USING CLIMATE CHANGE INTERVENTIONS ADOPTED BY INDIGENOUS MAIZE FARMERS AS A STRATEGY FOR DEVELOPING PRIMARY SCHOOL AGRICULTURE TEACHERS' COMPETENCES FOR DISASTER RISK REDUCTION PREPAREDNESS IN ESWATINI

by

DAVID DAMBUZA DLAMINI

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SUPERVISOR: PROFESSOR S. SHAVA

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DECLARATION

Name: David Dambuza Dlamini

Student number: 34836799

Degree: MASTER OF EDUCATION IN ENVIRONMENTAL EDUCATION

Title: Using climate change interventions adopted by indigenous maize farmers as a strategy for developing primary school agriculture teachers' competences for disaster risk reduction preparedness in Eswatini.

I declare that the above dissertation is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I submitted the dissertation to originality checking software and that it falls within the accepted requirements for originality.

I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.

25/04/2022

_____ _____

SIGNATURE DATE

DEDICATION

I dedicate this thesis to:

Prof. S. Shava. This document could not have been completed without his support and guidance to get to completion.

My wife Nomsa Dlamini, who was a source of encouragement and motivation during the study.

To my kids, Nolwazi and Hlengwa who supported and gave me space to engage whole-heartedly in this thesis and throughout the learning experience.

I salute them all.

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ABSTRACT

This study investigated the role of local indigenous agricultural practices prevalent among Eswatini indigenous farmers in the Wet and Dry Middle-veld selected areas in disaster risk reduction preparedness for maize production. The study also explored the implications of integrating indigenous agricultural practices into the grade 6 and 7 primary school curriculum in Eswatini

The study was qualitative in nature. Local farmers from four communities, two from Vusweni and Zombodze and the other two from Nhlambeni and Ngculwini areas in chiefdoms located in the Middle-veld participated in the study. In addition, individual qualified primary school's agriculture teachers for grade 6 and 7, four (4) teachers located in the Dry Middle-veld primary schools and another four (4) in the Wet Middle-veld primary schools, participated in this study to provide an educational perspective into the research. Data was collected through administration of interviews, observations and artefacts (museum pictures). The participants were permanent residents in the Wet Middle Veld and the Dry Middle Veld. The individual face-to face interview sample consisted of four individual informants from each of the selected communities. In addition, four focus group discussions were also conducted in the same communities with five participants in each group for in-depth understanding of the studied phenomena. Thirty-two (32) participants were involved in the study in total. The transcribed individual interviews and focus group discussions were analysed through textual analysis approach.

The findings of the study revealed that indigenous farmers used climate change adaptation interventions for Disaster Risk Reduction (DRR) preparedness. The indigenous agricultural practices adopted for DRR practices included household coping mechanisms such as soil moisture conservation, improvement of the soil nutrient status for enhanced food security by adding animal manure, intercropping, crop rotation, water harvesting, early planting, planting of legume crops, and fallowing. In addition, the observation and prediction of rain by interpreting the behaviour of plants and animals facilitated the operation of the indigenous farmers planting calendar.

The above applied indigenous agricultural practices were still visible in the Middle-veld farming rural areas of Eswatini. The participating individual primary school's agriculture teachers pointed out that agriculture teachers used some aspects of the indigenous agricultural practices to teach the primary school modern agriculture curriculum. Subsistence farming

should remain a viable alternative to commercial farming for food security in Eswatini no matter how small their contribution was to average national annual agricultural production as it supported local indigenous farmers' livelihoods.

KEY TERMS:

Climate change; Disaster risk reduction; Indigenous farmers; Local maize variety; Indigenous agricultural practices; Climate change preparedness; Eswatini Nation Land; Primary school's agriculture curriculum; Food security; Traditional food crops; Indigenous knowledge systems.

ACRONYMS

CEDU	College of Education
DRR	Disaster Risk Reduction
DFID	Department for International Development
ESNAU	Eswatini National Agricultural Union
FPRI	Food Security International, Food Policy, Research Institution
IAK	Indigenous Agricultural Knowledge
IK	Indigenous Knowledge
IPCC	Intergovernmental Panel on Climate Change
IAP	Indigenous Agricultural Practices
MEPD	Ministry of Economic Planning and Development
NDS	National Development Strategy
NDMA	National Disaster Management Agency
PELUM	Participatory Ecological Land Use Management
RVAA	Regional Vulnerability Assessment Analysis
SADC	Southern Africa Development Community
ENL	Eswatini Nation Land
TDL	Title Deed Land
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISA	University of South Africa
UNISDR	United Nations for Sustainable Disaster Reduction

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CHAPTER 1

INTRODUCTION

1.1 RESEARCH BACKGROUND AND CONTEXT

The African continent has for centuries been occupied by indigenous African societies and is characterized by indigenous cropping practices (Babu, Rajasekaran and Warren, 1991). Koohifikan and ltiera (2017) confirm the above assertion by stating that traditional cropping provides as much as 20% of the world's food supply. Smallholder's farms are responsible for the majority of agricultural production worldwide, providing up to 80% of food in Southern Africa and sub- Saharan Africa. Koohifikan and ltiera (2017) noted that traditional agriculture in other global arenas is often less well known and in need of support**.** Shackleton, Shackleton and Cousins (2000), further suggest that the operation of the subsistence sector (land and natural resources within these multiple-use communal systems) plays a significant role in the livelihoods and the household economies of rural dwellers.

The Department for International Development (DFID) (2009), Eicher (2009), and Haggblade and Hazell (2009) also present that African science, which comprises indigenous knowledge and associated traditional practices, has not been investigated and properly documented as a discipline in natural science. Seemingly, little or none of the success that indigenous knowledge and related skills that transform our rural communities get emphasized in Western indoctrinated school curriculum documents**.** In some countries, modernity has dominated the subsistence agriculture sector. Indigenous agricultural practices have usually been cited in scientific research studies with the intention to undermine the indigenous knowledge in existence.

According to Shilliam (2010), modernity is defined as a condition of a social existence that is radically different to all past forms of human experience. Noticeable forms of human experiences with new agricultural practices include adoption of new technology such as use of genetically modified maize seeds, use of hybrid planting materials, application of commercial fertilizers, pesticides and herbicides to name a few.

The Eswatini Market Assessment Report by the Ministry of Agriculture (2016) argues that Eswatini is a predominantly rural society, with most of the population dependent on agriculture

for their livelihood. It further states that the country has a dual land tenure system consisting of 1) Eswatini Nation Land (ENL) consisting around 60% of the total land area that is held in trust by the King who allocates land to households through traditional chiefs on his behalf and 2) Title Deed Land (TDL) which is a free land that is mostly owned by companies as well as some private individuals. Eswatini indigenous maize farmers acquired land for production through following and exhausting traditional procedures as dictated by the Eswatini Traditional Law.

In the SADC region, Eswatini is distinct for its continued protection of traditions and norms anchored on traditional structures. The Eswatini population census (2013) estimated the population at 1.01 million**.** Emaswati people aged 65 years and above comprise only 3.7% of the total population. About 25% of the population live in Urban or semi urban areas in the country due to rural to urban migration. The Eswatini economic profile (2018) indicates that the youth unemployment rate is currently at 26%. According to Mdluli (2017), over 66,480 elderly people in Eswatini benefitted from grants that were disbursed to senior citizens in the 2016/2017 financial year. The elderly population is one of the highly vulnerable groups to poverty and is still proactive in subsistence farming. Furthermore, in Eswatini, indigenous agricultural practices applied in maize production are common among some indigenous farmers .

Dlamini and Manana (2014:12) as well as Manyatsi, Masarirambi, Hachigonta, Sibanda and Thomas (2012) concur that maize is the staple food crop of Eswatini and is often used as an index of food availability in the country. Notable in Eswatini, the National Development Strategy Policy 2022 (1999) emphasises the importance of food security at household and community level, and the need for commercialization of agriculture on Swazi Nation Land to eradicate extreme poverty and hunger, with maize playing a central role as the staple food. This formulated policy imposes the commercialization of the subsistence sector in the rural areas.

According to Thompson (2017), Eswatini Nation Land (SNL) farmers are encouraged to perform on a commercial basis because agriculture is the major source of employment for the rural households. Seventy percent (70%) of the population is dependent on agriculture for their income. According to Corteva Agriscience Seed Company (2019), African women on average make up 40 percent of the agricultural labour force. In developing countries, most women's work is devoted to agriculture (Food Agriculture Organization, 2020). The participation of women agriculture practitioners improves the socio -economic status of the African women.

