farming (see Figure 6). All the farmers (representing 10%) who undertook the training said that it was useful; the same applies to the community members (10%). All the NGO participants (10%) who undertook the training also gave a positive review about the CSA training, while on the other hand 30% of the government organisations said the training was of importance, and 10% stated that the training was not all that knowledgeable. These responses of the participants can be credited to the fact that they developed a thorough understanding of climate change and how it affects South African agriculture. They also learned the value of CSA in terms of promoting their farming methods and addressing production issues caused by climate and weather.

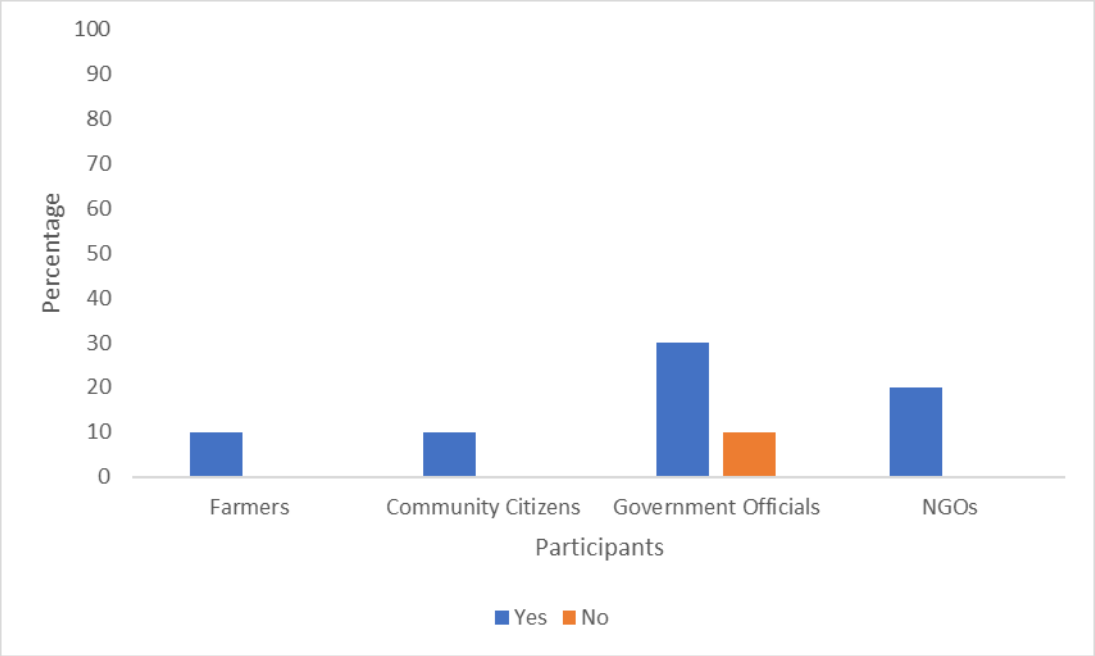

Figure 6. Was the knowledge gained from CSA training important?

Participants who took the CSA training were then asked to give examples of how the training was helpful to them after using it (Figure 7). Amongst the group of farmers, 10% stated that the “utilization of CSA techniques has resulted in higher yields, higher income; farming procedures became more efficient in the case of less wastage of resources and being able to use the resources for a longer period of time. There has also been reduction in the effect of climate change on the crops, the

fertility of the soil has also been improved, and it was easier to pass on the knowledge of the CSA training onto fellow farmers." The responses of farmers can be attributed to personal experience (farmers utilised CSA techniques that had been learnt from CSA training and then stated the benefits of the techniques).

With regard to the community citizens, 10% stated that there was an increase in yield, the farming procedures became more efficient, and there was a reduction in the effect of climate change. It can be deduced that the response of the community citizens stems from partaking in practical agricultural activities. The governmental organisation consisted of 20% of the participants stating that the training resulted in higher yields, higher income, more efficient farming methods, the reduction of climate change, and the improvement of the fertility of the soil respectively. While 10% of the officials from governmental organisations stated that, the training involved emphasising on how to reduce pollution in the environment when conducting farming practices and training them to impart the CSA knowledge onto farmers. The responses can be articulated based on the fact that according to one of the participants "the extension officers supervise farmers who have undertaken the CSA training and utilized the techniques that they have learnt. The extension officers then record the effects that the techniques have on the agricultural practices so as to impart the knowledge onto other farmers".

The NGOs who were asked to state how the CSA training has benefited their farming related activities consisted of 20% of the respondents stating that the training has resulted in high yield, high income, and more efficient farming methods. Furthermore, 10% stated that the training helped them in curbing the effects of climate change on their crops and livestock's, it improved their planting strategies to and in the process promoted the fertility of the soil on their farm lands, and the knowledge became easier to distribute to fellow colleagues. The respond can be attributed to the fact that the CSA knowledge that have been obtained in the training has been put into practice. The findings are in accordance with Zikhali et al. (2020), whereby participants who have participated in CSA training specified that the conferences as well as the workshops were very informative furthermore; organizations such as the Agricultural Research Council (ARC) spoke about matters such as soil, water, and land management in relation to changing climate.

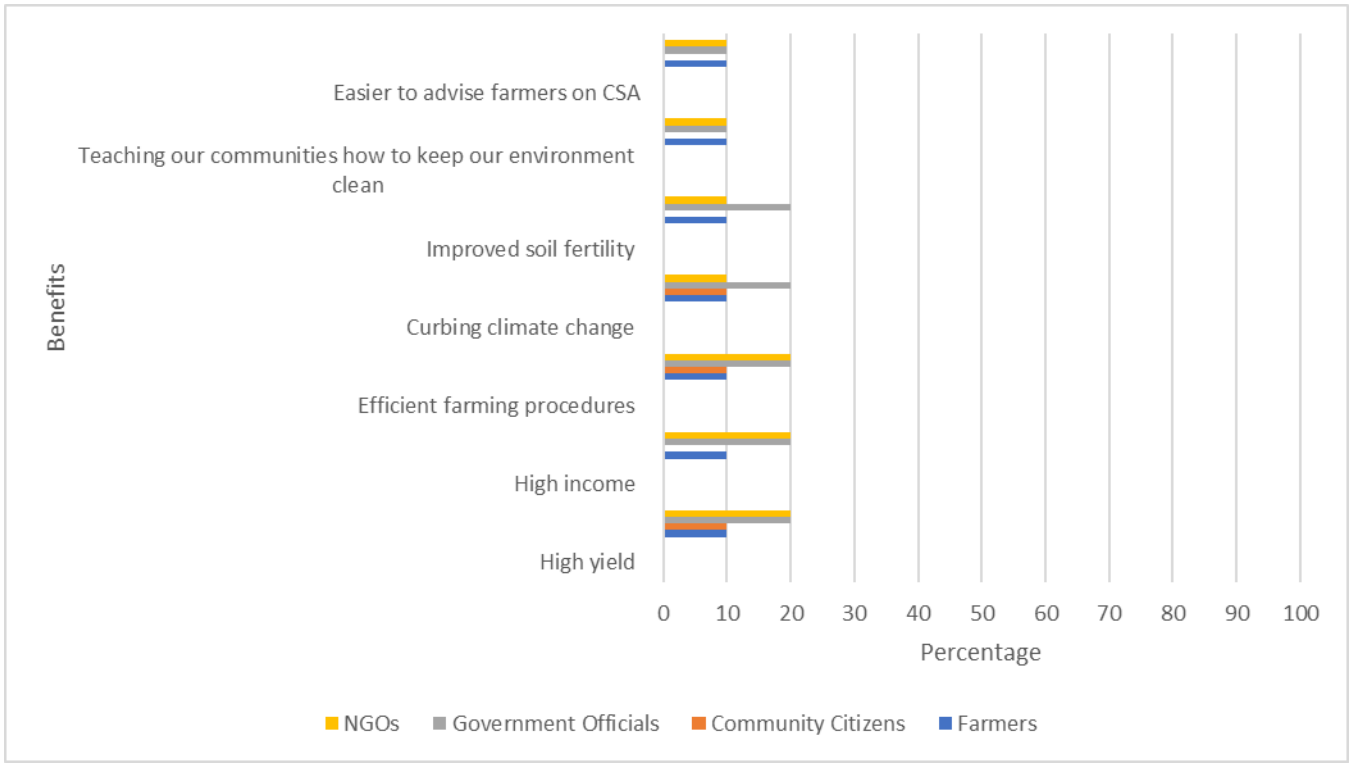

Figure 7. How has the CSA training benefited the participants that attended the training?

According to the findings of this study when the participants were asked to name some of the advantages that CSA brings about (see Figure 8), 30% of the participants from the group of farmers stated that CSA brought about high yield in farming and 20% stated that CSA brought about high income. Ten percent stated that farming procedure became more efficient, 30% stated that CSA curbs the effects of climate change, 30% stated that there is improvement in the fertility of the soil, 20% stated that CSA strengthened food security and benefitted the environment, and 50% of the participants stated that they had no knowledge on the advantages of CSA. The advantages that were listed by the farmers affirms the fact that they experienced some of these benefits on their farms.

The community citizen group was made up of 60% participants who said CSA led to high yield. Twenty percent stated that the utilization of CSA will lead to higher income. Eighty percent stated that CSA introduces more efficient farming procedures and 60% indicated that CSA benefits the environment by curbing climate change. Twenty percent stated that the usage of CSA techniques improved the fertility of the

soil, while the other 30% of the participants believed that, one of the benefits of CSA is to strengthen food security, protect, and promote the environment. The other group of participants (10%) did not know the advantages of CSA. These responses from the community citizens can be attributed to the fact that these agricultural professionals witnessed these benefits on various farms during practical activities and also read and taught about these benefits. .

When the governmental organisations were asked to state the advantage of CSA, 30% advocated for high yield, high income, more efficient farming, reduction of climate change, and the improvement of soil fertility respectively. Twenty percent of the participants from the governmental organisation group believed CSA would lead to the reduction of pollution and better management of the environment. Ten percent stated that it would strengthen food security and 60% of the participants had no knowledge on the advantages of CSA, which supports the findings that the participants from the governmental organisation have a low knowledge of CSA (see Figure 2). Only a few participants who have knowledge on the advantages of CSA can link their knowledge to their participation in CSA training and their interaction with farmers who have knowledge of CSA.

Amongst the participants of the NGOs, 40% indicated that CSA resulted in high yield, more efficient farming procedures, and it better improves soil fertility respectively. Thirty percent stated that CSA would lead to high income and strengthen the food security in addition to benefiting the environment. Twenty percent believed that CSA mitigates the effects of climate change and 50% had no knowledge regarding the advantages of CSA. The NGOs possessing knowledge on the advantages of CSA can be attributed to the fact that most of these organisations specialise in developing techniques that will protect agricultural practices from changing climate. In addition, most of these NGOs also specialise in conducting CSA trainings. The findings agree with Lipper (2014), who stated that the benefit of CSA is to augment food security, agricultural productivity, and improve the quality of life of people as well as the environment.

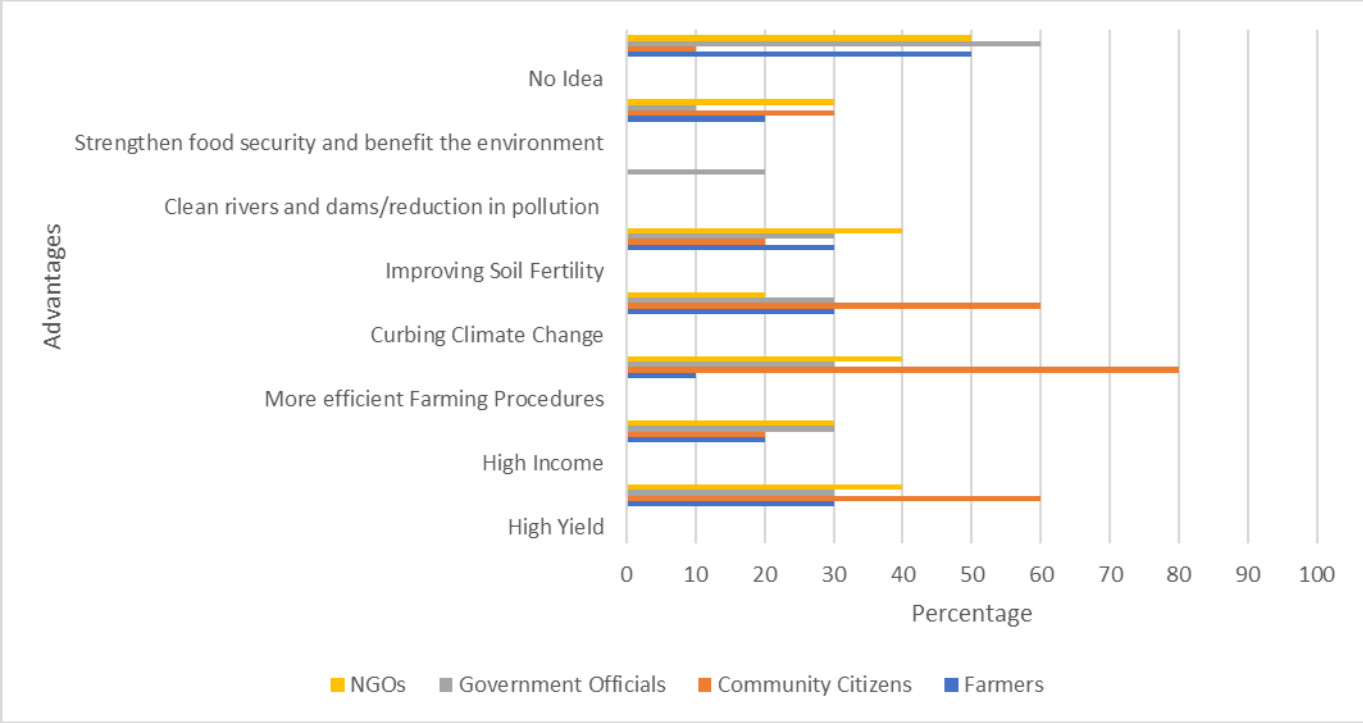

Figure 8. Advantages of CSA

In identifying the disadvantage of CSA (Figure 9), the findings of this study indicated that, 10% of famers believed that, CSA methods are expensive and that the smart farming based equipment also expect the farmers to understand and learn the use of technologies. Sixty percent had no idea what the disadvantage of CSA were, 30% believed that there was not enough knowledge regarding CSA when it comes to putting them into practices, in addition to the rate of adapting to the new techniques respectively. The high lack of idea on the disadvantages of CSA can be ascribed to the fact that the participants have no way of obtaining knowledge of CSA in the rural area, furthermore there is the lack of interconnectedness between the farmers and extension officers who should provide agricultural knowledge that will support farmers.

The results on advantages of CSA practices concerning the community citizen show that 10% believed that CSA methods were expensive, 20% stated that some of the CSA techniques requires equipment that most farmers don't have access to, in addition to gaining knowledge on these equipment if they by chance can get access to them and the process of obtaining knowledge on the utilization of the equipment is not common and hard to obtain respectively. Ten percent believed that CSA needs

availability of internet continuously, which is not accessible in certain rural areas where farming practices are usually prominent. Fifty percent had no idea on the disadvantages of CSA and believed that there was shortage of knowledge when it comes to putting CSA techniques into practices respectively, and 40% stated that the literacy level is low, and this adversely influences the adaption to the CSA techniques. A statement from one of the respondents supports this: “during a class trip to various farms, the farmers stated that CSA required technical skill and many farmers lack these skills”.

The group of governmental organisations consisted of 20% who stated that CSA practices were expensive for instance crop rotation required the input of a lot of money (Ng’ang’a, Rivera, Pamuk & Hella, 2020). Ten percent stated that specific equipment’s were required and not all farmers have access to them. Ten percent believed that CSA needs availability of internet continuously, which is not accessible in certain rural areas where farming practices are usually prominent. Seventy percent had no knowledge on the disadvantages of CSA, and 20% of the participants believed that there was shortage of knowledge when it comes to putting CSA techniques into practices as well as the literacy level being low, which was adversely influencing the adaption to the CSA techniques respectively. The lack of knowledge on the disadvantages of CSA can be attributed to the low knowledge of CSA amongst the participants from the government organisation.

The NGOs according to the findings indicated that 30% of the participants believed CSA to be an expensive method. Twenty percent indicated that specific equipment’s were required and not all farmers have access to them. Ten percent believed that CSA farming-based equipment’s required the farmers to have prior knowledge on how to operate them and not all farmers have access to the knowledge. Twenty percent believed that CSA needs availability of internet continuously, which is not accessible in certain rural areas where farming practices are usually prominent. Sixty percent had no idea on what the disadvantage of CSA was, and 30% of the participants stated that there was shortage of knowledge when it comes to putting CSA techniques into practices as well as the literacy level being low, which was adversely influencing the adaption to the CSA techniques respectively. This lack of

knowledge on the disadvantages of CSA is supported by the fact that half of the participants in the NGO group do not have any knowledge of CSA (see Figure 2).

The findings were in accordance with Makate et al. (2019), who stated that farmers cannot invest in CSA techniques due to low resources. Kirui et al. (2017) also stated that farmers are burdened by inadequate facilities; furthermore, Autio et al. (2021) emphasized that, due to the farmers' poor knowledge, their adoption rates of CSA technologies is low. Eshetu et al. (2020) also stated that, without assistance from government organizations that provide adaptive information and technology support, it becomes hard for farmers to utilize CSA techniques.

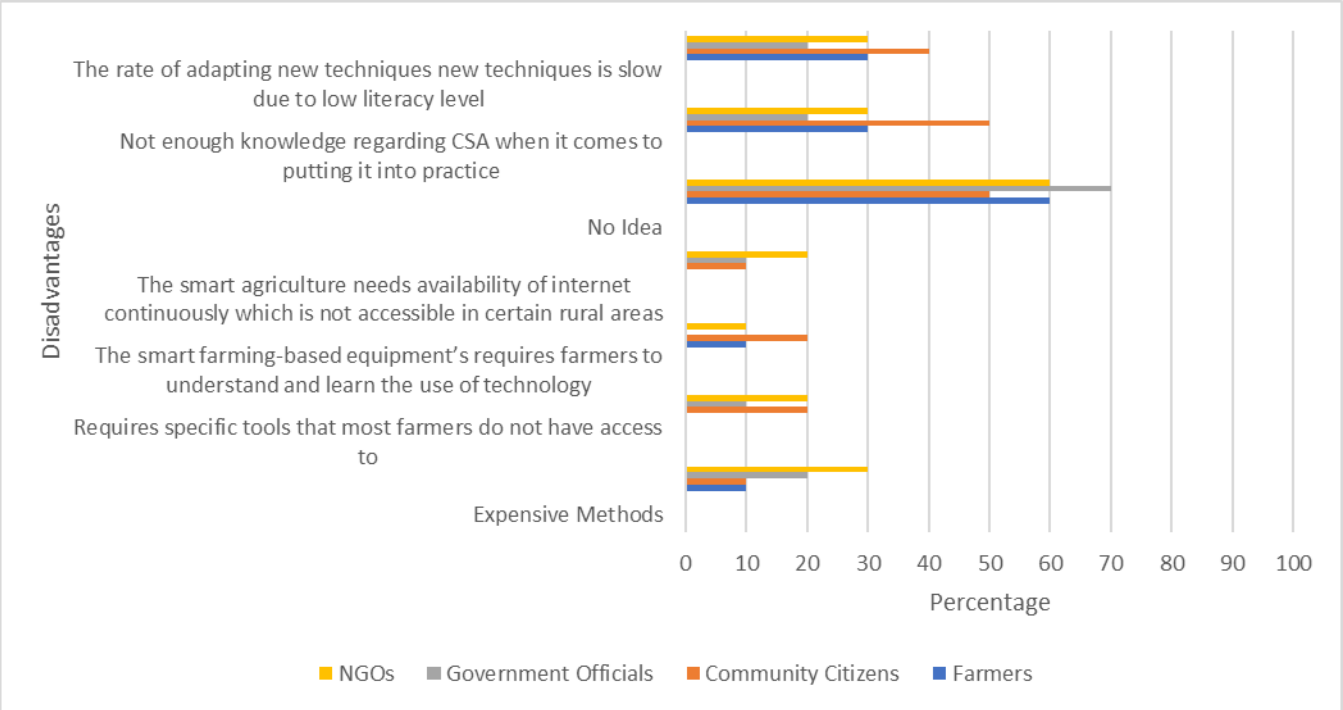

Figure 9. Disadvantages of CSA

The participants were asked if they knew of a policy governing CSA. According to the findings (Figure 10), 20% of the farmers stated that they knew of various policies governing CSA, 50% of the community citizen participants said they knew, 30% of the governmental organisation participants said yes, and 30% of the NGO participants gave the same answer. This response can be linked to the educational qualifications of the participants; the participants undergo modules that teach them

about the policies governing the agricultural sector while obtaining their BSc, MSc, or PhD.

The examples of the policy frameworks that the farmers knew include (see Figure 11) the guidelines for CSA marketing (20%), guidelines for holistic range livestock management (20%), agricultural insurance (10%), the guidelines on organic soil fertility management (10%), guidelines on CSA water management (20%), guidelines for using improved cultivars (10%), and the guidelines for selected in-field harvesting practices (20%).

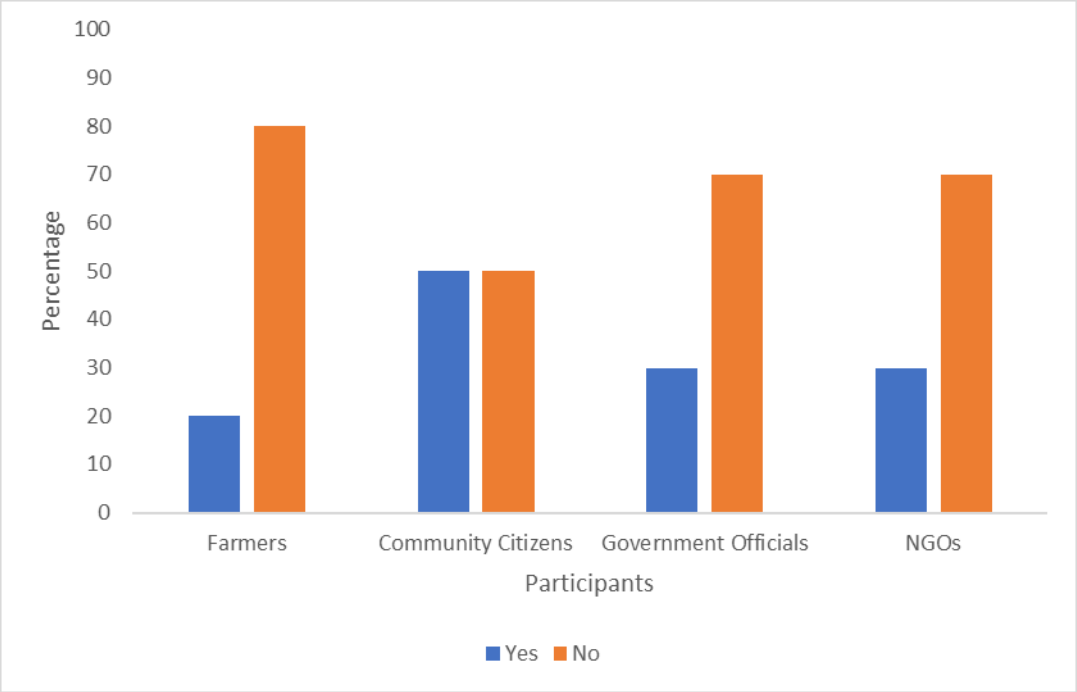

Figure 10. Is there a policy governing CSA?

Community citizens were familiar with certain policy framework such as the guidelines for CSA marketing (20%), guidelines for Holistic Range Livestock Management (20%), agricultural insurance (40%), the guidelines on organic soil fertility management (30%), guidelines on CSA water management (20%), guidelines for using improved cultivars (30%), and the guidelines for selected in-field harvesting practices (20%). The participants from the governmental organisations recognised the following policy frameworks: the guidelines for CSA marketing (20%), guidelines for holistic range livestock management (20%), agricultural insurance (30%), the guidelines on organic soil fertility management (30%), guidelines on CSA water

management (20%), guidelines for using improved cultivars (20%), and the guidelines for selected in-field harvesting practices (30%) (see Figure 11).

The policy framework that the participants from NGOs recognised (see Figure 11) include the guidelines for CSA marketing (30%), guidelines for holistic range livestock management (30%), agricultural insurance (30%), the guidelines on organic soil fertility management (30%), guidelines on CSA water management (30%), guidelines for using improved cultivars (30%), and the guidelines for selected in-field harvesting practices (20%).

The policy framework that all the participants recognised can be attributed to the knowledge they obtained while increasing their educational qualifications; it is also knowledge that could be obtained from CSA training.

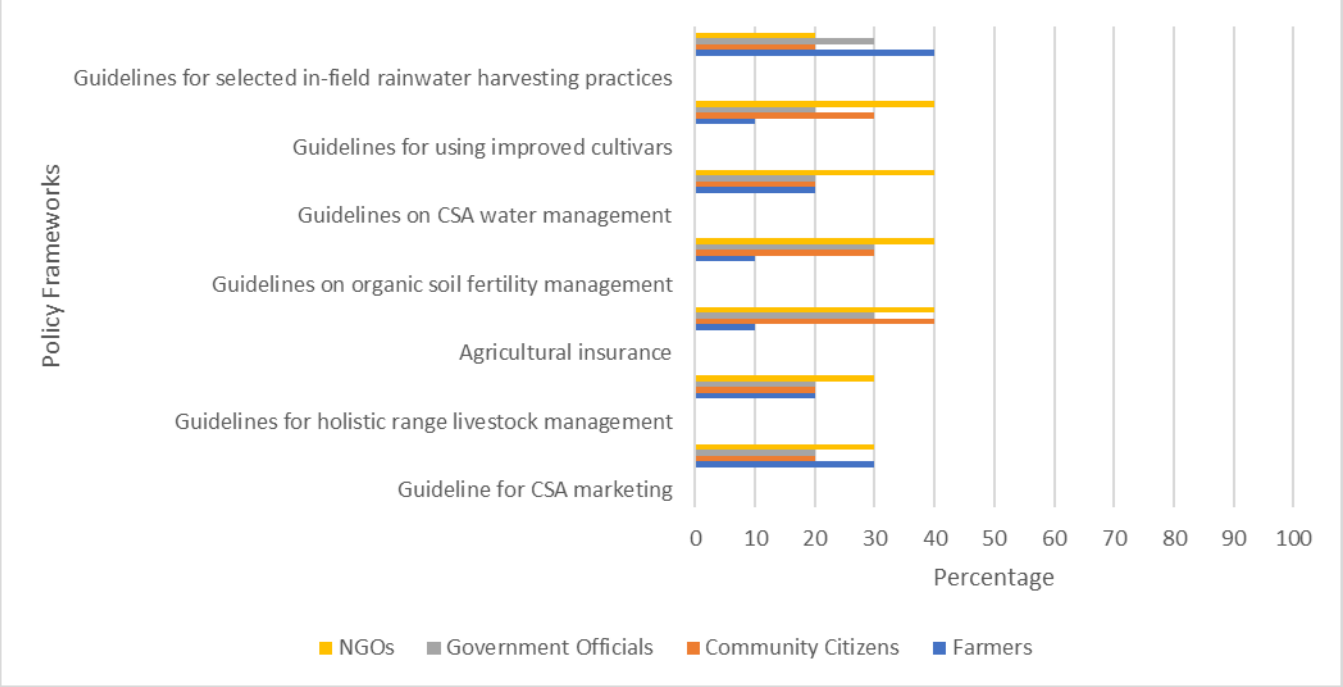

Figure 11. Policy frameworks for CSA which the participants recognise.

The participants were asked to state if CSA policies have been implemented in the district municipality of Ngaka Modiri Molema. Thirty percent of the farmers; 40% of the community citizens; 20% of the participants of the governmental organisation; and 30% of the NGOs participants stated that CSA policies have been implemented (Figure 12). The response, showing a low recognition of CSA policies, can be

connected to the fact that most of the participants lack proper knowledge of CSA and have very little interaction with the process of formulating, planning, and implementing the policies.