The mothers who mostly stay with their children is able to meet their needs due to the household financial stability. These women position has a positive implication on productivity as well as teaching and learning of the trade. According to Dlamini and Manana (2014) there are approximately 56000 homesteads in Eswatini on Eswatini Nation Land, with about ten people living in each homestead. The children would acquire the transferable skills from their mother and contribute to the labour-force on family households. That means they learn how to farm in the context of practice: apprenticeship of observation and practice.

Besides maize as a staple food crop on Eswatini Nation Land, other field crops include sweet potatoes, sorghum, groundnuts, jugo beans, pumpkins and cowpeas (Thompson, 2017; Dlamini & Manana, 2014). Some of these field crops compliment maize in an intercropping system as well as serve as a cover crop or are used for nitrogen nutrient-fixation. Government investment in the subsistence sector is necessary to mitigate the impacts of poverty and hunger during drought crises.

Panin and Hlope (2013) undertook a study to determine the extent to which subsistence agriculture plays a crucial role in food security in Eswatini. The study concluded that subsistence agriculture was capable of ensuring food security to only 37% of the sampled households the study generalized on. Therefore, the food insecurity challenge due to climate change could be addressed when both the subsistence and the commercial sector's farming technologies are given equal attention.

Some African governments tend to impose policies on indigenous farmers with little or no farmer participation on what changes to make on indigenous farming technology. The suppression of indigenous agricultural practices in maize production is clearly understood with the case of Zimbabwe. According to Page and Page (1991), Zimbabwean communal farmers were now less food secure than they were two generations ago. The root cause of this decline was the historic forced replacement of their sustainable indigenous farming practices due to a policy shift toward agricultural commercialisation that is dependent on hybrid seed varieties and inorganic fertilisers. Commercialization practices require highly priced inputs (Page & Page, 1991).

Apparently, there is no political will by some African governments to invest in indigenous agricultural knowledge for food security. In fact, the application of indigenous agricultural practices is the main source of food security and independence for indigenous farmers for the

purposes of self-sufficiency in maize production. Westernization appears not to promote the sense of self-dependency and, in short, results in self-denial (Mamo, 1999). Arguably, some agricultural policies deliberately marginalize indigenous farmers on the decision to replace and exclude the indigenous farming practices.

The study intends to investigate the indigenous climate change interventions employed by Eswatini maize farmers and explore their possible application in developing primary school teacher's competencies for disaster risk reduction preparedness.

1.2 PRELIMINARY LITERATURE REVIEW

In Africa, a disparity of opinion still exists between indigenous and western scientists on the preservation of indigenous agricultural practices used in the production of maize as a staple food. These opinions are skewed towards modern agriculture due to the influence of the Western education system. Western scientists profess the commercialization approach in food production as the best solution towards food security. However, despite the prevalence of commercialized agriculture, there is still a surging global demand for relief food programmes worldwide. This westernised orientation in farming has criminalized indigenous agricultural practices in the rural areas, thereby suppressing traditional agricultural practices in maize production (Page & Page, 1991).

In Africa, a decline in food security is due to marginalization of indigenous agricultural practices such as those employed in maize production. This negative attitude is an impediment to an effective and inclusive strategy towards disaster risk reduction, prevention and preparedness in our continent. According to the European Commission on Humanitarian Aid and Protection (2013), disaster preparedness refers to the knowledge and capacities developed by governments, professional response and recovery organizations, community and individuals to effectively anticipate and respond to impacts of likely, imminent or current hazardous events or conditions. A bottom-up approach could instil ownership of such initiatives to the beneficiaries through enabling active participation.

According to the SADC Regional Vulnerability Assessment and Analysis Report (2019), food insecurity is a challenge for thirteen of the 16 SADC member states. The report concurred with Koohifikan et al.'s findings (2017) that smallholder farmers are responsible for the majority of

production worldwide, providing up to 80% of food in Southern Africa and sub- Saharan Africa. On the status of maize as a staple food, Rijkenberg (2019) revealed that in Eswatini the average annual consumption of maize currently stands at around 130 000 metric tonnes, while the annual average production is 100 000 metric tonnes. This means that Eswatini has a deficit of 30,000 metric tonnes annually, which is met by maize imports (Rijkenberg, 2019). The country has remained insufficient in maize production for the past 20 years (Dlamini, 2019).

According to Rijkenberg (2019), consumption of white maize by Emaswati is common amongst the population practising subsistence farming. Indigenous farmers have for centuries sustained food security by using indigenous agricultural practices as climate change interventions for maize production in Eswatini. The use of indigenous methods in maize production presents a legacy of previous successes of indigenous agricultural practices for climate change intervention which could be incorporated into curriculum review in the primary school education system.

According to Thompson (2017), seventy percent (70%) of the Emaswati population is dependent on agriculture for their livelihood in a predominately rural society. The contribution of the subsistence agriculture sector should not be neglected as an option towards stable food security in the country. African governments and indigenous practitioners should preserve indigenous agricultural practices, by investing in traditional maize production for the alleviation of hunger and poverty.

1.3 RESEARCH PROBLEM

Subsistence farmers mainly produce enough food to meet their family needs (Owen, 1985; Dlamini et al., 2014), have a low level of education and sometimes practice conservatism (Ngugi, Karau & Nguyo, 1990). Farming operations in the subsistence sector have no succession plan for long-term production purposes, but rely on faith in indigenous agricultural practices. The use of indigenous practices such as traditional weather prediction by observing moon phases and the application of animal kraal manure as fertiliser are common raditional agricultural practices. Eswatini's National Development Strategy 2022 (1999) emphasises the

importance of food security at household and community level and the commercialization of agriculture on Eswatini Nation Land.

Currently, policy makers in Eswatini tend to be biased towards Western agriculture over indigenous farming practices because of the dominance of Western Education system in schools. The application of indigenous knowledge and its dynamics can be best handled and explained by the traditional practitioners with the competent experience.

Indigenous knowledge practitioners such as community elders have in-depth information on the production of maize in areas with changing rainfall patterns. The problem is the suppression and criminalizing of indigenous knowledge possessed by indigenous farmers through imposed government policies. The question on the applied techniques and how indigenous maize farmers respond to climate vulnerability using indigenous agricultural knowledge will be explored.

The purpose of the study is to prepare emerging Emaswati maize farmers in the rural areas to climate change effects by adopting some indigenous farming practices for sustainable food security. Tertiary educational institutions could facilitate the adoption process by incorporating such traditional systems during their curriculum development processes.

1.3.1 The Research Aims and Objectives

The study seeks to:

i. Document some of the indigenous knowledge and survival skills on maize growing related to Disaster Risk Reduction and awareness for incorporation into the curriculum for developing the competencies of teachers in training to respond to the needs of the community with respect to climate change.
ii. Determine the indigenous climate change adaptation measures employed by indigenous maize farmers in their farming operations for sustainable food security in the Rural Development Areas.
iii. Identify the climate change interventions adopted by Swazi maize indigenous farmers that can be used for the development of teachers' competencies for disaster risk reduction preparedness in Eswatini.
iv. Inform the development of disaster preparedness plans to mitigate the impact of severe weather conditions on maize at the cobbing and seeding stage in the rural areas for crop resilience in Eswatini through the incorporation of indigenous farming practice.

v. Advise on indigenous agricultural knowledge and practices that can be integrated into the primary school's curriculum for climate change disaster risk reduction.

1.3.1.1 Research Questions

1.3.1.1.1 The Main Research Question

i. What are the indigenous climate change interventions employed by Emaswati maize farmers towards disaster risk reduction preparedness for sustainable food security in the rural areas?

1.3.1.1.2 The Sub-questions

i. What are the local indigenous agricultural practices related to maize production that indigenous Swazi farmers are conversant with?
ii. How do indigenous farmers implement these indigenous agricultural practices during maize growing?
iii. What are the indigenous climate change preparedness strategies maize farmers possess for disaster risk reduction in relation to maize farming in the Dry and Wet Middle-veld rural areas?
iv. What are the current climate change interventions adopted by Swazi maize indigenous farmers that can be employed for development of teachers' competencies for disaster risk reduction preparedness in Eswatini?
v. What are the possibilities and implications of integrating indigenous agricultural practice into the grade 6 and 7 primary school modern agriculture curriculum in Eswatini for disaster risk preparedness?

1.3.2 RATIONALE

Indigenous knowledge on sustainable farming practices and skills should be integrated into the school curriculum to enable collaboration between indigenous and modern scientists in order to interrogate the hegemony on western scientific knowledge and provide an enabling environment that could advance the availability of information to learners on indigenous science and its application to maize farming.