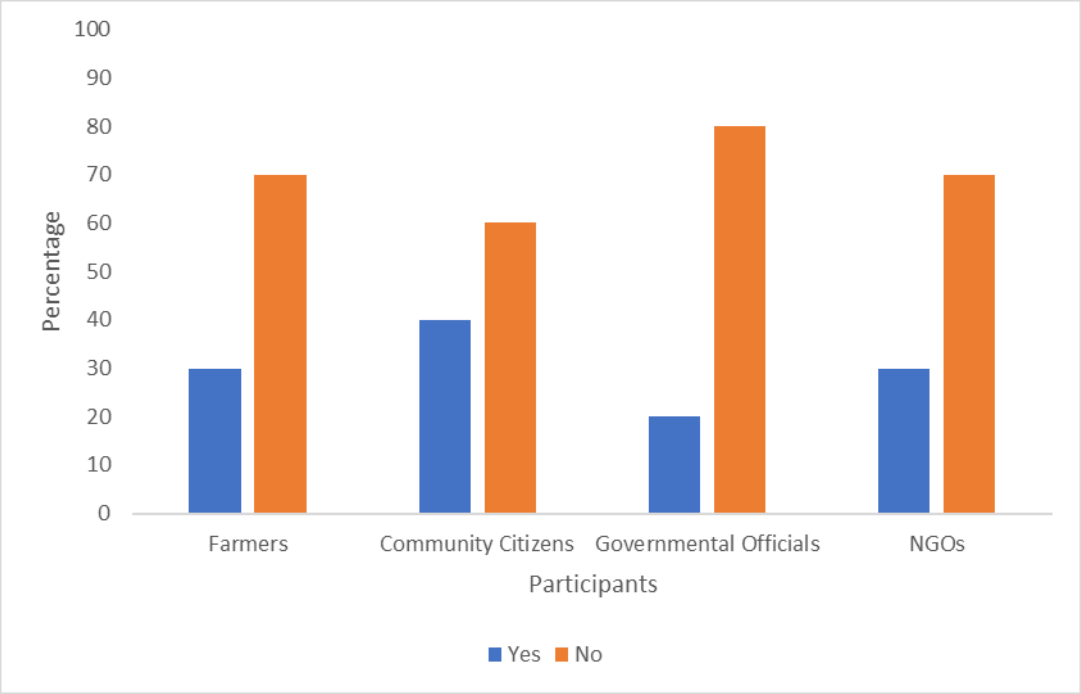

Figure 12. Are CSA policies implemented in NMMDM?

The participants (see Figure 12), who stated that CSA policies have been implemented, were then asked to list the policies that have been implemented in NMMDM. Only 10% stated that the guidelines for CSA marketing have been implemented in NMMDM, 20% stated that agricultural insurance has been implemented, 10% stated that the guidelines on organic soil fertility have been implemented, 30% indicated that the guidelines on CSA water management have been implemented, 20% voiced out that the guidelines for Holistic Range Livestock Management have been implemented, 20% stated that the guidelines for using improved cultivars have been implemented, and 10% stated that the guidelines for selected in-field rainwater harvesting practices have been implemented.

The findings from the community citizens group (Figure 13) indicated that the participants included only 20% who stated that the guidelines to CSA marketing have been implemented in NMMDM. Thirty percent stated that agricultural insurance has been implemented. Ten percent stated that the guidelines on organic soil fertility

have been implemented. Another 10% indicated that the guidelines on CSA water management have been implemented, 20% voiced out that the guidelines for Holistic Range Livestock Management have been implemented, 30% stated that the guidelines for using improved cultivars have been implemented, and 10% stated that the guidelines for selected in-field rainwater harvesting practices have been implemented.

The participants from the governmental organisation (Figure 13) included 10% of participants stating that the guidelines to CSA marketing have been implemented in NMMDM. Thirty percent stated that agricultural insurance has been implemented. Ten percent stated that the guidelines on organic soil fertility have been implemented. Thirty percent indicated that the guidelines on CSA water management have been implemented, 20% voiced out that the guidelines for holistic range livestock management have been implemented, 10% stated that the guidelines for using improved cultivars have been implemented, and 20% stated that the guidelines for selected in-field rainwater harvesting practices have been implemented.

Finally the NGOs statements included 30% of the participants who stated that the guidelines to CSA marketing have been implemented in NMMDM. Thirty percent stated that agricultural insurance has been implemented. Thirty percent stated that the guidelines on organic soil fertility have been implemented. Twenty percent indicated that the guidelines on CSA water management have been implemented, 30% voiced out that the guidelines for Holistic Range Livestock Management have been implemented, 20% stated that the guidelines for using improved cultivars have been implemented, and 20% stated that the guidelines for selected in-field rainwater harvesting practices have been implemented (see Figure 13).

The awareness by all the participants of the policies that have been implemented in NMMDM can be attributed to knowledge that stems from CSA training, interaction with farmers, and information from research that has been published which raises awareness on what policies have been implemented. The findings matched Mnkeni's (2019b) study, that stated that various CSA policies have been implemented in NMMDM, and those policies he stated include the policies that have been listed

above. The policies have been implemented in various areas all over South Africa and this has cemented the way for the advancement of CSA in South Africa (including in Ngaka Modiri Molema).

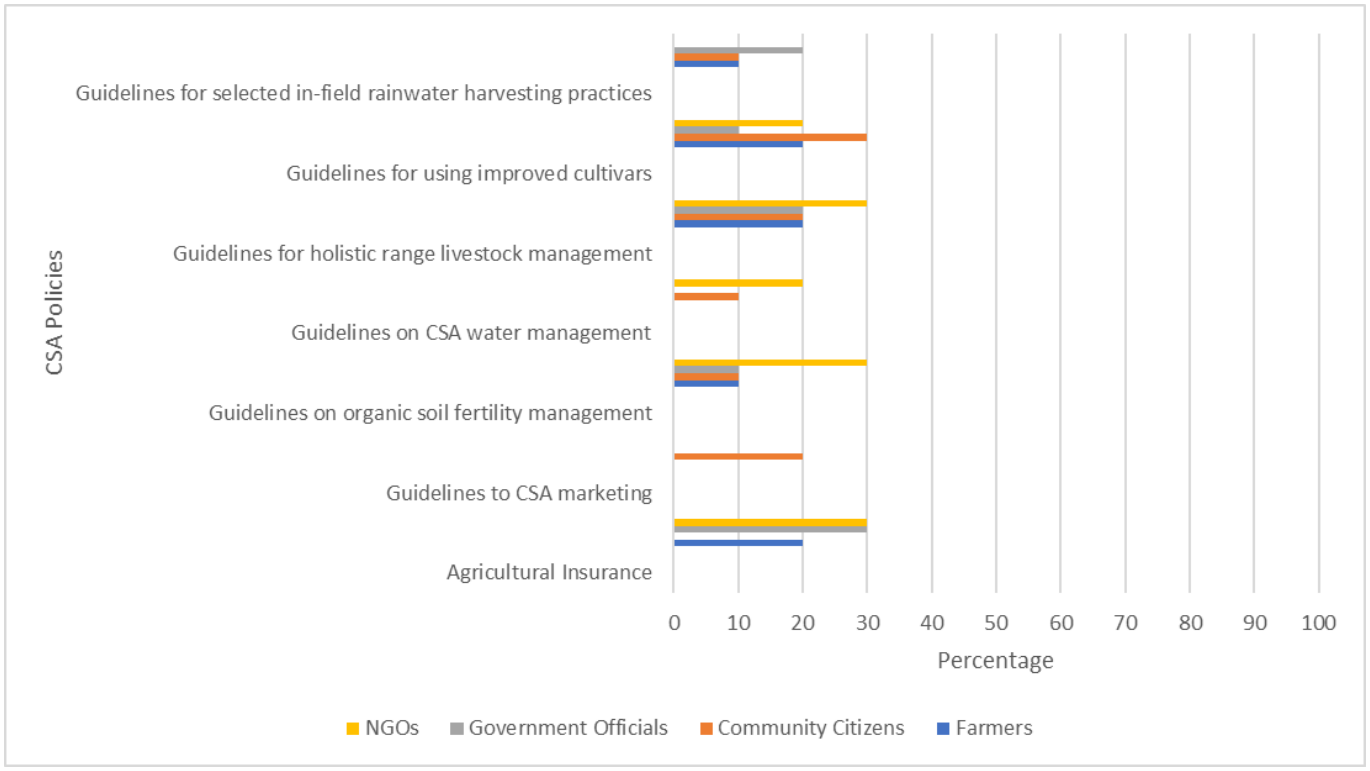

Figure 13. CSA policies that exist in Ngaka Modiri Molema according to the participants

Various barriers have been identified as factors influencing the implementation of CSA by the participants of this study. Amongst the farmers, 50% stated that the poor access to information and knowledge on new technologies about changing climate is one of the barriers influencing the implementation of CSA, the insufficient information on climate change initiatives has been identified as a barrier by 60%, 30% identified poor working environment as a barrier, the existence of a poor linkage amongst extension and meteorology institutions have been identified as a barrier by 20%, 10% raised the insufficient mobility of staff as a barrier, the absence of climate change subject matter specialists has been identified as a problem by 20%, another 20% identified the high personal cost in acquiring competencies on CSA techniques as a barrier, 10% stated that the lack of CSA training resources served as a barrier, and 20% stated that the inadequate organisational support in acquiring knowledge

on CSA initiatives served as a barrier towards the implementation of CSA (see Figure 14). Most of the farmers who listed the barriers influencing their use of CSA could attest to these facts based on their personal experience.

The community citizens identified poor access to information and knowledge on new technologies about climate change (90%), the insufficient data on climate change initiatives (60%), the poor working environment (60%), the existence of a poor linkage between meteorology institutions and extension (70%), the deficient mobility of staff (40%), the absence of climate change subject matter specialists (40%), the high personal cost in attaining proficiencies on CSA techniques (20%), the lack of CSA training resources (30%), and the inadequate organisational support in acquiring knowledge on CSA initiatives (20%) as the barriers that are adversely influencing the implementation of CSA (Figure 14). The awareness of the barriers can be attributed to the knowledge the participants gain from interacting with farmers as well as from recollecting research that has been published on the topic.

The barriers that have been identified by the participants of the governmental organisation include the poor access to knowledge and information on latest machineries concerning climate change (30%), the scarce data on climate change initiatives (20%), the poor working environment (10%), the existence of a poor linkage amongst extension as well as meteorology institutions (10%), the insufficient mobility of staff (10%), the absence of climate change subject matter specialists (40%), the high personal cost in acquiring competencies on CSA techniques (10%), the lack of CSA training resources (30%), and the inadequate organisational support in acquiring knowledge on CSA initiatives (20%) (see Figure 14). The knowledge of the barriers influencing CSA implementation amongst the experts, according to one of the participants, “stems from the complaints regarding CSA that the farmers present to the governmental officials.”

The NGO participants indicated that the poor access to information as well as knowledge on new machineries about climate change (60%), the insufficient information on climate change initiatives (40%), the poor working environment (20%), the existence of a poor linkage amongst meteorology institutions and extension (20%), the insufficient mobility of staff (30%), the shortage of climate

change subject matter specialists (30%), the high personal cost in acquiring competencies on CSA techniques (20%), the lack of CSA training resources (30%), and the inadequate organisational support in acquiring knowledge on CSA initiatives (30%) are the barriers that are negatively affecting the establishment of CSA (see Figure 14). Knowledge regarding the barriers can be linked to the interaction and supervision between the farmers and NGOs.

The findings of the study are in accordance with Makate et al. (2019), who stated that farmers have a high personal cost in gaining proficiencies in CSA techniques. Kirui et al. (2017) also noted that farmers are burdened by poor access to information and knowledge on new machineries about changing climate; this is also supported by Autio et al. (2021), who emphasized that, due to the farmers' shortage of knowledge, there are low adoption rates of CSA technologies. Eshetu et al. (2020) also stated that without government extension services, the lack of changing climate subject matter specialists, and the weak/poor linkages between extension as well as meteorology institutions, it becomes hard for farmers to utilize CSA techniques.

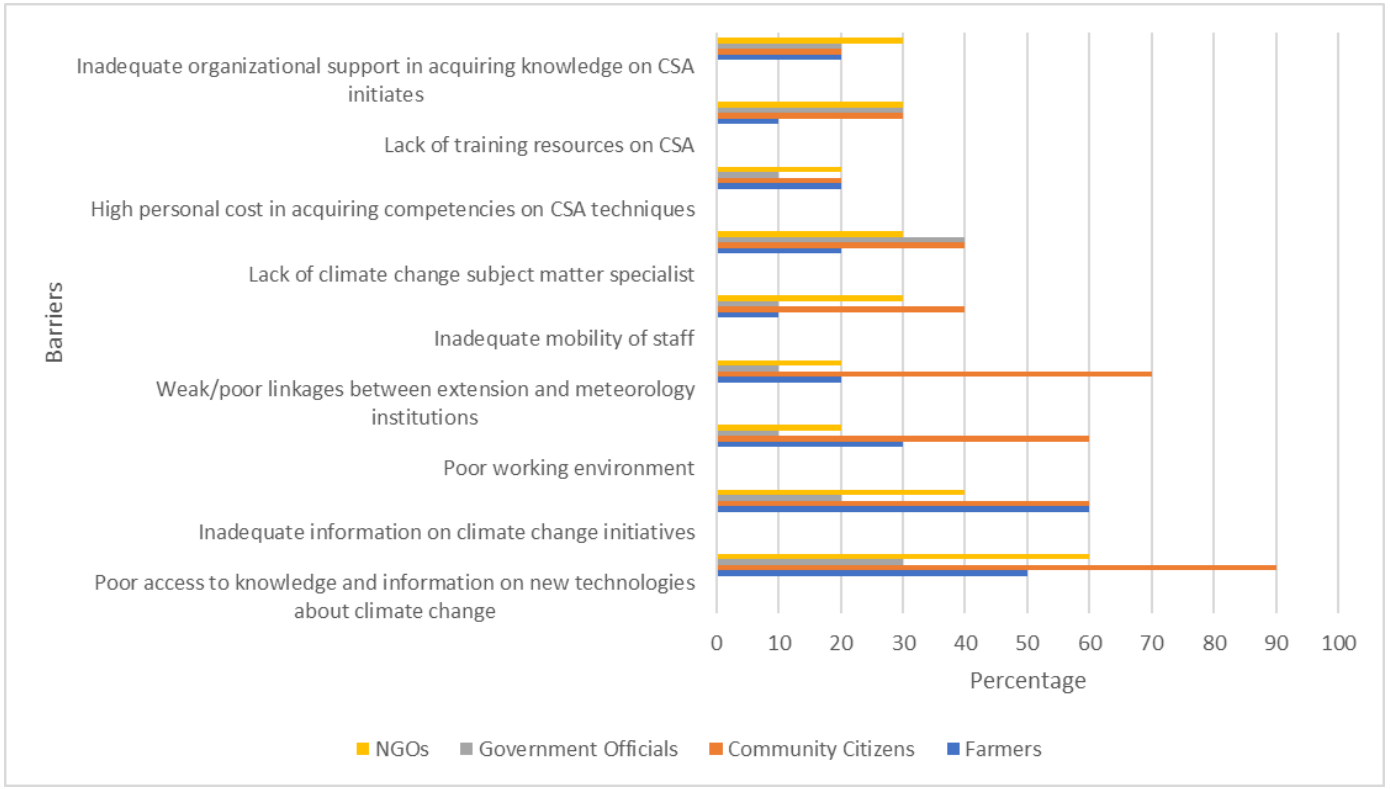

Figure 14. The barriers that exist towards the implementation of CSA policies

The participants were then asked if they know of any farms that are utilising CSA. Thirty percent of the farmers, 20% of the community citizens, 30% of the governmental organisation participants, and 40% of the NGO participants stated that they knew of farms where CSA is being utilised (Table 2). Examples of these farms include Molemo farm, Masubi fresh product, Lokaleng farm, and the Farm Union.

Table 2. Do you know of any farms that are using CSA?

Variables	**Farmers**	**Community Citizens**	**Government Officials**	**NGOs**
Yes	3 (30%)	2 (20%)	3 (30%)	4 (40%)

The participants were then asked to explain how CSA has improved the agricultural activities on these farms (see Figure 15). Thirty percent of the farmers reported that the farm experienced better soil management, better resource management, higher income, and higher yields, as well as the reduction in the wastage of resources such as water and fertilizers. Twenty percent of the community citizens observed better soil management, 10% stated that there was better resources management, 20% stated that there was an increase in yield as well as in income, and 10% stated that wastage of resources such as water, fertilizers and seeds was reduced. The governmental organisation indicated that 30% of the participants observed better soil management, 20% stated that there was better resources management, 30% stated that there was an increase in yield as well as in income, and 20% stated that wastage of resources such as water, fertilizers and seeds was reduced. The benefits of CSA on farms, as stated by the participants, can be associated with the fact that all these benefits have been observed and their benefits have been distributed amongst farmers.

The NGOs indicated that 30% of the participants observed better soil management, 30% stated that there was better resources management, 30% stated that there was an increase in yield as well as in income, and 30% stated that wastage of resources such as water, fertilizers and seeds was reduced. The findings of this study are supported by those of McCornick et al. (2013), who stated that CSA leads to the rethinking of water storage to reduce water wastage; there is also an increase in the

production, in addition to enhancing resilience through the use of improved agricultural and water management technology, as well as initiatives for income diversification.

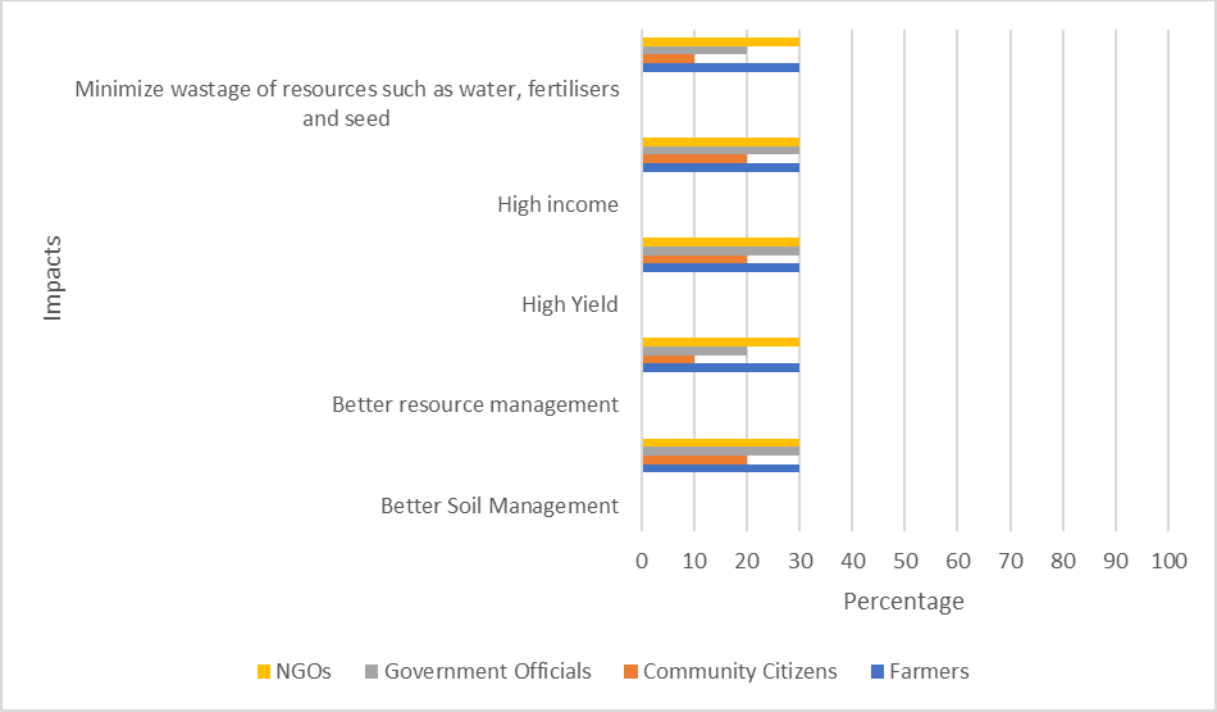

Figure 15. The impact of CSA on farms

The participants were asked to identify CSA techniques that are used to promote farming, and according to the findings, the highest number of CSA techniques that are being used to promote farming amongst the farmers include drip irrigation (40%), water harvesting (40%), the use of herbicides and crop residue (20%), the use of mixed farming and crop rotation (50%), and pest-resistant varieties (60%) (Figure 16). The highest number of CSA techniques that are being used to promote farming, according to community citizens (see Figure 16), include drip irrigation (40%), water harvesting (50%), the use of herbicides (40%), the use of crop residues (30%), mixed farming and crop rotation (30%), and pest-resistant varieties (20%).

The highest number CSA techniques that are being used to promote farming, as identified by the participants from the governmental organisation, include the use of drip irrigation and water harvesting (40%), the use of herbicides and crop residues (30%), mixed farming (40%), crop rotation, and pest-resistant varieties (30%)(Figure

16). The highest number of CSA techniques that are being used to promote farming that the participants from NGOs stated include the use of irrigation (50%), water harvesting (60%), the use of herbicides (40%), the use of crop residues (50%), mixed farming (70%), the use of crop rotation (60%), and the use of pest-resistant varieties (40%) (as indicated in Figure 16).

The techniques that the participants chose can be attributed to CSA knowledge. These techniques are utilized after observing the benefits that they bring about when being used by fellow farmers, and the techniques are also utilized by the participants as per the advice of extension officers. Branca and Perelli (2020) do not support the findings regarding the techniques used. They argue that the most-utilised CSA techniques in semi-arid areas like NMMDM include various conserving and water-harvesting techniques such as cover-cropping, mulching, tied ridging, minimum tillage, and planting pits, which are more successful in dryland environments, where agricultural output is frequently limited by low rainfall and high evapotranspiration.

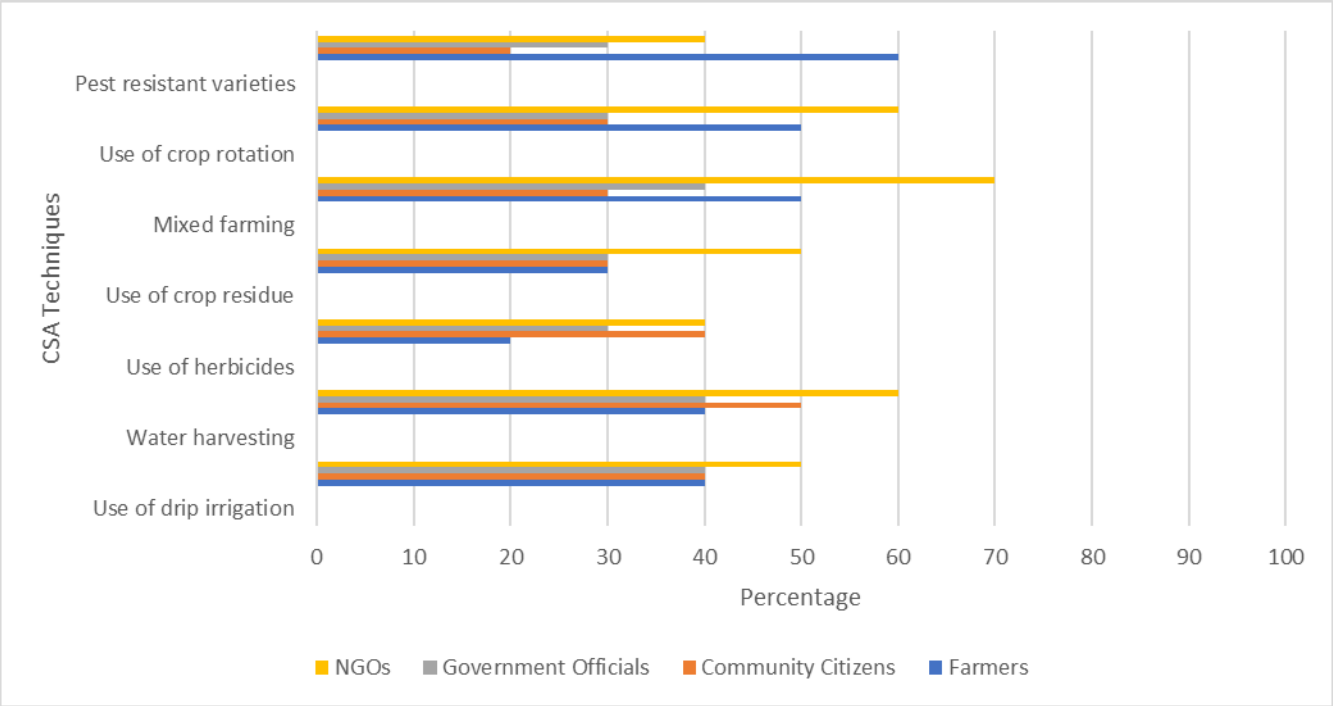

Figure 16. CSA techniques used to promote farming.

Table3 deals with the policy problems affecting CSA. According to the findings (see Table 3), 30% of the farmers, 60% of the community citizens, 20% of the

governmental organisation participants, and 40% of the NGO participants were aware of the policy problems affecting CSA. This is supported by the participants' knowledge capacity on CSA.

Table 3. Are you aware of policy problems affecting CSA?

Variables	**Farmers**	**Community Citizens**	**Government Officials**	**NGOs**
Yes	30%	60%	20%	40%

The participants were then asked to give examples of policy problems that are affecting CSA. Among the farmers, 30% reported institutional problems such as the lack of guidelines in policies as an example of a policy problem affecting CSA. Twenty percent reported the issue of land rights as an example of the policy problems affecting CSA. Thirty percent reported the lack of compensation for positive externalities like improved ecosystems for wildlife, soil carbon, as well as increase food security, as other examples of the policy problems affecting CSA. Thirty percent believed the lack of incentives to adopt CSA practices contributed to the policy problems affecting CSA. Twenty percent believed that the policy problems affecting CSA can be attributed to the lack of promotion of CSA practices, as well as the lack of uniformity between sustainable agriculture development activities as well as general development orientation with other districts. Thirty percent stated that lack of consistency and assimilation between agriculture and climate change is the reason for policy problems that are affecting CSA (Figure 17).

The community citizens included 50% participants stating that institutional problems, such as the lack of guidelines in policies, was an example of a policy problem affecting CSA. Fifty percent stated that the issue of land rights is an example of the policy problems affecting CSA. Thirty percent stated that lack of compensation for positive externalities like improved ecosystems for wildlife, soil carbon, as well as increases food security is another example of the policy problems affecting CSA, and furthermore, the lack of incentives to adopt CSA practices lead to the policy problems affecting CSA. Thirty percent believed that the policy problems affecting CSA can be attributed to the lack of promotion of CSA practices, as well as the

absence of uniformity between sustainable agriculture development activities as well as general development orientation among other districts. Twenty percent stated that lack of consistency and assimilation between climate change and agriculture is the reason for policy problems that are affecting CSA (see Figure 17).

Amongst the governmental organisation participants, 10% stated institutional problems such as the lack of guidelines in policies was an example of a policy problem affecting CSA. Twenty percent stated that the issue of land rights is an example of the policy problems affecting CSA, as well as the lack of compensation for positive externalities like improved ecosystems for wildlife, soil carbon, as well as increased food security is another. Ten percent believed that the absence of incentives to adopt CSA practices account for the policy problems affecting CSA, 20% believed that the policy problems affecting CSA can be attributed to the lack of promotion of CSA practices. Ten percent stated that the lack of uniformity between the general development orientation and sustainable agriculture development activities among various sectors is a problem, and 20% stated that lack of consistency and assimilation between agriculture and climate change is the reason for policy problems that are affecting CSA (Figure 17).

Amongst the NGOs, 40% stated that institutional problems such as the lack of guidelines in policies was an example of a policy problem affecting CSA. Forty percent stated that the issue of land rights is an example of the policy problems affecting CSA. Twenty percent stated that lack of compensation for positive externalities like improved ecosystems for wildlife, soil carbon, as well as increase food security is another example of the policy problems affecting CSA. Forty percent believed that the lack of incentives to adopt CSA practices contributes to the policy problems affecting CSA, and 40% believed that the policy problems affecting CSA can be attributed to the lack of promotion of CSA practices. Forty percent stated that the absence of uniformity between sustainable agriculture development activities as well as general development orientation, and 30% stated that lack of consistency and assimilation between agriculture and climate change is the reason for policy problems that are affecting CSA (see Figure 17).

The response to policy issues affecting CSA is supported by one of the participants who stated that “the lack of interconnection between all actors in the agricultural sector is the main political issue affecting the implementation of CSA.” Furthermore, other participants said that only after all actors have focused on CSA can there be decisions and actions to improve CSA knowledge among all study participants.