The agricultural discipline still requires in-depth scientific investigation by tertiary and higher educational institutions into the real aspects of traditional farming on local maize varieties, climate change and indigenous practices for greater impact on food security. The information possessed by the indigenous old farmers on indigenous practices in farming could be documented for the purpose of restoration of good community lifestyles and quality of life. This working and operationalized indigenous knowledge and skills in the society should be identified and documented.

1.3.3 MOTIVATION FOR THE RESEARCH

Climate change effects, particularly drought and high temperatures, are a global environmental crisis that severely limits crop growth conditions and productivity worldwide, often causing extensive economic losses to agriculture. As global climate change progresses, agricultural production worldwide faces a series of threats from frequent extreme weather events (Chen, Xu, Velten, Xin and Stout, 2012). Indigenous knowledge on maize farming is a community centred experience that embraces sustainable indigenous practices and skills that can be used in responding to climate change effects. However, this knowledge is given little attention in formal agriculture education processes and needs to be rediscovered and applied as a possible solution to climate change effects.

1.3.4 THE RESEARCH PARADIGM OVERVIEW

According to Creswell (2013:18), a paradigm is a basic set of beliefs or philosophy that guides action. It is essentially a worldview or frame of belief (Creswell, 1994). Creswell (2013) also added that these philosophical assumptions have been articulated by and Lincoln (1994, 2000, 2005, 2011) and as the ‘axiomatic’ issues advanced by Guba and Lincoln (1988) as guiding the philosophy behind qualitative research. These beliefs have been called paradigms (Denzin, Lynham, & Guba, 1994, 2000, 2005, 2011; Mertens, 2010) philosophical assumptions, epistemologies and ontology (Crotty, 1998), broadly conceived research methodologies (Neuman, 2000) and alternative knowledge claims (Creswell, 2009). They are beliefs about ontology, epistemology, axiology, and methodology.

Creswell (2013:20) narrates that the ontological issues relate to the nature of reality and its characteristics. In qualitative studies, researchers embrace the idea of multiple realities, as do the individuals being studied and the readers of qualitative research. Interpretivists emphasize the multiple socially constructed realities (McMillan et al., 2014:4). Evidence of multiple realities includes the use of multiple themes, using the actual words of different individuals and presenting different perspectives. Creswell (2013:21) also points out that epistemology relates to what counts as knowledge and how knowledge claims are justified. In epistemological assumptions, the researchers as get close as possible to the participants being studied. Subjective evidence is assembled based on individuals' views in the field site for contextualization of the information. Knowledge is known through the subjective experience of people.

This research is a qualitative study. Creswell (2013) reiterates that all researchers bring values (such as religious beliefs) to a study, but qualitative researchers make their values known in the study. Moreover, this is the axiological assumption that characterizes qualitative research. In a qualitative research study, the inquirers admit the value laden nature of the study and actively report the values and biasness as well as the value laden nature of information gathered from the field. They 'position themselves' in the study. Creswell (2013:20) adds that the procedures of qualitative research or its methodology are characterized as inductive, emergent, and shaped by the researchers' experience in collecting and analysing the data. During data analysis, the researcher follows a path of analysing the data to develop an increasingly detailed knowledge of the topic area to be studied (Creswell, 2013).

The research study will adopt a qualitative research paradigm due to the subjectivity of the topic area, targeting the perspectives of individual participants who experience the same phenomena in the field, engaging in the interactive process for capturing new emerging issues and to bring value to the study for inflexibility in the research outcomes.

1.3.4.1 Phenomenology Theory

Creswell (2013:77) observed that different arguments on phenomenological philosophy rest on some common grounds, namely: the study of lived experiences of a person, the view that these experiences are conscious ones (Van Manen, 1990), and the development of descriptions of the essences of these experiences for all the individuals (Moustakas, 1994). In this research the

lived experiences that subsistence farmers possess in the application of indigenous agricultural practices in response to climate change effects over time, particularly drought, are shared. All of the participants who experienced the same phenomena (Polkinghorne, 1989) give different meaning to the particular event concerned. Henning, Van Rensburg and Smit (2013) observe that interpretivists construct knowledge by observing the phenomena and also by recording descriptions of people‘s intentions, beliefs, values and reasons, meaning and making self-understanding.

1.3.4.2 Phenomenological multiple case study design

According to McMillan and Schumacher (2014: 6), a research design refers to the plan that describes the conditions and procedures for collection and analysing data to answer the research questions. This study seeks to explore information on the lived experiences of Eswatini subsistence farmers on the application of indigenous agricultural knowledge practices for growing maize in drought prone conditions. Community elders who are senior citizens above 65 years (both males and females) were chosen to participate as key informants of this field research. Grade 6 and 7 primary school agriculture teachers from schools in the selected study areas also participated in the research.

The participants (indigenous farmers and agriculture teachers) were purposively selected from the four-targeted chiefdoms located in the Dry and the Wet middle-veld of Eswatini. For the purpose of the study, the researcher adopted a qualitative research approach. The researcher identified the qualitative paradigm because it provides in-depth or deeper description of the participant narratives for enrichment. A phenomenological multiple case study design was relevant for the study.

The phenomenological approach involved each of the different chiefdoms as a case study site on lived experiences for data collection. According to Yin (2003: 4) a researcher chooses a multiple case study to analyse the data within each situation and also across different situations. The use of multiples sources of data enables the researcher to cover a broad range of issues and to develop converging line of inquiry by the process of triangulation. Therefore, more evidence is collected of a specific phenomenon.

Participants reflected their lived experiences, opinions and feelings on the same climate change interventions adopted for disaster risk reduction preparedness in maize production. Qualitative

research refers to in-depth study using face to face or observation techniques to collect data from people in their natural settings (McMillan et al., 2014). Transcribed interviews were analysed during data analysis. The findings were coded and presented in themes in the conclusion.

1.3.5 RESEARCH METHODS

Creswell (2013:44) observes that qualitative researchers use an emerging qualitative enquiry, collecting data in a natural setting sensitive to the people and places under study, and data analysis that is both inductive and deductive and establish patterns or themes. McMillan et al. (2014: 6) refers to research methods as the procedures used to collect and analyse data. For this research the data collection techniques included semi-structured interviews with individual participants, four focus group discussions forums with five members each, observation and document analysis. An interview guide was administered by the researcher in person in face to face interactions with key participants. A field observation schedule and journal notebook information was used for complimenting the collected data during textual analysis.

1.3.5.1 Conceptual Framework

A conceptual framework is a descriptive tool, which explains the main things to be studied, the mains issues, constructs or variables and the supposed association among them (Bell, 2005).

Woodley (2004) presents a model from a traditional system where knowledge is acquired within the local context as a conceptual framework for representing Indigenous Education Knowledge (IEK). The model hinges on three subsystems, namely: 1) context 2) practice and 3) belief that is embraced within the ecosystem or traditional structure. The model highlights the social dynamism and bounds within each social traditional organizational structure concerning creation and implementation of indigenous practices by subsistence farmers in rural areas. This bound explains reasons for traditionalists to resist new technology. The five original technology adopters categories espoused by Rogers (2001) profiled innovators at 2.5%, early adopters (13.5%), early majority (34%) and then outlined traditionalists in the late majority (34%) and the laggards (16%) group by their slow rate of adoption of policy over time. Rogers described traditionalists as sceptical while they prefer to maintain the status quo.

Shava and Nkopodi (2013: 243) point out key aspects that characterize and define indigenous knowledge.

> *These are people, context (place and time) culture, language and practices and dynamism. The people are the knowers who are the creators of indigenous knowledge and give discourse and meaning based and relating to their experiences in interaction with their environment (known) over time. The gap between what is known, and the knower determines the accuracy and the richness of the information from the primary source for any research investigation.*
>
> *The knowledge that indigenous people generate is embedded in their culture and embodied in their practices. This knowledge is transmitted from generation to generation orally (through narratives, stories etc.), visually (through arts, writings, paintings etc.) and practically through doing. Language is the main medium for transmission of indigenous knowledge and changing language results in a lot of modification, accommodations and loss of language or distortion during transmission.*

African governments must protect and preserve all the original forms of indigenous knowledge in archives or as heritage sites as they would any intellectual property in a modern society platform. This conceptual framework for representing Indigenous Education Knowledge (IEK) model was adopted from Woodley (2004) for representing indigenous agricultural knowledge for this research as shown in figure 1.

Model from a traditional system where knowledge is acquired within the local.