The finding regarding institutional problems being a policy problem was supported by Mnkeni (2019b), who stated that there is an absence of practical guidelines for the enactment of CSA, even though there is considerable knowledge of CSA in South Africa. With regard to the issues such as land rights, and the lack of uniformity amongst sustainable agriculture development activities as well as general development orientation, and other sectors, this finding is in accordance with Williams (2015), who stated that land tenure is an example of policy problem affecting CSA, whereby numerous impoverished farmers have insecure and unstable access to land. Furthermore, on another level, CSA is negatively impacted by the inability to evaluate the benefits as well as the risks of CSA and make wise investment decisions due to the lack of accurate and up-to-date information, technical advice, accessibility, and availability of inputs, including appropriate crop varieties. Finally, compatibility issues with the current policy frameworks, whose development was not guided by the demand or need for CSA, are likely to arise.

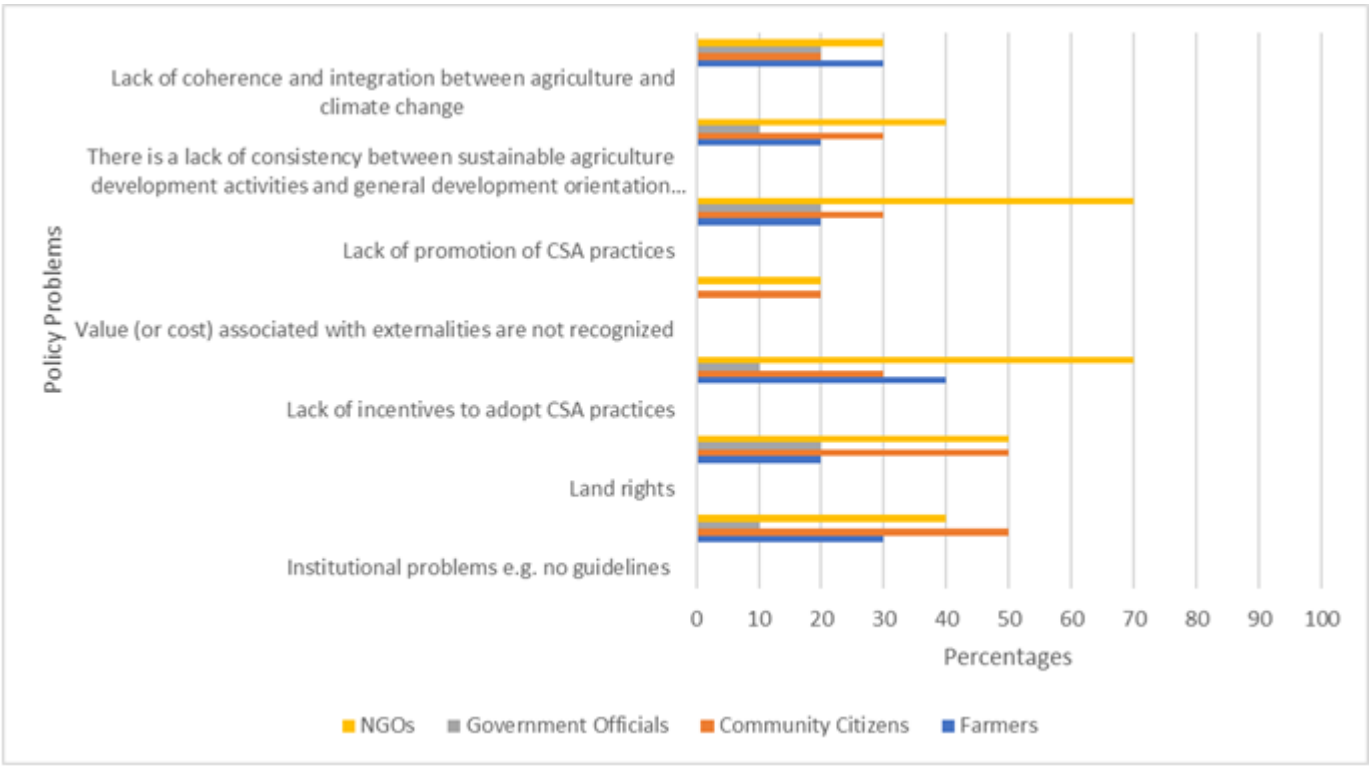

Figure 17. Policy problems affecting CSA

4.4 Strategies that can promote Climate-Smart Agriculture in the Ngaka Modiri Molema District Municipality

The participants were then asked to explain how CSA policies can be improved in the NMMDM, after being given five options. The finding amongst the participants from the group of farmers (Figure 18) indicated that 40% believed that investing in ecosystem-based approaches was beneficial. Sixty percent stated that better technologies will enable an environment to improve as well as accelerate uptake of CSA. Thirty percent indicated that the access of governments, smallholders, and private sector entrepreneurs to the money required to create and execute CSA will be improved through the creation of creative financing strategies to unlock both agriculture and climate funding. Seventy percent stated that the process of CSA awareness-building and profile-raising by highlighting CSA opportunities and success stories to smallholder farmers will be essential. Twenty percent stated that advancing the coordination of policies as well as strengthening local, national, and regional institutions will promote the implementation of CSA.

According to the community citizens (see Figure 18), 60% believed that investing in ecosystem-based approaches was beneficial. Ninety percent stated that better

technologies will enable an environment to enhance and facilitate uptake of CSA. Fifty percent indicated that the access of governments, smallholders, and private sector entrepreneurs to the money required to create and execute CSA will be improved through the creation of creative financing strategies to unlock both agriculture and climate funding. Seventy percent state that the process of CSA awareness-building and profile-raising by highlighting CSA opportunities and success stories to smallholder farmers will be essential, and 40% stated that advancing the coordination of policies as well as strengthening local, national, and regional institutions will promote the implementation of CSA.

The findings from the governmental organisations indicated that 60% believed that investing in ecosystem-based approaches was beneficial. Seventy percent stated that better technologies will enable an environment to enhance and facilitate uptake of CSA. Forty percent indicated that the access of governments, smallholders, and private sector entrepreneurs to the money required to create and execute CSA will be improved through the creation of creative financing strategies to unlock both agriculture and climate funding. Sixty percent stated that the process of CSA awareness-building and profile-raising by highlighting CSA opportunities and success stories to smallholder farmers will be essential, and 60% stated that advancing the coordination of policies as well as strengthening local, national, and regional institutions will promote the implementation of CSA (Figure 18).

Finally the findings from the NGO participants (see Figure 18) indicated that 50% believed that investing in ecosystem-based approaches was beneficial. Seventy percent stated that better technologies will enable an environment to enhance and facilitate uptake of CSA. Seventy percent indicated that the access of governments, smallholders, and private sector entrepreneurs to the money required to create and execute CSA will be improved through the creation of creative financing strategies to unlock both agriculture and climate funding. Seventy percent state that the process of CSA awareness-building and profile-raising by highlighting CSA opportunities and success stories to smallholder farmers will be essential, and 50% stated that advancing the coordination of policies as well as strengthening local, national, and regional institutions will promote the implementation of CSA.

The options given to the participants to improve CSA in the study area are that they believe that the utilization of technical capital "may be used to provide knowledge and support systems for producers, agricultural extension agents, as well as other organizations involved in agriculture management." The other participants believed that since the study area's economy is primarily based on agriculture, governmental investment in CSA should be given top priority in order to encourage farmers to embrace CSA techniques. The investment plans should include easily adaptable plans for designing and implementing policies, as well as clear prospects for CSA investments. The commercial sector and other stakeholders should be connected in order to make informed investment choices on the identified CSA technologies.

This finding is supported by Branca and Perelli (2020), who stated that the widespread use of CSA technology will encourage its implementation. Farmers will be motivated to adopt CSA practices if there are incentives in place, such as ecological compensation or access to financing for climate-related projects. The establishment of CSA will also be supported by increased access to scientific and practical evidence about CSA technology among governmental organisations, researchers, and farmers.

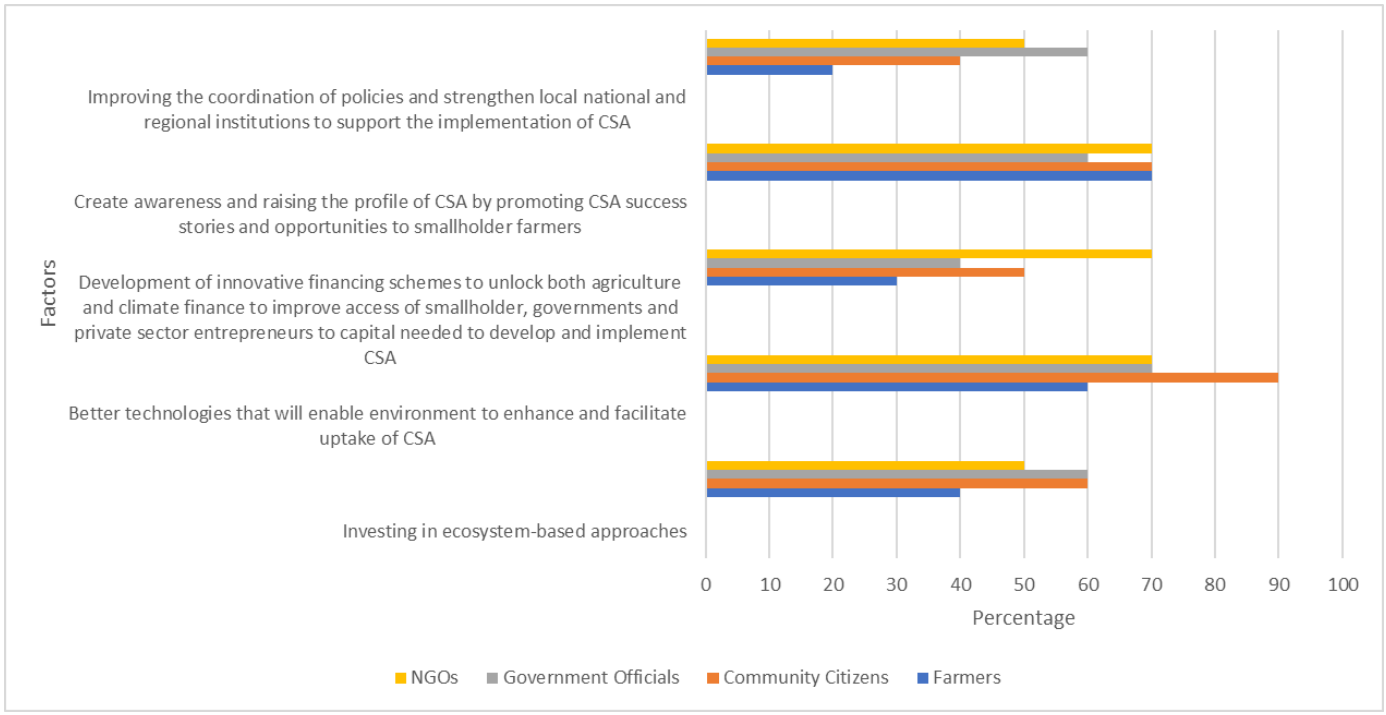

Figure 18. Factors that will promote CSA in Ngaka Modiri Molema District Municipality.

With regard to how CSA policy can be improved in the agricultural sector (see Figure 19), 30% amongst the farmers stated that the development and implementation of consistent CSA awareness campaigns on issues with soil health and land degradation would be essential, in addition to assisting in the annual formulation and execution of provincial CSA programmes to restore degraded lands. Twenty percent stated that encouraging the use of CSA technology and methods at the farm level across the nation by means of provincial CSA programmes would be beneficial. Forty percent believed that a diverse funding base to support CSA would promote CSA in the agricultural sector, and 40% insisted that the integration of CSA into the current agriculture, forestry and fisheries Investment and planning strategies would benefit the agricultural sector greatly.

Amongst the community citizens (Figure 19), 80% stated that the development and implementation of consistent CSA awareness campaigns on issues with soil health and land degradation would be essential, and 70% stated that assisting in the annual formulation and execution of provincial CSA programmes to restore degraded lands. Seventy percent stated that encouraging the use of CSA technology and methods at

the farm level across the nation by means of provincial CSA programmes would be beneficial. Ten percent believed that a diverse funding base to support CSA would promote CSA in the agricultural sector, and 50% insisted that the integration of CSA into the current agriculture, forestry and fisheries Investment and planning strategies would benefit the agricultural sector greatly.

Of the officials from government, 80% stated that the development and implementation of consistent CSA awareness campaigns on issues with soil health and land degradation would be essential, and 50% stated that assisting in the annual formulation and execution of provincial CSA programmes to restore degraded lands. Also 50% stated that encouraging the use of CSA technology and methods at the farm level across the nation by means of provincial CSA programmes would be beneficial. 50% believed that a diverse funding base to support CSA would promote CSA in the agricultural sector, and 60% insisted that the integration of CSA into the current agriculture, forestry and fisheries Investment and planning strategies would benefit the agricultural sector greatly (Figure 19).

The results from the NGO participants (see Figure 19), 90% stated that the development and implementation of consistent CSA awareness campaigns on issues with soil health and land degradation would be essential, 70% stated that assisting in the annual formulation and execution of provincial CSA programmes to restore degraded lands, and another 70% stated that encouraging the use of CSA technology and methods at the farm level across the nation by means of provincial CSA programmes would be beneficial. Fifty percent believed that a diverse funding base to support CSA would promote CSA in the agricultural sector, and 60% insisted that the integration of CSA into the current agriculture, forestry and fisheries Investment and planning strategies would benefit the agricultural sector greatly. The participants believed that there is poor knowledge of CSA amongst the participants, and that raising awareness, together with promoting the adoption of CSA technologies, a diverse funding base to support CSA, and the integration of CSA into the current agriculture sector, can boost the comprehension of CSA in the study areas.

The findings are supported by those of Van Staden (2018), who stated that, to improve CSA in the agricultural sector, it is necessary to involve the Department and other Agricultural Innovation Systems in additional to network-building and transformative change procedures. To make sure that alignment and articulation between these systems are working, specific communication linkages should be built. Farmer-centred learning networks within the system that seek to comprehend the system and determine how change might began should be given time and effort. Furthermore, to help the agricultural training and teaching staff to start Climate Smart innovation within the system, funding and assistance need to be given to them.