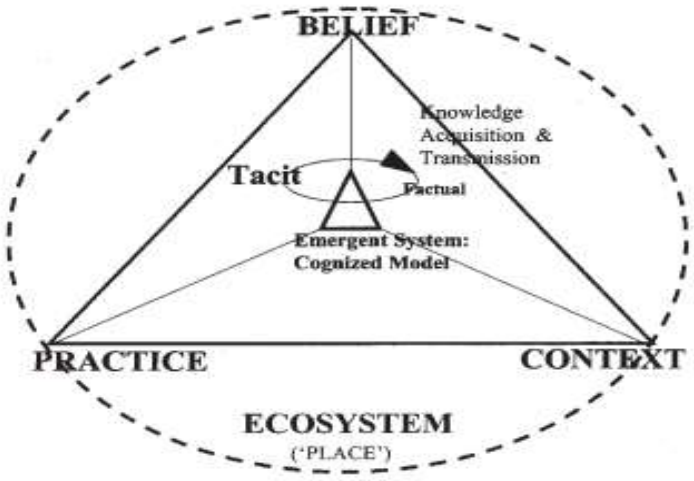

Figure 1: Conceptual Framework for representing Indigenous Education Knowledge (IEK)

The application of climate change interventions adopted by maize indigenous farmers on Swazi Nation Land (SNL) for Disaster Risk Reduction preparedness are dependent on Indigenous Agricultural Knowledge (IAK), which is anchored in community traditional structures. The IAK embraces indigenous practices (e.g. use of local maize varieties), beliefs (spiritual guidance and admonishing by ancestors) and institutions which communicate to the subsistence farmer's activities, the traditional cropping and farming systems in conformity with traditional laws. The system, enshrined in indigenous belief, is key to traditional climate change intervention practices characterized by oral tradition. Both factual (explicit) knowledge and tacit (implicit) knowledge constitute the mental model (Woodley, 2004). The indigenous farmers acquired and transmitted indigenous agricultural knowledge from generation to generation through interaction.

Government policies imposed on subsistence farmers such as adoption of genetically modified seed technology may contaminate the traditional maize varieties and impact on dietary diversity, the food and nutritional security (PELUM Eswatini, 2018). African governments do not have the political will power to regulate extraction (mutilation) of commercial traits in the indigenous seed genes. The climate change treaties ratified by the Eswatini Government lack participation of indigenous maize farmers for ownership and recognition of indigenous knowledge (traditional maize crops and indigenous practices) for food security. Unaware, African governments contribute towards suppressing IAK practices and transform indigenous maize farmers into a dependency syndrome (depending on seed and agrochemical companies), a leeway to food insecurity. According to the World Health Organization report (2016), children and adult groups fall into the vulnerable category of our society.

The successes of indigenous farmers in maize production activities during drought conditions for survival, led to the development of climate adaptive strategies. Farmers have the indigenous knowledge perspective for predicting rainfall by observing the moon phases and studying animal 'birds' or plants behaviour to foretell early rains expectations for early planting preparations.

1.3.5.2 Ethical considerations

Lipson (1994) groups ethical issues into informed consent procedures, deception or covert activities, confidentiality towards participation, sponsors and colleagues, benefits of research to participants over risks and participants' requests that go beyond social norms. This study explored information from lived experiences of indigenous farmers on the application of indigenous agricultural knowledge practices for growing maize in drought prone conditions. Participants directly involved were the elderly who are regarded as a vulnerable research group.

Research standards require adherence to the research ethics and this requirement is emphasized by the University of South Africa (UNISA) policy on Research Ethics as reinforced by UNISA Ethical Clearance committee (UNISA Research Policy, 2018). The researcher was issued with a UNISA College of Education (CEDU) Research Ethics Clearance Certificate for data collection. Once the interview plan had been finalized the process of ethical clarification can begin. The aspects for ethical consideration included prior informed consent to participate, guaranteed anonymity, and privacy protection. Participants need to give informed consent first to participate in a research study (Henning, Van Rensburg & Smit, 2013).

The researcher informed the participants about the importance and the benefits of the study. The participants were assured of confidentiality, provided background research information before prior informed consent of participants was sought. To remove biasness from individual interviews, the researcher engaged in focus group discussions for triangulation purposes. He also allowed examination of findings by the participants to establish trustworthiness and then adopted the triangulation procedure for confirmation of the findings.

The participation of the key informants was voluntary and consensual. The researcher is a community member raised in traditional structures of authority that dictate that the elderly bestow blessings, and are thus honoured and obeyed. On site, the gap between the researcher and the participants was closed by voiding the researcher's hierarchical position as a barrier in order to establish a parallel level for open communication in the participant's language. This removed the natural personal suspicion community members had with unknown people before the actual interaction regardless of the earlier introduction.

1.3.6 DEFINITION OF KEY TERMS

1.3.6.1 Agricultural drought:

Agricultural drought is defined as existing when the soil moisture in the root zone is at, or below the permanent wilting percentage .The condition continues until rain falls in excess of the daily evapotranspiration (Rickard, 2012). A deficit of rainfall over cropped areas during critical periods of the growth cycle can result in destroyed or underdeveloped crops with greatly depleted yields. Agricultural drought is typically evident after metrological drought but before hydrological.

1.3.6.2 Indigenous knowledge

Indigenous knowledge (IK) refers to the understanding, skills and philosophies developed by societies with long histories of interaction with their natural surroundings. For rural and indigenous people, local knowledge informs decision-making about fundamental aspects of day-to-day living. This knowledge is integral to a cultural complex that also encompasses language, systems of classification, resource use practices, social interactions, rituals and spirituality (UNESCO, 2017). Therefore, indigenous knowledge, is a body of knowledge that should be nurtured and preserved for a breakthrough in indigenous sciences.

1.3.6.3 Climate change

Climate change refers to any change of climate over time whether due to natural climate variability or as a result of human activity (IPCC, 2007). Community elders and traditionalists possess wealth of indigenous knowledge of maize production for managing the impact of drought due to climate change.

1.3.6.4 Maize

Maize (*Zea mays*), ummbila (siSwati), is an introduced exotic annual food crop with its origin in Mexico and South America, produced by rural dwellers in areas receiving evenly distributed annual rainfall. Maize is the most important staple food in Africa and is consumed cooked in various traditional methods. The maize crop has a potential to adapt to areas with favourable even annual rainfall distribution.

1.3.6.5 Indigenous crops

Indigenous crops refer to crops of African origin such as sorghum, pearl millet and finger millet. The cereal crops are ground and processed into starchy cereal foods or cooked (Owen, 1985) and their consumption depends on the taste and preference. The production of indigenous crops is authorized by community elders and indigenous practitiners as landowners as dictated by traditional laws

1.3.6.6 Traditional crops

Traditional crops refer to crops that have been grown by indigenous people over a long time but are of exotic origin, such as maize. The maize crop responds positively to indigenous and cultural practices that manage the soil, build the soil structure and promote long-term soil water conservation as intervention factors for the plant to strive well.

1.3.6.7 Indigenous practices

Indigenous practices involves all the traditional agricultural activities that include nurturing the environment in which the indigenous crops (sorghum, pearl millet, and finger millet) and traditional crops (maize) grow until attainment of the harvesting stage. Indigenous practices include cultural practices such as growing drought and pest resistant crops, early planting, use of animal manure, crop rotation and weed control (Owen, 1985). Currently, farming is skewed towards commercialization due to the dominance of Western agricultural practices. Aspects of indigenous practices are selectively appropriated by modern sciences, as traditionalists tends to communicate them orally, and are lost as intellectual property due to the government's discriminating policies.

1.3.6.8 Local maize seed varieties

Local maize seed varieties refer to planting (seeding) materials developed and grown by local indigenous people. There is lack of political will in African government structures to support and preserve local maize seed materials. Seed multiplication companies tend to undermine and mutilate (appropriate) the commercial indigenous traits in indigenous seed materials during seed breeding for commercial purposes.

1.3.6.9 Traditional farming systems

Traditional farming systems refers to the ordered combination of crops grown, husbandry and cultural practices followed such as intercropping and/or mixed cropping. According to Challinor, Wheeler, Gerforth, Graufurd and Kassam (2007), there is evidence that farmers and farming systems can respond creatively and adaptively to environmental change. Indigenous agricultural practices modify the growth environment for the maize crops to strive well. The traditional farming system is environmentally friendly.

1.3 6.10 Traditional cropping practices

Traditional cropping practices refers to planting patterns that can mitigate the effects of variable rainfall due to climate change. It includes planting mixtures of crops and using crop varieties more resistant to climate stress. Traditional cropping practices involve aspects that have always been part of indigenous farming practices.