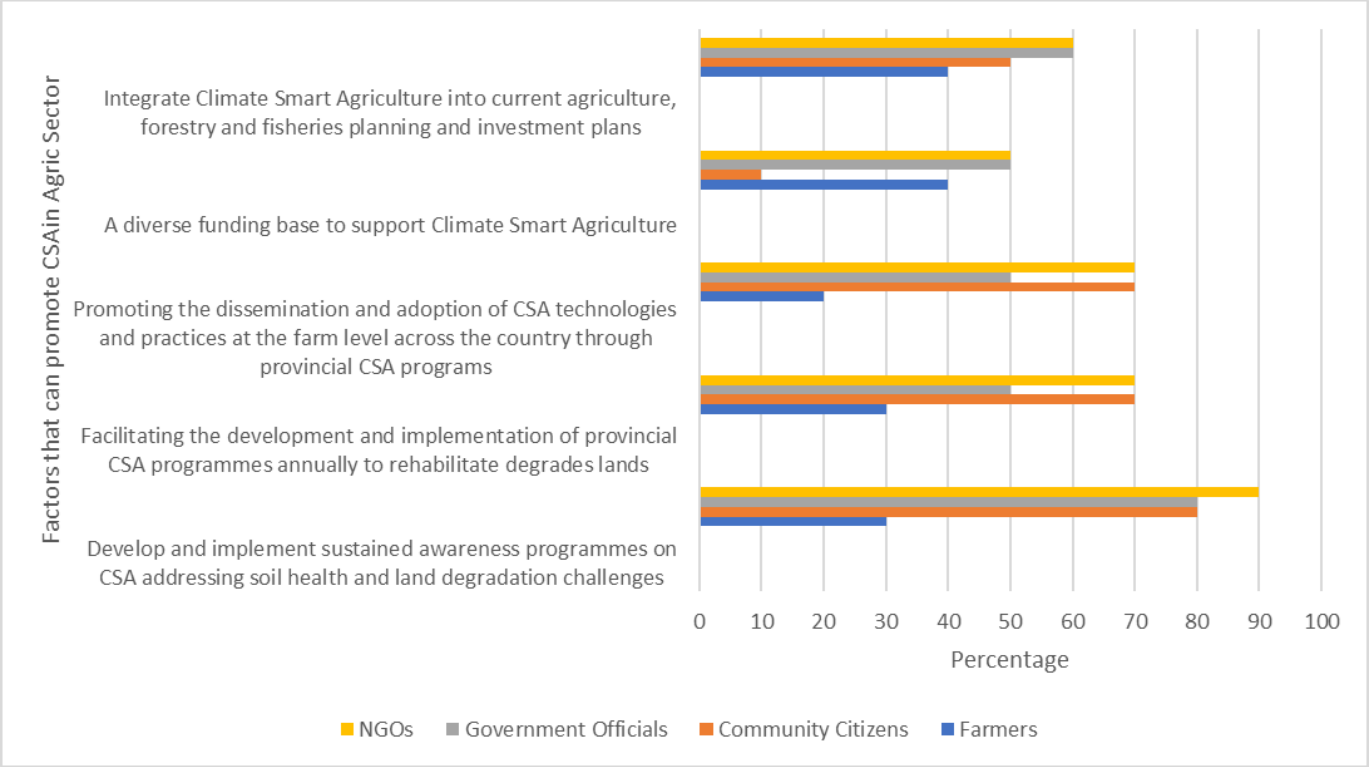

Figure 19. Respondents' suggestions for CSA improvement in agricultural sector

When it comes to successfully implementing CSA in NMMDM, the participants were asked to select the actors or institutions they view as essential to the implantation of CSA (see Figure 20). All the participants (100%) belonging to the government official groups stated that the farmers' association as an actor or institution was essential for successfully implementing CSA in NMMDM. Ninety percent of the respondents from the group of NGOs, as well as from the farmers group, indicated that the farmers' association was important for successfully implementing CSA in NMMDM, while 80%

of the participants from the community citizen group indicated that the farmers' association was necessary for successfully implementing CSA in NMMDM.

The next actors or institutions, which were the input dealers (Figure 20), had the support of 20% of the farmers, 30% of the community citizens, 30% of the governmental officials, and 30% of the NGO participants. They indicated that input dealers are essential towards successfully implementing CSA in NMMDM. Processors, according to 30% of farmers, 60% of community citizens, 30% of government officials, and 40% of NGO participants, are important actors who will promote the successfully implementation of CSA in NMMDM. The next actor or institution, namely marketers, is stated to be an integral part of attaining successful implementation of CSA in NMMDM according to the respondents of this study (50% farmers, 50% community citizens, 60% governmental officials, and 30% NGO participants). For the successful implementation of CSA in NMMDM, 10% of the farmers, 10% of the community citizens, 40% of the governmental officials, and 10% of the NGO participants from this study stated that retail outlets were essential.

The participants of this study were asked if extension officers were essential actors/institutions for the successful implementation of CSA in NMMDM. Only 40% of the farmers, 30% of the community citizens, 40% of the governmental officials, and 60% of the NGO participants stated that extension officers were essential. For the successful implementation of CSA in NMMDM, 40% of the farmers, 20% of the community citizens, 20% of the governmental officials, and 40% of the NGO participants stated that commodity associations were important actors or institutions. With regard to NGOs as an actor or institution, 30% of the farmers, 40% of the community citizens, 50% of the governmental officials and 70% of the NGO respondents indicated that these were essential for the successful implementation of CSA in NMMDM (see Figure 20).

The farmers' association was recognised by the participants as an essential core for implementing CSA. According to most of the participants, this can be based on the fact that "this type of association supports and promotes agricultural knowledge (the latest agricultural techniques, adaptation and mitigation methods, and affordable farming tools) amongst all individuals that participate in agricultural activities." NGOs

were also indicated by the participants as an important aspect for implementing CSA because, according to one participant, “NGOs serve important duties by fulfilling the government's agriculture service deficiencies.” Most of the participants stated that extension officers, commodity associations, marketers and processors are essential for providing instructions on the CSA techniques and how to distribute and sell their products afterwards.

The findings are supported by Williams (2015), who stated that the adoption of CSA is reinforced by a variety of institutions and stakeholders, including farmers (including farmer associations), business sector organizations, educational institutions, public sector organizations, civil society organizations, and research institutes; in addition, these actors or institutions will be beneficial towards promoting the implementation of CSA.

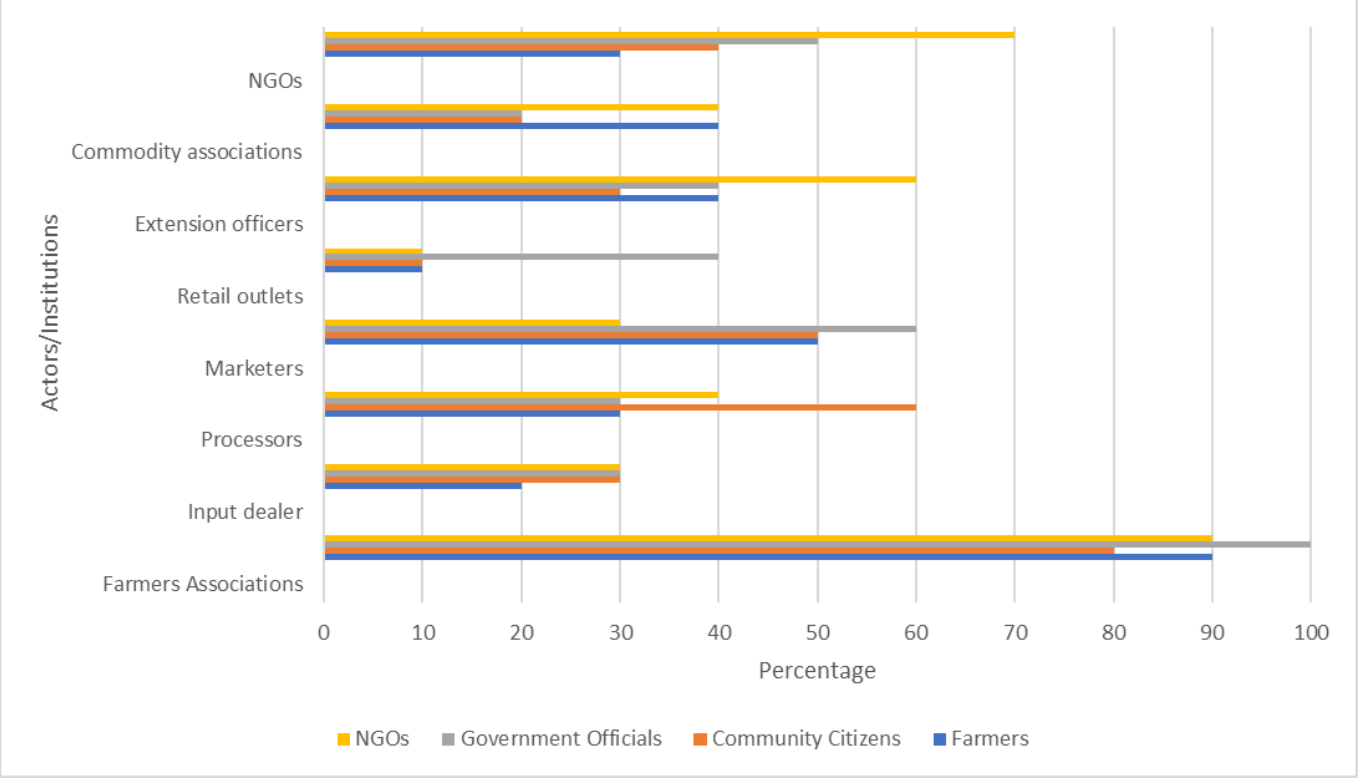

Figure 20. The main institutions and actors essential to the successful implementation of CSA in Ngaka Modiri Molema District Municipality

The participants were asked to choose several factors that will support the integration of CSA policies into current policies. Based on the finding (see Figure

21), amongst farmers, 50% believed that proper management of natural resources will enable this. Forty percent advocated for the integration of policies which will encourage initiatives that will limit the emission of gases with greenhouse effect, in addition to assisting producers and communities adopt mitigation and adaptation strategies for climate change into existing policies. Fifty percent believed that significant bodies of sectorial policies are essential towards creating a favourable environment that will foster CSA, 40% stated that financing CSA was essential towards the integration of CSA into the current policies, and 40% stated that increasing the participation of the private sector in CSA promotion for the adoption of practises in the field would also be essential.

Amongst the community members (Figure 21), 50% believed that the proper management of natural resources will support the integration of CSA policies into current policies. Forty percent advocated for the integration of policies which will encourage initiatives that will limit the emission of gases with greenhouse effect, in addition to assisting producers and communities adopt mitigation and adaptation strategies for climate change into existing policies. Fifty percent believed that significant bodies of sectorial policies are essential towards creating a favourable environment that will foster CSA. Thirty percent stated that financing CSA was essential towards the integration of CSA into the current polices, and 40% stated that increasing the participation of the private sector in CSA promotion for the adoption of practises in the field would also be essential.

The findings from the governmental officials shows that 80% believed that the proper management of natural resources will enable this. Fifty percent advocated for the integration of policies which will encourage initiatives that will limit the emission of gases with greenhouse effect, in addition to assisting producers and communities adopt mitigation and adaptation strategies for climate change into existing policies. Fifty percent believed that significant bodies of sectorial policies are essential towards creating a favourable environment that will foster CSA. Sixty percent stated that financing CSA was essential towards the integration of CSA into the current polices. Sixty percent stated that increasing the participation of the private sector in CSA promotion for the adoption of practises in the field would also be essential (see Figure 21).

Finally, the findings from the NGOs indicated (Figure 21) that 70% believed that the proper management of natural resources will enable this. Sixty percent advocated for the integration of policies which will encourage initiatives that will limit the emission of gases with greenhouse effect, in addition to assisting producers and communities adopt mitigation and adaptation strategies for climate change into existing policies. Forty percent believed that significant bodies of sectorial policies are essential towards creating a favourable environment that will foster CSA. Seventy percent stated that financing CSA was essential towards the integration of CSA into the current polices, and 60% stated that increasing the participation of the private sector in CSA promotion for the adoption of practises in the field would also be essential.

Based on observations, most of the participants believe that if the benefits of CSA are advertised, more people will be willing to adopt CSA techniques. One of the participants stated that if “there is proper natural resource management which will in turn lead to the reduction of the wastage of resources such as fertilizers and water, and in the process, money can be saved; this would support the integration of CSA policies into current policies.” Another respondent stated that “the reduction of the effects of changing climate on crops and livestock and boosting the capacity to cultivate food on the land as well as strengthening the health of the soil is an enticing benefit of CSA which would support the integration of CSA policies into current policies.”

Adhikari’s (2018) finding supports the result of this study by emphasising that to integrate CSA properly and carefully into the current policies would require encouraging context-driven, climate-smart methods and solutions. This will necessitate investing in innovative technologies, ecosystem-based strategies, and a supportive environment to improve as well as accelerate adoption of CSA. Furthermore, improving policy coordination and strengthening regional, local, and national organisations to aid the enactment of CSA is needed, and creative funding programmes to increase smallholders' access to both agriculture and climate finance will need to be developed.

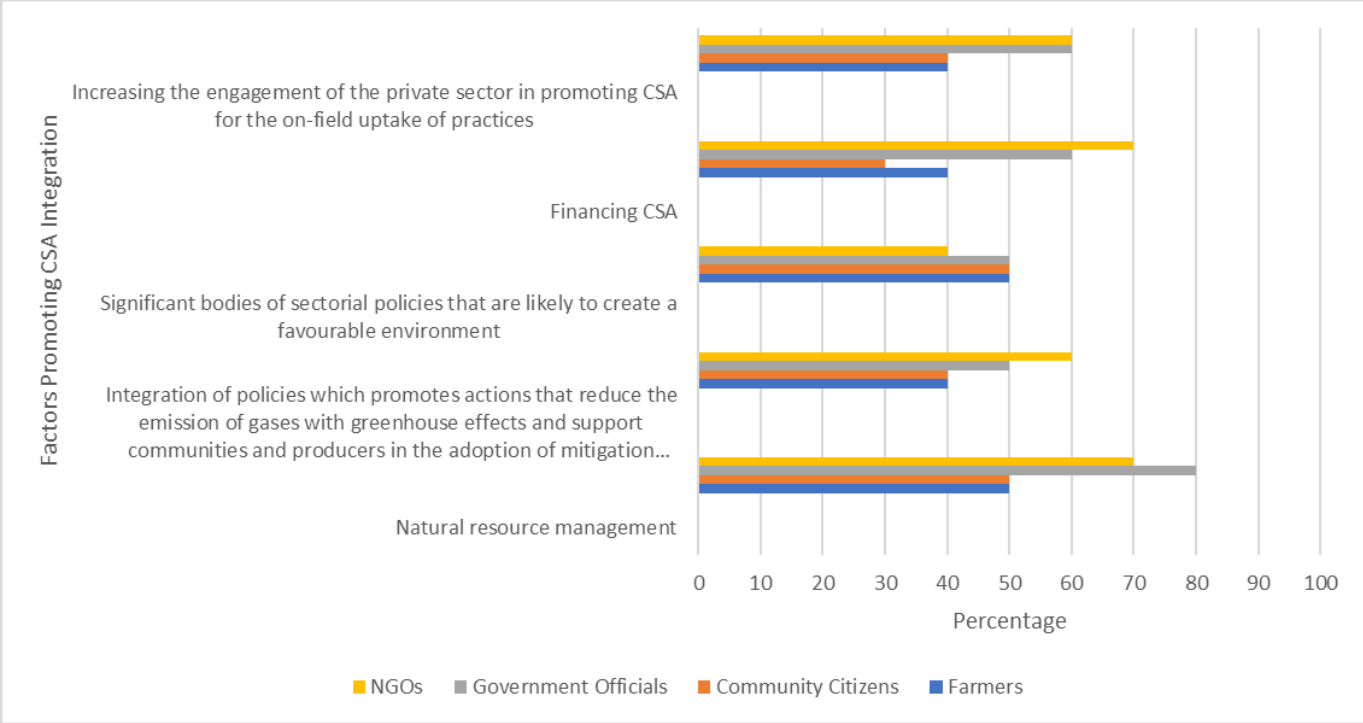

Figure 21. Factors that make it easier to integrate CSA policies into current policies

4.5 Conclusion

In summary, this chapter presented the findings of the study from 40 participants, consisting of 4 different groups that were purposively selected. Descriptive results from the participants were presented to get an understanding of the knowledge of the participants on CSA. Their socio-economic linkage was also explored to identify in what way they interrelate with their knowledge on CSA. The participants' level of education was compared to their knowledge of CSA. This was done so that the participants' knowledge of CSA could be compared to their educational qualification, and the number of years which they have spent working with agricultural-related activities. Results showed that while most of the participants have spent more than five years working in agricultural related activities, the number of participants who did not know what CSA was outweighed the number of people who did. The next chapter consists of the summary, conclusion, and the recommendations that should be taken into consideration in case this type of research were to be conducted again.

CHAPTER FIVE:
SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Introduction

This chapter summarises the study and also highlights the key findings of the study, the major conclusions drawn from the results, and provides recommendations in relation to the key findings to improve the knowledge, the utilization and the policy-relevant strategies and references that can facilitate CSA policy in the agricultural sector in the study area.

5.2 Summary

Agricultural production in NMMDM is not designed to withstand the effects of changing climate; this is further supported by the fact that most of the agricultural practices that are utilized in the area incentivise environmental deterioration, water stress, and climate change (Naude & Rivett-Carnac, 2018). Policies have been put in place to address these problems, yet the North West Province of South Africa lacks integrated strategic and comprehensive CSA planning, while having a robust national policy framework. Regarding food security, the development of and maintenance of decent jobs, and other factors, this is unsustainable (FANRPAN, 2017).

The aim of this study was to analysis CSA policies in NMMDM in the North West Province of South Africa. The objectives were to examine the existing institutions and legal frameworks for CSA nationally, provincially, and locally, assessing the policy problems affecting CSA in the agricultural sector of the North West Province, and proposing relevant strategies and references that can facilitate CSA policy in the agricultural sector in the study area. The study outcomes revealed that the educational level amongst the participants was above average, and that the participants were knowledgeable in their field of work (agricultural-related activities). Furthermore, it was discovered that most of the participants have spent more than four years in farming-related activities, which is also recognised as one of the drivers of the economy in NMMDM.

Although the study discovered that most of the participants were knowledgeable, the findings on their knowledge of climate change indicated otherwise; the knowledge of CSA amongst governmental organisation staff and farmers was very low. The amount of CSA training that took place in NMMDM is not sufficient, according to one of the participants, who stated that CSA training tends to take place four times in a year, which is very little. Those who participated in CSA training praised the training indicating that it has promoted their farming activities. With regard to the advantages of CSA, an average number of the participants knew about CSA benefits, but a large number of the governmental organisation participants had no knowledge regarding the benefits of CSA. The CSA's disadvantages were not well-known amongst all the group of participants.

The policy frameworks that are governing CSA were also not well-known by most of the participants of this study, not even the ones that have been implemented in NMMDM. Very few participants knew of the CSA policies implemented in NMMDM such as the guidelines to CSA marketing, agricultural insurance, the guidelines on organic soil fertility, the guidelines on CSA water management, the guidelines for holistic range livestock management, the guidelines for using improved cultivars, and the guidelines for selected in-field rainwater harvesting practices.

The participants were aware of the barriers influencing their knowledge of CSA. The various barriers encountered by the participants in CSA ranged from the inaccessibility of knowledge, lack of information on latest technologies about changing climate, the insufficient information on climate change initiatives, to the existence of a poor linkage between extension and meteorology institutions, and also the lack of changing climate subject matter specialists, the high personal cost in attaining proficiencies on CSA techniques, the lack of CSA training resources, and the inadequate organisational support in acquiring knowledge on CSA initiatives. The number of participants who were aware of farms utilising CSA was abysmally low; in addition, the CSA techniques that could be utilised by farmers were not all that known, except for the techniques that were more basic and common, such as mixed farming and crop rotation. Apart from the community citizens, the other groups of participants were not aware of the policy problems affecting CSA.

With regard to the first objective of this study, the findings discovered that the knowledge of most of the participants on the CSA policies being implemented in NMMDM was weak. The finding indicated that policies such as the guidelines to CSA marketing, agricultural insurance, guidelines on organic soil fertility, guidelines on CSA water management, guidelines for holistic range livestock management, guidelines for using improved cultivars, and guidelines for selected in-field rainwater harvesting practices have been implemented, but very few participants had knowledge of their existence. Furthermore, the only policy which was widely recognised amongst the participants was the agricultural insurance, followed by the guidelines for holistic range livestock management, and the guidelines for using improved cultivars (see Figure 13).

The findings of this study in relation to assessing the policy problem influencing CSA negatively in the study areas indicated that many of the participants noticed various policy problems that are influencing CSA, especially amongst the NGO participants and the community citizens. Some of the policy problems highlighted include institutional problems such as the lack of guidelines in policies, the issue of land rights such as women not having access to land as compared to males, and the lack of compensation for positive externalities; these include improved ecosystems for wildlife, soil carbon, and enhanced food security, in addition to the absence of incentives to adopt CSA methods (Figure 17).

With regard to the third objective, when the participants were asked to propose strategies that would facilitate CSA policy in the agricultural sector of NMMDM, most of them stated different factors. Some of these factors include investing in ecosystem-based approaches such as the preservation and restoration of wetlands, peatlands, forests, the protection of the oceans, better management of grasslands, and the utilization of ecologically-friendly agriculture methods due to the fact that these encourage fair and sustainable use while promoting conservation (Chong, 2014).

Others suggested the utilization of better technologies, to enable the environment and augment the uptake of CSA. Smallholders, government, and private sector entrepreneurs will have better access to capital in order to develop and implement

CSA. Innovative funding plans will unlock both agriculture as well as climate finance. The coordination of policies as well as the enhancement of local, national, and regional institutions will promote the enactment of CSA, in addition the awareness-building and profile-raising by highlighting CSA opportunities and success stories to smallholder farmers will be essential. Furthermore, the participants believed that when it comes to strengthening the coordination of CSA, it is essential to involve various institutions and actors (see Figure 20). The participants believed that actors such as the farmers' association, input dealers, processors, the marketers, retail outlets, extension officers, commodity associations, and NGOs, are essential institutions that can contribute to the implementation of CSA in NMMDM.

A number of policies already exist to combat climate change. The participants were of the opinion that proper management of natural resources was one of the benefits that would ensue, then raising awareness of this benefit would make it easier for the policies to be integrated. Other benefits that the participants stated would be to improve the chances of integrating CSA policies into current policies, which will encourage measures that will limit the emission of gases with greenhouse effects. It will also assist producers and communities in adopting mitigation as well as adaptation strategies for climate change into existing policies; others stated that financing CSA was essential towards the integration of CSA into the current polices, and in the process, increasing the participation of the private sector in CSA promotion for the in-field uptake of practices would also be essential.

5.3 Conclusion and Recommendations

This study explored the policy analysis of climate smart agriculture strategies in NMMDM and indicates that CSA is a technique that can be used to achieve sustainability and food security. Limitations in this study include participants providing one-word answers, and not being expressive. There was no language barrier in this study due to the fact that almost all the participants were sufficiently literate to comprehend the instrument for data collection. The most recognisable limitations that were faced in this study is that most of the participants had poor knowledge about CSA. This was more common among the participants from government departments and ministries. Although the knowledge of CSA in the study area is lacking, it is indicated that there are methods available that might be used to increase resilience and guarantee huge yields under the present circumstances. In order for the study's participants to increase their resilience and guarantee a more sustainable agriculture sector, appropriate CSA practices must be developed and put into effect.

In order to achieve this, funding must be set aside for sustainable development initiatives, and national policy must be institutionalized at the provincial and local levels more successfully. By doing this, the agricultural sector in the NMMDM can develop into a lucrative industry that helps ensure the viability of this area. It is necessary to perform a more thorough examination into the factors endangering the viability of crop production in communal agricultural regions of NMMDM. However, there still room for more research on CSA in this area, particularly with regard to the challenges facing knowledge-transfer-focused extension services. This study suggests that further research be done on an efficient educational programme for CSA knowledge transfer to farmers.

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APPENDICES

APPENDIX A: INTERVIEW GUIDE FOR FARMERS

My name is Oladele Olamide John, I am a master's student in the school of Geography, Archaeology and Environmental Studies at the University of the Witwatersrand, Johannesburg. I am conducting a research study on the Policy analysis of Climate Smart Agricultural strategies in South Africa. A case study of Ngaka Modiri Molema District Municipality (NNMDM) of North West Province, South Africa. This interview is aimed at obtaining more knowledge on CSA in NMMDM. I will be thankful for your participation, and your response will remain anonymous. Thank You.

Section A: Demographic Information

1. Gender: Male ( ); Female ( )
2. Marital Status: Single ( ); Married ( ); Divorced ( ); Widowed ( )
3. Educational Qualification: Primary School ( ) High School ( ) College ( ) B Degree ( ) B.Sc. ( ); MBA ( ); M.Sc. ( ); PhD. ( ); None ( )
4. Name of farm: _____
5. Years in farming: _____ years
6. Farm Size: _____

Section B: Information related to Climate-Smart Agriculture

7. Have you heard about Climate Smart Agriculture? Yes ( ); No ( )
8. If yes, can you please explain what you think climate-smart agriculture is?

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9. Have you ever participated in a Climate Smart Agricultural training, such as a workshop or seminar? Yes ( ); No ( )

10. If yes, what did the training consist of/what was it about?

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11. Was the knowledge and information gained from the training important and useful for your current farming activities? Yes ( ); No ( )

12. If yes, explain why

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13. To your knowledge what are some of the advantages and disadvantages of climate-smart agriculture?

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14. Do you know of any policy framework governing climate-smart agricultural practices? Yes ( ); No ( )

15. If so, what are these policies? Mention some of these policies

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16. Are these policies implemented? Yes ( ); No ( )

17. If no, can you state some of the barriers that exist towards the implementation of these policies

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18. Do you use Climate Smart Agriculture on your farm? Yes ( ); No ( )

19. Are you aware of some of the climate-smart agricultural techniques (e.g. water management initiatives) that are used to promote farming? Yes ( ); No ( )

20. If so, what are some of the techniques that you use on your farm?

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21. Can you explain in what way you utilize Climate Smart Agriculture on your farm?

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22. In your opinion, since you started using climate-smart agricultural practices has your farm become more successful as compared to when you were not using it? Yes ( ); No ( )

23. If yes, can you explain how your farm has become more successful?

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24. Are you aware of policy problems affecting the use of climate-smart agriculture on your farm? Yes ( ); No ( )

25. If yes, can you list some of the policy problems affecting climate-smart agriculture on your

farm.....

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Section C: Strategies that can promote Climate-Smart Agriculture in the NMMDM.

26. Can you list the main institutions and actors in the NMMDM that can promote climate-smart agriculture amongst farmers and are needed for the successful utilization of Climate Smart

Agriculture.....

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27. From your perspective as a farmer in what way do you think Climate Smart Agriculture can be better improved to become more effective and efficient to use on your farm as well as by other farmers?

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APPENDIX B: INTERVIEW GUIDE FOR COMMUNITY CITIZENS

My name is Oladele Olamide John, I am a master's student in the school of Geography, Archaeology and Environmental Studies at the University of the Witwatersrand, Johannesburg. I am conducting a research study on the Policy analysis of Climate Smart Agricultural strategies in South Africa. A case study of Ngaka Modiri Molema District Municipality (NNMDM) of North West Province, South Africa. This interview is aimed at obtaining more knowledge on CSA in NMMDM. I will be thankful for your participation, and your response will remain anonymous. Thank You.

Section A: Demographic Information

1. Gender: Male ( ); Female ( )
2. Marital Status: Single ( ); Married ( ); Divorced ( ); Widowed ( )
3. Educational Qualification: Primary School ( ) High School ( ) College ( ) B Degree ( ) B.Sc. ( ); MBA ( ); M.Sc. ( ); PhD. ( ); None ( )
4. Occupation: _____
5. Years in Organisation: _____ years

Section B: Information related to Climate Smart Agriculture

6. Have you heard about Climate Smart Agriculture? Yes ( ); No ( )
7. If yes, can you please explain what you think climate-smart agriculture is?
   .....
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   .....
8. To your knowledge what are the advantages as well as the disadvantages of Climate-Smart Agriculture?
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9. Do you know any policy framework governing climate-smart agricultural practices in NMMDM? Yes ( ); No ( )
10. If yes, what are these policies? Mention some of these policies

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11. Do you know of some of the barriers that exist towards the implementation of Climate Smart Agriculture?