1.4 CHAPTER SUMMARY

In this chapter, the researcher provided a contextualized research background and the preliminary literature review on the topic area. The research problem, research questions which arose from the problem, aims and objectives, rationale, motivation of the study and key concepts were covered. The proposed research design, which responded to the research questions, was presented and an overview of the research paradigm which focused on the phenomenological theory that informed the study was discussed together with the conceptual framework. The chapter also covered the research methods and ethical considerations of the study. The next chapter is the literature review of the study.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In many developing African countries where educational programs are characterised by the adoption of Western education systems, small scale farmers (indigenous knowledge practitioners) are often portrayed as backward, obstinately conservative, resistant to change ,lacking innovative ability, and even lazy (International Federation of Agricultural Producers 1990,p 24) . This indicates that indigenous farmers are marginalised as obstruction to community agricultural development. For example, in Eswatini subsistence farmers are encouraged 'to transform into commercialization' according to Thompson (2017). Therefore, Eswatini Nation Land (SNL) farmers are persuaded to perform on a commercial basis.

This chapter presents a theoretical framework and related review of literature on coping mechanisms and adaptation strategies indigenous maize farmers' use against the impact of climate change globally, as disaster risk reduction management practices. Furthermore, the chapter will present the education organizational structure of the Grade 6 and 7 primary school's modern agriculture curriculum. The chapter will also highlight the indigenous weather forecasting practices by the observation of the moon cycle and the behaviour of natural entities (plants and animals) to predict rainfall. The primary schools modern agriculture syllabus should provide a foundation for learning for the primary school learners at an early stage in Eswatini.

2.1.1 The primary school's modern agriculture curriculum in Eswatini.

2.1.1.1 The perspective on Grade 6 and 7 primary schools' modern agriculture curriculum

The teaching of agriculture in Eswatini schools, called modern agriculture, is for both boys and girls (Ministry of Education and Training, 2009). Concerning the Eswatini primary school education level, the primary school curriculum is composed of the following subjects: English, Mathematics, Science, Religious Education, SiSwati, French, Home Economics, Practical Arts and Physical Education. According to the Ministry of Education and Training (2009) the

Eswatini primary school modern agriculture syllabus by its design seek to achieve its objectives by integration with other subjects. Primary Education in Eswatini begins at the age of six and it is from grade I to grade 7 (Ministry of Education and Training, 2021). Therefore, the primary school level in Eswatini consists of 7 years. The seven years of elementary education end with the Swaziland Primary Certificate.

The Swaziland Primary Certificate (SPC) syllabus is designed as a two – year course (grade 6 and 7) for examination in Grade 7. Agriculture as a subject, plays an important role in shaping attitudes and developing knowledge and skills that contribute to the development of the agriculture industry. The approach to handling the subject in the schools allows learners to develop and engage in practical activities while following principles and using the environment sustainably (The examination Council of Eswatini, 2020 – 2022). Hence, the agriculture subject area is considered as an integrated subject taught with science and health materials as basic assumptions (Ministry of Education and Training, 2009) However, the primary school agriculture curriculum lacks coverage of indigenous agricultural practices that indigenous farmers use for food security and climate change resilience .

2.2 OVERVIEW OF CLIMATE IN ESWATINI

Strahler (2013) describes climate as generalized statements of the prevailing weather conditions at a given place based on statistical records over a long period of time. However, the weather readings are prone to manipulation by scientists, hence they must be collaborated with records from other meteorological weather stations of international standards.

According to Magagula and Dlamini (2014) the mean temperatures in the four regions of Eswatini are different due to the varying height of the geographical relief above the sea level. The Highveld has the lowest temperature and the Lowveld has the highest temperature readings. Farmers can do little to control temperatures but are able to choose planting dates that suit their region. Moreover, farmers also choose seed varieties that tolerate local temperatures. Crops that do well between 18-27^{o}C include, sorghum and cotton that can tolerate high temperatures and are suitable for the lowveld areas. Magagula et al. (2014) reiterates that in Eswatini rainfall is one of the aspects of climate that is a limiting factor in crop production. It is often very heavy and much of it runs overland and is wasted.

Table 1: The regional average annual temperatures and rainfall distribution in Eswatini

REGION	AVERAGE TEMPERATURE (in degrees Celsius)	AVERAGE RAINFALL RECORDED mm/year
HIGHVELD	17	1270
MIDDLEVELD	19	940
LOWVELD	22	660
LUBOMBO	19	787

Source: Ministry of Education and Training (2014)

2.3 CLIMATE CHANGE EFFECTS IN ESWATINI.

According to the Eswatini Climate Change Policy (2016) climate change is already affecting Eswatini and the key sectors of her economy. Some of the climate change impacts being experienced include significant variations in precipitation patterns, higher temperatures and increase in frequency and intensity of severe weather events such as droughts, floods and cyclones. In fact, the recurrence of natural disaster means that the Eswatini government requires financial budget allocation for prevention and intervention measures for disaster risk reduction management practices.

The Climate Change Policy (2016) further reveals that these changes negatively impact on agricultural yields, biodiversity, forests harvests and availability of clean water. Bearing the brunt of all these climate change effects are the majority of the rural poor who depend on climate sensitive sectors such agriculture, forestry, traditional fishing for much of their day to day needs. The policy document highlights that the agriculture sector is a critical mainstay of local livelihoods and contributes approximately 9.5% of the country's Gross Domestic Product (GDP). Moreover, the Climate Change Policy (2016) predicts that yields for staple food,

especially maize, will fall sharply with 1-2-degree centigrade changes in temperature and more erratic rainfall.

2.3.1 Disaster Risk Reduction (DRR)

According to the World Bank (2015) disaster risk reduction (DRR) aims at reducing to the damage caused by natural hazards like earthquakes, drought and cyclones through an ethic of prevention. Moreover, disaster often follows natural hazards. Consequently, natural hazards threaten livelihoods and human lives. Choices on DRR and prevention relate to how we grow our food, where and how we build our homes, what kind of government we have, how our financial systems work and even what to teach in schools (World Bank, 2015). Each decision action either makes us more vulnerable to disaster or more resilient (World Bank, 2015). Disaster management agencies should educate indigenous farming communities about disaster risk reduction practices to save human life drawing on local knowledge and practices. Capacity building may enhance planned rescue missions.

The United Nations World View (2018) points out that DRR is a concept and practice of reducing risks through systematic efforts to analyse and reduce the causal factors of disasters. Examples of DRR include reducing exposure to hazards, lessening vulnerability of people and property, improving preparedness and early warning for adverse events, and wise management of land and the environment (United Nations World View, 2018). Consequently, all continents are vulnerable to some form of natural hazards that require effective interventions in place for saving human lives. Therefore, preparedness plans require capital investment in infrastructural development projects for resilience to natural hazards for sustainable development in the future. Indigenous farmers have been using furrow irrigation for gardening and other crops.

2.3.2 Disaster Risk Reduction Framework

The Disaster Risk Reduction (DRR) framework aims to contribute to adaptive and disaster resilient economies that can support inclusive and sustainable development in the face of disaster and the ‘new normal’. The Framework seeks to address impacts of climate change related disasters and focuses on agriculture, forestry, development resilience food security, ecological integrity and technology and others (UNIDRR, 2018).

2.3.2.1 The four pillars of disaster risk reduction (DRR)

According to the UNDRR (2018), the Disaster Risk Reduction framework consists of four interoperable and mutually reinforcing pillars, namely: i) Prevention and Mitigation, ii) Preparedness, iii) Response, and iv) Rehabilitation and Build Back Better. The pillars correspond to the four elements for ensuring achievement of the overall aim to have adaptive and disaster-resilient economies. Noticeably, the pillars of DRR are community based. The four pillars are discussed below.

i. Prevention and Mitigation

This pillar focuses on prompt visitation for identification and assessment of the hazards. Proactive structural and non-structural measures need to be identified, evaluated, prioritized, funded and undertaken to mitigate the impact of disaster. The stakeholders for the National Disaster Management Agency (NDMA) conduct a needs assessment of the existing hazards to identify the impact for reporting and prioritizing assistance on most affected victims to prevent loss of life. Indigenous farmers should seek to incorporate climate change interventions that prevent them from the impact of natural disasters in maize production with good planning.

ii. Preparedness

This pillar pertains to a series of multi-sectorial and multi-level measures that help ensure and enhance the state of readiness of economic systems and communities. The pillar focuses on establishing and strengthening the capacity of community to anticipate, cope and recover from the negative impacts of disaster. Through regional cooperation we can strengthen early warning mechanisms for transboundary hazard. Preparedness involves utilizing advanced communication and comprehensive disaster management systems. In fact, the community dwellers should be prepared and guided on action to take to save their lives before the emergency team arrives. Indigenous farmers time their planting and intercrop with cover crops to conserve soil moisture for their indigenous maize crops to strive during drought for preparedness.

iii. Response

Response as a pillar focusses on engaging stakeholders of the affected economies in operational interventions immediately after the disaster. It involves identification, assessment of the impacts to the economy and marketplace following the disaster and the implementation of the response programme. The programme includes procurement

of relief goods and services for addressing immediate needs. Some indigenous farmers have coping and adaptive strategies to respond following the disaster for survival.

iv. Rehabilitation and Build Back Better.