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12. Have you ever seen/noticed climate-smart agricultural practices being used on any farm in NMMDM? Yes ( ); No ( )
13. If yes, can you name the farm and its location?

.....

14. Are you aware of some of the Climate Smart Agriculture techniques? Yes ( ); No ( )
15. If so, what are some of these techniques?

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16. Do you know of any policy problems affecting Climate-Smart Agriculture in NMMDM? Yes ( ); No ( )
17. If yes, can you list some of the policy problems affecting climate-smart agriculture in the NMMDM?

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18. **Section C: Strategies and references that can facilitate Climate Smart Agriculture in the NMMDM**
19. What factors are essential for the development of climate-smart agriculture in NMMDM?

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20. Can you list the main institutions and actors for the successful implementation of climate-smart agriculture in NMMDM?

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21. In your own opinion, what steps should be taken to facilitate and improve the Climate Smart Agriculture in the agricultural sector of NMMDM?

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APPENDIX C: INTERVIEW GUIDE FOR GOVERNMENTAL OFFICIALS

My name is Oladele Olamide John, I am a master's student in the school of Geography, Archaeology and Environmental Studies at the University of the Witwatersrand, Johannesburg. I am conducting a research study on the Policy analysis of Climate Smart Agricultural strategies in South Africa. A case study of Ngaka Modiri Molema District Municipality (NNMDM) of North West Province, South Africa. This interview is aimed at obtaining more knowledge on CSA in NMMDM. I will be thankful for your participation, and your response will remain anonymous. Thank You.

Section A: Demographic Information

1. Gender: Male ( ); Female ( )
2. Marital Status: Single ( ); Married ( ); Divorced ( ); Widowed ( )
3. Educational Qualification: B.Sc. ( ); M.Sc. ( ); PhD. ( ); None ( )
4. Organisation: _____
5. How many years have you spent in the organisation: _____ years
6. Position at work place: _____

Section B: Information related to Climate Smart Agriculture

1. Have you heard about Climate Smart Agriculture? Yes ( ); No ( )
2. If yes, can you please explain what you think Climate Smart Agriculture is?

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3. Have you ever participated in a Climate Smart Agricultural training? Yes ( ); No ( )

4. If yes, what did the training consist of/what was it about?

.....

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5. Was the knowledge and information gained from the training important and useful for your current farming-related activities? Yes ( ); No ( )

6. If yes, explain why

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.....

.....

7. To your knowledge can you state and explain some of the advantages and disadvantages of Climate-Smart Agriculture?

.....

.....

.....

8. Is there a policy framework governing climate-smart agricultural practices? Yes ( ); No ( )

9. If so, what are these policies? Mention some of these policies

.....

.....

.....

10. Are these policies implemented? Yes ( ); No ( )

11. If not, what barriers exist towards the implementation of these policies?

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12. Do you know of any farms where Climate Smart Agriculture is used? Yes ( ); No ( )

13. If yes, can you name the farm and its location?

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.....

.....

14. Can you explain how this farm has succeeded in applying climate-smart agriculture?

.....

.....

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15. Are you aware of some of the Climate Smart Agricultural techniques (e.g., water management initiatives) that are used to promote farming? Yes ( ); No ( )

16. If so, what are some of these techniques?

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17. Are you aware of policy problems affecting Climate Smart Agriculture in the NMMDM? Yes ( ); No ( )

18. If yes, can you list some of the policy problems affecting Climate Smart Agricultural Policy in the NMMDM, for example, no guidelines or lack of incentives?

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Section C: Strategies and references that can facilitate Climate Smart Agriculture in the NMMDM

19. What factors do you think are needed in the development of a Climate Smart Agriculture policy in the NMMDM?

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20. How can Climate Smart Agriculture policy be improved in the agricultural sector, of the NMMDM?

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21. Can you also list the main institutions and actors for the successful implementation of climate-smart agriculture in NMMDM?

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22. What factors do you think will support climate-smart agriculture through harmonised policy? Do you think the financing of climate-smart agriculture, the proper management of natural resources, and significant bodies of sectorial (agriculture, environment, and forestry) policies that are likely to create a favourable environment are some of this factors? Yes ( ); No ( )

23. If yes, can you give a reason to support your answer?

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APPENDIX D: INTERVIEW GUIDE FOR NGOs

My name is Oladele Olamide John, I am a master's student in the school of Geography, Archaeology and Environmental Studies at the University of the Witwatersrand, Johannesburg. I am conducting a research study on the Policy analysis of Climate Smart Agricultural strategies in South Africa. A case study of Ngaka Modiri Molema District Municipality (NNMDM) of North West Province, South Africa. This interview is aimed at obtaining more knowledge on CSA in NMMDM. I will be thankful for your participation, and your response will remain anonymous. Thank You.

Section A: Demographic Information

1. Gender: Male ( ); Female ( )
2. Marital Status: Single ( ); Married ( ); Divorced ( ); Widowed ( )
3. Educational Qualification: B.Sc. ( ); M.Sc. ( ); PhD. ( ); None ( )
4. Organisation: _____
5. How many years have you spent in the organisation: _____ years?
6. Position at work place: _____

Section B: Information related to Climate Smart Agriculture

7. Have you heard about Climate Smart Agriculture? Yes ( ); No ( )
8. If yes, can you please explain what you think Climate Smart Agriculture is?

.....

.....

.....

9. Have you ever participated in a Climate Smart Agricultural training? Yes ( ); No ( )

10. If yes, what did the training consist of/what was it about?

.....

.....

.....

11. Was the knowledge and information gained from the training important and useful for your current farming activities? Yes ( ); No ( )

12. If yes, explain why

.....

.....

.....

13. To your knowledge can you state and explain some of the advantages and disadvantages of Climate Smart Agriculture?

.....

.....

.....

14. Is there a policy framework governing climate-smart agricultural practices? Yes ( ); No ( )

15. If so, what are these policies? Mention some of these policies

.....

.....

.....

16. Are these policies implemented? Yes ( ); No ( )

17. If no, what barriers exist towards the implementation of these policies?

.....

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.....

18. Do you know of any farms where Climate Smart Agriculture is used? Yes ( ); No ( )

19. If yes, can you name the farm and its location?

.....

.....

.....

20. Can you explain how this farm has succeeded in applying climate-smart agriculture?

.....

.....

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21. Are you aware of some of the Climate Smart Agricultural techniques (e.g., water management initiatives) that are used to promote farming? Yes ( ); No ( )

22. If so, what are some of these techniques?

.....

.....

.....

23. Are you aware of policy problems affecting Climate Smart Agriculture in the NMMDM? Yes ( ); No ( )

24. If yes, can you list some of the policy problems affecting Climate Smart Agricultural Policy in the
NMMDM,.....

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Section C: Strategies and references that can facilitate Climate Smart Agriculture in the NMMDM

25. What factors do you think are needed in the development of a Climate Smart Agriculture policy in the NMMDM?

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26. How can Climate Smart Agriculture policy be improved in the agricultural sector, in the NMMDM?

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27. Can you also list the main institutions and actors for the successful implementation of climate-smart agriculture in NMMDM?

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.....

28. What factors do you think will support climate-smart agriculture through harmonised policy? Do you think the financing of climate-smart agriculture, the proper management of natural resources, and significant bodies of sectorial (agriculture, environment, and forestry) policies that are likely to create a favourable environment are some of this factors? Yes ( ); No ( )

29. If yes, can you give a reason to support your answer?

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APPENDIX E: ETHICS COMMITTEE CLEARANCE

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Oladele

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H22/07/33**
PROJECT TITLE	Policy analysis of Climate Smart Agricultural strategies in South Africa. A case study of Ngaka Modiri Molema District Municipality of North West Province, South Africa
INVESTIGATOR(S)	Mr O Oladele
SCHOOL/DEPARTMENT	Geography, Archaeology and Environmental Studies/
DATE CONSIDERED	22 July 2022
DECISION OF THE COMMITTEE	Approved Risk Level: Minimal
EXPIRY DATE	09 August 2025
DATE 19 August 2022	**CHAIRPERSON** (Professor J Watermeyer)

cc: Supervisor : Dr N Kubanza

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to submit an amendment of the protocol to the Committee. **I agree to completion of a regular progress report. For Minimal and Low studies, this is due annually on 31 December. For Medium and High Risk studies, this is due twice annually on 30 June and 31 December.**

Signature

22, Aug, 2022
Date

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

APPENDIX F: EDITORS CERTIFICATE

House 367

Hex River Lifestyle Estate

Waterkloof East Ext 12

Rustenburg 0299

15/09/2022

This is to certify that the dissertation entitled

POLICY ANALYSIS OF CLIMATE SMART AGRICULTURAL STRATEGIES IN SOUTH AFRICA. A CASE STUDY OF NGAI<A MODIRI MOLEMA DISTRICT

MUNICIPALITY OF NORTH WEST PROVINCE, SOUTH AFRICA

Submitted by OLAMIDE JOHN OLADELE 2488789

For the degree of MASTER OF SCIENCE

(Geography, Archaeology, and Environmental Studies)

At the UNIVERSITY OF THE WITWATERSRAND

Has been edited for language by

Mary Helen Thomas (B.Sc. Hons. PGCE)

Email: thomashelen212@gmail.com

Cell: 072 242 9066

I have been a language editor for students and staff at the North-West University, Mafikeng Campus since 2006, and have also edited for clients at other universities. I have edited over 100 Master's dissertations, 50 doctoral theses, and 60 articles and book chapters. I am willing to supply references of professors and lecturers at NWU who are regular clients.

APPENDIX G: PERMISSION LETTER FOR FIELD RESEARCH

agriculture & rural development
Department:
Agriculture and Rural Development
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

2030 NDP

AgriCentre Building
Cnr. Dr. James Moroka and
Stadium Rd
Private Bag X2039, Mmabatho 2735

OFFICE OF HEAD OF THE DEPARTMENT

Tel: +27 (18) 389 5953
Fax: +27(18) 392 4377
E-mail:tmokhatla@nwpg.gov.za

OLADELE OJ
1 JAN SMUTS AVE
BRAAMFOTEIN
JOHANNESBURG
2000

Dear Sir/Madam

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH STUDY

The North West Provincial Department of Agriculture and Rural Development wishes to inform you that your request to conduct research towards fulfilment of your research study has been granted with the following conditions:

1. The information gathered must be used solely for purpose of the research topic **"Policy analysis of a Climate Smart Agricultural strategies in South Africa"** only in order to protect unauthorised sharing of Departmental information in line with POPIA Act no 4 of 2013.
2. You must make the necessary appointment with the respective managers that are required to support you during your research to ensure that DARD officials are not disrupted in performing their duties.
3. Your conduct during the duration of your research at DARD must be of a professional nature at all times.
4. The Department must be provided with a copy of your final research report.

I wish to inform you that the Department of Agriculture and Rural Development will not bear any financial and legal liabilities that may arise from your research study. I further wish to bring to your attention that research ethics must be considered and adhered to in this regard.
Given the nature of your research subject, you must contact the **Director: Veterinary Services/Chief Director-Agricultural Development Services, Ms B. Pule at** Bothoboile@nwpg.gov.za **/ 018 389 5698** to facilitate your assistance that you require during your research.

Hope you find this in order.

MR THUPI MOKHATLA
HEAD OF DEPARTMENT
DATE: 17/08/2022.

APPENDIX H: CONSENT FORM

Title of project: Policy analysis of Climate Smart Agricultural strategies in South Africa. A case study of Ngaka Modiri Molema District Municipality of North West Province, South Africa

Name of researcher: Oladele Olamide John

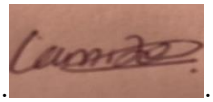
I, ……., agree to participate in this research project.

I agree to the following:

(Please circle the relevant options below)

The research study was explained to me. I understand what this study is about.	YES	NO
I understand that I can volunteer to take part in the study	YES	NO
I agree that I may be audio recorded	YES	NO
I agree that direct quotations from my interview may be used by the researcher in their research report	YES	NO
I agree that my participation will remain anonymous (my name will not be used by the researcher in their research report)	YES	NO
I agree that other researchers may use the information I provide in my interview (depending on their own ethics clearance being obtained) but my name and any personal information will not be used or passed on	YES	NO

…… (signature)
…… (name of participant)
…… (date)

……  …… (signature)
…Oladele Olamide John…… (name of researcher/person seeking consent)
……13-June-2022…… (date)

APPENDIX I: PARTICIPANT INFORMATION SHEET

Dear Sir/Madam

My name is Oladele Olamide john, I am a master's student in the school of Geography, Archaeology and Environmental Studies at the University of the Witwatersrand, Johannesburg. My supervisor is Dr Nzalalemba Serge Kubanza. I am conducting a research study about Climate Smart Agriculture policy analysis. The study title is Policy analysis of Climate Smart Agricultural strategies in South Africa. A case study of Ngaka Modiri Molema District Municipality of North West Province, South Africa.

I am inviting you to take part in an interview. If you decide to take part, your participation in this research study will last about 15 minutes. The interview will take place in person during working hours, and will be conducted in English.

With your permission, I would like to audio record the interview. This data will be stored in a locked computer for three years and will be deleted after only three years have elapsed. Only the researcher will have access to the data.

During the research activity, I will need to ask for some personal information about you, including your name, age, and job.

The interview will be confidential and anonymous. When I share the results of the research study, I will not include your name or anything else that could identify you. With your permission, other researchers may use the data collected from this research study, but your name and any personal information will not be used or passed on.

If you decide to take part in the research study, it should be because you want to volunteer. You do not have to take part. You can stop being in the study at any time. You do not have to answer any questions if you do not want to. You will not get any direct benefits if you choose to join the research study. You will not lose any services, benefits or rights you would normally have if you decide not to join. Taking part in the research study will not cost you anything. You will not be paid for being in this research study. Your travel/data costs to attend the interview will be reimbursed to a maximum of R150.

The risks for this research study are no more than what happens in everyday life.

This research study will be written up as a research report. The report will be available on the university library website. If you would like to receive a summary of this report, I will be happy to send it to you.

If you have any questions during or afterwards about this research study, feel free to contact me or my supervisor on the details listed below. If you have any concerns or complaints about the ethical

procedures of this research study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za.

Yours sincerely,

Oladele Olamide John

Researcher: Oladele Olamide John, 2488789@students.wits.ac.za, 0740265794

Supervisor: Dr Nzalalemba Serge Kubanza, serge.kubanza@wits.ac.za, 0117176515