The rehabilitation and build back better pillar aim to enable disaster-affected communities to rehabilitate and build back better by ensuring minimal disruption in their livelihood and other economic activities. It entails a shift from simple recovery and restoration towards a safer, more adaptive, resilient and inclusive community. This is where the responsive business continuity plan becomes most important. Immediate access to financing will empower communities and enable them to recover and build back better within a short duration. In cases where farming materials are distributed in favourable conditions, indigenous farmer are able to start afresh with farming activities to rebuild their lives.

2.4 AGRICULTURAL FARMING METHODS.

According to Chipungalelo (2015) research findings on indigenous knowledge sharing strategies for supporting food security in Tanzania, made some revelations on indigenous communication styles. The respondents indicated that farmers used a socialization approach to share indigenous knowledge. Therefore, indigenous farmers share information through interaction.

Du Plessis (2002) and Ellen and Harris (2002) argue that, in the light of increasing temperature, more severe drought and short rainfall seasons for food crops, it has been found that indigenous knowledge is increasingly used by local communities to adapt to harsh conditions. Therefore, the indigenous knowledge practices are also visible in traditional farming, including maize production.

2.4.1 Indigenous knowledge Systems: Concepts

UNESCO (2017) pointed out that indigenous knowledge is a cultural complex that also encompasses language, systems of classification, resource use practices, social interactions, rituals and spirituality. These unique ways of knowing are important facets of the world's

cultural diversity. Therefore, the African society should revive the traditional structures that expose community members to indigenous knowledge at an early stage to instil appreciation of African identity and enhanced self-esteem.

Fisher (1989: p14) perceives the term 'indigenous' as 'systems that are generated by internal initiative with a local community itself'. He further says that the term 'indigenous' should be used in preference to traditional because the term 'traditional' implies continuity whereas indigenous refers to new development. Warren (1987) debates that indigenous knowledge is local knowledge that is unique to a given culture or society. Practically, internalization of indigenous knowledge practices comes with imparted skills and knowledge at an early age as it is community driven.

McClure (1989:13) points out that indigenous knowledge systems are learned ways of looking at the world. They have evolved from years of experience in problem solving by groups of people working to meet the challenges they face in their local environments. Seemingly, indigenous knowledge concepts define the active role that traditional structures in our African society play in mentorship of young men and women in their early stages as they perform their defined community tasks.

Anandaraja, Rathakrishnan, Ramasubramanium, Scravanan and Suganth (2008) highlight that indigenous knowledge (IK) is a systemic body of knowledge acquired by local people through accumulation of experiences, informal experiments and intimate understanding of the environment in a given culture. Consequently, indigenous knowledge is acquired through engagement of traditional practices for guidance, especially during community and national traditional services.

Altieri (1995) concurs with Anandaraja et al. (2008) that indigenous knowledge systems are a body of knowledge, or bodies of knowledge of the indigenous people of particular geographical areas in which they have survived on for a very long time. They are forms of knowledge that have failed to die despite the racial and colonial suppression at the hands of Western imperialism and arrogance. IKS are forms of knowledge that have originated locally and naturally. Therefore, indigenous system manifest themselves through different dimensions, among which are agriculture, medicine, security, botany, zoology, craft skills and linguistics (Mapara, 2009).

McClure (1989, 13) presents the definition of IKS as the sum of experience and knowledge of a given ethnic group that forms the basis for decision making in the face of the familiar and unfamiliar problems and challenges. McClure (1989, p.1) expounds that indigenous knowledge systems permeate all that we do and think and believe. Some indigenous knowledge is fact as the Western scientist knows and defines fact. Some of it is belief as philosophers and theologists define belief and a lot of it is folk wisdom.

Similar to McClure's (1989, p.13), Senanayake (2006) mentions that indigenous knowledge is unique knowledge confined to a particular culture or society. It is also known as local knowledge, folk knowledge, people's knowledge, traditional wisdom or traditional science. This knowledge is generated and transmitted through communities over time, in an effort to cope with their own agro-ecological and socio-economic environment. Warren (1990) reiterates that IK is the information base for the society which facilitates communication and decision making. IK is the actual knowledge of a farming population which reflects their experiences based on traditions as well as recent experiences with modern technologies. The method entails many kinds of insights, wisdom, perceptions, and practices related to people's resources and environments. Therefore, it is not static.

2.4.2 The value of Indigenous Knowledge

Warren (1990, p.16) observes that IK is dynamic, changing through indigenous mechanisms of creativity and innovations as well as through contact with other local and international knowledge systems. Pretty and Brook (1991) acknowledge that today, because of its oral tradition as well as the introduction of new technologies, the preservation of IK is at risk. IKS are tuned to the needs of local people and the quality and quantity of available resource efficiency lies in the capacity to adapt to the changing circumstance.

In appraisal, Warren (1987a) points out that IKS often are elaborate, and they are adapted to local cultural and environmental conditions. Thurston (1992) argues that IKS reflecting agriculture are often broad, detailed, and comprehensive, although this is not always the perceptions among agricultural scientists and development workers. In fact, it has often been overlooked by Western scientific research and development (Warren, 1990b). Salas and Tillman (1989) pronounce that any development program should respect and reinforce

indigenous knowledge by emphasizing and restoring local knowledge. Hence, development agencies should consider the traditional lifestyle of the community beneficiaries in their rural development agenda for the sustainability of rural projects.

According to Norgaard (1984, p.7), traditional knowledge has been viewed as the major obstacle to development, as a necessary starting point, and as a critical component of a cultural alternative to modernization. Only very rarely, however, is traditional knowledge treated as knowledge per se in mainstream agriculture and environmental management literature that contributes to our understanding of agricultural production and the maintenance and use of environmental systems (Norgaard, 1984). Development agencies and western scientists tend to assume that people with traditional knowledge, do not know what they need because of their traditional lifestyle. The traditional lifestyle suggests that the people are native or indigenous in that environment as long time standing locals. These local people possess indigenous knowledge concerning exploitation of the available natural resources such as land use. In farming application of indigenous agricultural practices makes use of land wisely for sustainable food security.

Salas et al. (1989, p.18) state that peasant societies have developed their own logic in the use of nature, partly based on a wealth of local experimentation. By recording these systems, the agricultural extensionists can understand better the basis for decision making within a given society. In support of subsistence farmers, Farrington and Martin (1987) admit that IK may not be always as abstract as scientific knowledge; but is still often concrete and relies strongly on intuition, historical experiences and directly perceived evidence.

The salient features of IKS according to Thrupp (1989, p.139-140) are as follows:

> *IKSs are adaptive skills of local farmers derived from many years of experience and often accumulated through 'oral traditions' and learned through family members over generations. Such knowledge is not a static body of wisdom, but usually consists of dynamic insights and techniques which are changed over time through experimentation and adaptations to environmental and sociological changes.*
>
> *IKS are not possessed by only one sector of the society. In many cultures, women and elders have impressive sight into certain aspects of culture. Sometimes, researchers have not been unaware of such perspectives among rural people due partly to their*

biased focus on land owning male farmers, neglecting other members of society. Indigenous knowledge is embraced by both female and male elders of the society.

2.4.3 Consequences of Disregarding Indigenous Knowledge Systems

Richards (1995) and Warren (1990) warn that undermining farmers' confidence in their traditional knowledge can lead farmers to become increasingly dependent on outside expertise. Atteh (1989, p.12) states that indigenous knowledge systems of local people are usually considered as 'unproductive and primitive'. Small farmers are often portrayed as backwards, obstinately conservative, resistant to change, lacking innovative ability, and even lazy (IFAP, 1990, p 24). The International Federation of Agricultural Producers (IFAP, 1990): elucidated certain reasons for such a perception, namely:

- Lack of understanding of traditional agriculture due to a communication gap that exists between its promoters and practitioners giving rise to myths.
- The accomplishment of farmers is not recognized because they are not recorded in writing or made known; and
- Poor involvement of farmers and their organizations in integrating, consolidating and disseminating what is already known.

Loss and non-utilization of IK (which) results in the inefficient allocation of resources and manpower to inappropriate planning strategies which have done little to alleviate rural poverty. With little contact with rural people, planning experts and state functionaries have attempted to implement programs which do not meet the goals of rural people or affect the structures and processes that perpetuate rural poverty (Atteh, 1989). Human natural resources in the rural areas have remained inefficiently used or not used at all. There is little congruence between planning objectives and the realities facing the rural people. Planners think they know what is good for these 'poor', 'backward' ignorant and 'primitive' people. According to Warren (1990), indigenous knowledge system has often been overlooked by western scientific research and development.

2.4.3.1 Indigenous knowledge on food production.

According to Fernandez and Salvaterra (1989), small scale farmers have access to a systematic and historic body of knowledge which may influence their food production practices. In dissatisfaction, Woodley (2004) points out that foreign missions and new forms of national governance that encouraged plantation development and formal education changed the local

economy, prohibited indigenous customs and changed methods of gardening of indigenous communities. There was also more time spent on modern church related activities than on indigenous cultural practices. At the same time the productivity of traditional staple food crops was increasingly undermined by the disuse of traditional practices, which all resulted in the increase of diseases and pests. There was a changing value system from traditional foods to preference by younger generations for introduced crops as well as imported foods (Woodley 2004). Consequently, commercialization of the subsistence agriculture sector is not the only solution to food security.

2.4.3.2 Soil Taxonomies in Africa

Arwyn (2009) reveals that indigenous knowledge of soils was regarded by the western scientific community as a simplistic collection of human experiences and primary attitude towards understanding natural resources. Ethnopedology studies in Africa revealed that indigenous soil classification is based primarily on the soil's productive capacity (Arwyn, 2009). Consequently, indigenous knowledge provides basis for science research advancement on classification of soils with respect to climate change and maize plant ecological requirement details for indigenous farmers.

Moreover, Arwyn (2009) points out that the main factors controlling soil taxonomy fall into two groups. The first aspect includes environmental factors such as landforms (topography), vegetation and fauna. The vegetation can also be used to differentiate soil classifications to original vegetative cover (e.g. forest soils, savannah soils). Plant species can also be used as soil fertility or infertility indicators. Apparently, the observable natural features in the environment are exploited by indigenous farmers and captured for the application of indigenous knowledge in soil classification practices.

The second aspect used in soil classification comprises topsoil morphological properties such as colour, depth texture, and density, stoniness, and water movement. Some derived secondary factors include land slope, soil workability, stickiness and hardness. Examples include the soil colour which reflects soil fertility level. Dark soils are considered more fertile than other colours (e.g. red, white, etc.). The soil texture gives information about the workability and soil water retention capability. 'Bissiga' in Moore language (Burkina Faso) or 'umhlaba lonesihlabatsi' in Siswati means sandy soil and is usually used for millet and vegetable crops.

‘Bore’ in Moore language or ‘umhlaba lonelibumba’ in Siswati ‘denotes clay soils’, which are suitable for sorghum for sorghum and other crops that need more moisture (Arwyn, 2009). In indigenous knowledge practice, indigenous farmers use practical hands-on activities for soil classification before planting.

Arwyn (2009) elaborates that, in terms of soil management, soils with course texture are easier to work with the hoe. They have a high infiltration rate but a low water holding capacity. The landform is used to locate soils in the topographic position in the landscape and to estimate the level of erosion risks based on the slope. In Moore language, the upper part of the slope is called ‘zegedga’ or ‘lugadvule’ in Siswati language, which denotes where the risk of erosion is high. In the Yemba language (Dschang, West Cameroon), soils of well drained plains, called ‘tsa’a pepeuo’ or ‘umhlaba longaselusentseni lwemfula’ in Siswati are considered to be very fertile and used for intensive agriculture. Poorly drained soils of inland valleys, called ‘tsa’a ngui,’ in the Yemba language or ‘umhlaba loseteteni’ in Siswati, are only used for off season crop production or for grazing (Arwyn, 2009). Indigenous knowledge skills and knowledge also focus on the physical and chemical properties of the soil for classification purposes.

Warren (1992) conducted an analysis of indigenous soil classification systems in four ecozones of Nigeria. He came out with the following findings: firstly, the indigenous soil classification systems for the Yoruba, Kulere, Nupe and Hausa are very similar, being based on identifiable properties of texture, colour and water retentiveness; secondly, all four systems include knowledge of the nature of soil fertility and ways to retain and improve fertility. Thirdly, the Hausa farmers carried out a remarkable rehabilitation of soils in the dry season which are regarded by most agriculturists as useful for agriculture. Thus, indigenous farmers in Africa use good soil properties such as rate of infiltration, soil particle sizes and soil structure formation as key soil indicators for soil classification.

2.4.3.3 Traditional Practices and Soil Fertility Status Determinants

Bailey (2003) in Jamaica, Price (2007) in Philadelphia and Akullo, Kanzikwera, Birungi, Alum, Aliguma and Barwogeza (2010) in Uganda found that, apart from low crop yield and poor growth of crops and weeds, farmers determine soil fertility by using plant characteristics such as crop colour, layers of humus, appearance of certain plant species, as well as soil characteristics such as presence of compacted soil. Therefore, indigenous farmers can observe

and interpret the deficiency symptoms associated with maize crops when determining the soil physical and chemical needs in drought-stricken environments due to climate change.

2.4.3.4 Indigenous Soil and Water Conservation methods

Sanghi & Kerr (1991) contend that subsistence farmers have engaged in indigenous soil and water conservation methods as climate change adaptation interventions to increase the survival rate of their maize crops. Indigenous methods for conserving soil fertility and moisture are cost-effective. They include aurovillians, mulch, growing of leguminous trees and growing of certain legumes which can survive for six months in the dryland. These methods enhanced biological activity in the soil instead of leaving it dry. Balasubramanian (1987) observed that farmers in the eastern Uttar Pradesh state of India reclaim alkaline soils by applying large quantities of farmyard manure and water. Organic material is the common source of fertilizer for restoring nutrients and sustaining life forms in the soil such as micro- and macro- organisms for the maintenance of good soil properties.

Gupta (1985) found that the common belief regarding summer ploughing among the farmers of Hissa Village of Gujarat state is that it opens the soils into ridges and furrows, therefore preventing soil erosion. Alders et al. (1991) articulate that farmers recycle nutrients by using nitrogen fixing and deep-rooted plants, fallowing and rotations. In support, Sanghi and Kerr (1991) add that some farmers utilize soil moisture conservation practices of deep ploughing during the summer (in black soils with low rainfall and in red soil with high rainfall); sowing seeds across the major slope; and furrowing as a part of seeding and intercultural operation for maize in red soil areas. The effectiveness of indigenous soil and water conservation methods seems to be directly related to the soil organic material content status for maize growing in water stressed soil conditions due to climate change.

2.4.3.5 Indigenous Cropping System

The United Nations Declaration on the Rights of Indigenous People (UNDRIP) has highlighted five indigenous farming practices that have helped shape sustainable farming systems and practices all over the world (Perroni, 2017). These five indigenous farming practices include agroforestry, crop rotation, mixed farming or intercropping, polyculture and water harvesting.

According to Okigbo and Greenland (1970), multiple cropping is part of traditional farming practices in Africa. Francis (1986) and Norman, Pearson and Searle (1995) reveal that multiple cropping may refer to either growing more than one crop on a field during the same time (intercropping), or after each other in a sequence (sequential cropping), or with overlapping growing periods (relay cropping). Multiple cropping systems provide more harvest security for farmers, increased erosion control, allow for crop intensification, influence ground cover, albedo, soil chemical properties, pest infestation and the carbon sequestration potential (Francis, 1986; Norman, Pearson & Searle, 1995). Therefore, planting different crops in the same field provides a higher possibility of beneficial harvest outcome in unpredictable weather conditions due to plant adaptation in the sub-Saharan region.

Ngugi, Karau and Nguyo (1990:12) point out that subsistence farmers are motivated by yield formation for food security. Intercropping is a type of agriculture that involves planting two or more plants simultaneously at the same time, thereby diversifying production. Moreover, the system involves small patches of a pure stand of crops at varying distances from each other and they are also more common than successive cropping sequences. Therefore, traditional farmers' use both intercropping and multiple cropping to get higher total yields and greater returns than the same crops grown in pure culture.

Madebwe, Madebwe and Kabeta (2005) added that intercropping provides a number of benefits, including natural resistance to crops disease infestations and attacks by pests and resistance to drought. Moreover, in this type of cropping system, maize, beans and squash were grown together in the same garden. The three seeds were planted together, with maize acting as support for beans, and both together acting as shade and humidity control for squash, and the squash acting as a weed suppressant.

Dlamini and Manana (2014) noticed that intercropping is practiced by many farmers on Eswatini Nation Land. Some crops that grow well together are maize and beans, maize and pumpkins, maize and groundnuts. Seemingly, maize has a wide range of optional crops for intercropping with; mostly cover crops that increase the soil moisture conservation capacity in harsh weather conditions.

Indigenous farmers repeatedly experiment with maize growing even when the prevailing harsh conditions do not allow. In the study conducted by Waha, Muller, Bondeau, Dietrich,

Kurukulasuriya, Heinke and Lotze (2012) they discovered that farmers in the sub-Saharan Africa grow a wide range of crops and apply different cropping systems. Farmers clearly prefer long-growing crop cultivars in single cropping systems and short growing cultivars in sequential cropping systems. In single cropping systems crops grow longer but are harvested once a year, leading to lower crop yields than in sequential cropping shorter systems with shorter growing periods but higher cropping intensities.

The study by Waha et al., (2012) found that at least one sequential cropping system is traditionally utilized in 35% of all administrative units in the database in sub-Saharan Africa, mainly maize or groundnuts. Aggregated mean yields in sub-Saharan Africa decreased by 6% to 24% due to climate change depending on the climate scenario and the management strategy (Waha et al., 2012). Interestingly, some traditional sequential cropping systems in Kenya and South Africa gained yields by at least 25% (Waha et al., 2012). Hence, farmers' choice of adequate crops, cropping systems and sowing dates can be an important adaptation strategy to climate change and the traditional crop management options should be considered in climate change impact studies on agriculture. Consequently, indigenous cropping systems require further exploration for the benefit of maize subsistence farmers in the Southern African region. Waha et al. (2012) conducted a study in ten sub-Saharan African countries and it was identified that traditional farmers engaged in sequential cropping systems.

According to Sanchez (2002), over a 10-year period, a soil replenishment approach has been developed by researchers from the International Centre for Research in Agroforestry (ICRAF) and national and international partners in collaboration with farmers using resources naturally available in Africa. Leguminous trees of the genera *Sesbania, Tephrosia, Crotalaria, Glyricidia,* and *Cajanus* are interplanted into a young maize crop and allowed to grow as fallows during the dry seasons. The Leguminous trees accumulate 100 and 200kg N / ha $^{-1}$ over the period from 6 months to 2 years in the sub-humid Tropical regions of East and Southern Africa. The captured quantities are similar to those applied as commercial fertilizers to grow maize in developed countries. Consequently, deep rooted leguminous trees provide an agro-ecological environment for the healthy maize crops to strive well in drought weather conditions. According to Dlamini (1988) degradation and deforestation of indigenous forests is occurring. Noticeably, this bad practice may threaten the survival of leguminous trees of the genera *Sesbania, Tephrosia, Crotalaria, Glyricidia,* and *Cajanus* if not protected by law.

Sanchez (2002) observed that, after harvesting the wood from the tree fallows, nitrogen rich leaves, pods, and green branches are hoed into the soil before planting maize at the start of the subsequent rainy season. This above ground litter decomposes with the tree roots, releasing nitrogen and other nutrients to the soil. Yields of maize, the staple food in the region, increased two to fourfold as nitrogen deficiency was overcome. Farmers are now establishing rotations of 1 year of trees followed by one crop of maize in bimodal rainfall areas of East Africa, and 2 years of trees followed by two to three maize crops in unimodal rainfall areas of southern Africa. Henceforth, litter material provides a top spongy layer that increases the soil water holding capacity to reduce water stress in maize plants that is due to climate change effects.

Correspondingly, in Chile, the peasant farmers developed a diversified combination of vegetables, staple foods (corn, beans, potatoes, fava beans), cereals, forage crops, fruit trees, forest trees, and domestic animals by using a seven crop rotational system designed to produce a maximum variety of basic crops in six plots, taking advantage of the soil restoring properties of the legumes (Altieri , Merrick and Anderson ,1987). The multi-cropping system of Africa is environmentally friendly and considers sustainable exploitation of abundant natural resources in line with indigenous knowledge practices for maize production.

According to Amare (2018) some research results in Ethiopia on indigenous knowledge of rural communities for combating climate change in arid zones revealed stunning conclusions. Firstly, it was found that rural communities have local knowledge in areas such as weather and seasonal forecasting (44%), drought forecasting (20.9%), crop pest and disease (47%) and weed control methods (99%) to adapt to some of the climate change impacts. Secondly, it was found that not all households had the same level of indigenous knowledge. It is worth noting that Indigenous knowledge practices are contextualized to individual community locations (Amare, 2018).

2.4.3.6 Indigenous Plant Protection Strategies

Healthy young maize plants strive well in an environment rich in organic matter as a natural growth medium. However, the success of climate change adaptation interventions utilized by Emaswati maize subsistence farmers may be hindered by prevalence of pests and diseases. Thurston (1992) provided a long list of indigenous practices for managing plant diseases. These included altering of plant and crops architecture, biological control, burning, adjusting crop

density, planting diverse crops, fallowing, flooding, mulching, planting without tillage, using organic amendments, planting in raised beds, rotation, sanitation, and manipulating shade. Thurston (1992) explains that manipulation of the plants' growing environment by covering the soil with live and dead plant materials is helpful in plant disease management. Moreover, some of the climate change adaptation interventions utilized by Emaswati indigenous farmers in maize production have beneficial effects such as pest and disease population control, allowing earth-worm habitation and enhanced soil water retention capacity.

Upawansa (1989, p.17) recorded several indigenous mechanical methods of pest control: 1. A recent practice for brown plant hoppers is lighting powerful firecrackers near infested spots. According to farmers, this practice gives very good results. Selected herbal treatments are also adopted by StriLankan farmers (Upawansa, 1989, p.18). Creepers called 'kaluwel' (*Derris scanders*) are placed in a similar way to control hoppers: 2. A solution prepared from *Mimosa pudica*, and an extract of cattle urine, margosa leaves, and asafetida is used as a general purpose insecticide. Environmentally friendly solutions that are common in indigenous knowledge applications should be assessed for their effectiveness in pest population control.

2.4.3.7 Modern vs Traditional Maize Seed Treatment.

Wambungu, Mathenge, Auma and Van Rheenen (2009) found that traditional maize seed treatment allow preservation of local seed qualities in traditional seed banks for higher germination rate during the planting season. A baseline survey was conducted in Western Kenya (Siaya) on modern and traditional maize seed treatment on a local variety and an improved variety in selected households (Wambungu et al., 2009). The results indicated that maize seed treated with cow dung ash in airtight containers showed the highest seed vigour and maintained viability for a long time with minimal loss. Often, ash is effective in controlling damage under this traditional technology, mixing an equal volume of sieved ash and grain and putting in a tight container. The ash/grain mixture should be covered with a 3cm layer of ash. The study concluded that the airtight storage provides excellent control and prevents the grain from absorbing moisture from humid outside air. The insects suffocate as soon as the oxygen in the container is used up. On comparable levels by statistical analysis, there was no significant difference between cow dung ash and modern pesticide in storage insect control. The finding recommended that cow dung ash as a traditional seed treatment method should be used to design low cost storage containers for resource by poor farmers which would result in better

seed quality. Indigenous knowledge such as traditional seed storage methods can maintain the quality and viability of seeds in airtight storage to reduce seed deterioration during storage (Wambungu et al., 2009). Traditional maize seed treatment practices have the basic local scientific principles to meet the seed material handling requirements for indigenous farmers during the post-harvest period.

2.4.3.8 Indigenous preservation methods

The use of ash as an indigenous seed preservation method discussed above is a common practice among Emaswati maize producing subsistence farmers for ensuring the availability of drought tolerant local seed varieties the next growing season. Modi (2003) confirms that some native subsistence farmers in South Africa store maize cobs above the fireplace and subject the seeds to smoke and heat which dries and protects the seed respectively. Yam or amadumbe (*Colocasia esculenta* L.Schott) corms are preserved in dry pits for one month in layers separated by grass straw and water is prevented from contacting them. Modi (2003) mentions that for centuries seeds were preserved either in baskets buried with ash, sealed in adobe structures or packed in elevated thatched huts as traditional storage techniques. These methods have been used together with others to maintain landraces for centuries, but they have largely been abandoned with no modern technology replacements. The objective of seed storage is to maintain seed quality for the longest duration possible. This approach provides guarantees of seed supply in years when acceptable seed quality production is low. Traditional seed banks should be revived to prevent the local maize seed variety from extinction.

Thurston (1992) argues that clean seed or healthy propagating materials often have positive and dramatic effects on plant health and crop yield. In support, Gnanadeepa (1991) adds that traditional farmers have used several practices that help to manage seed borne pathogens. If the same seeds are continually used season after season, they lose their yield potential and may contain mixtures like weed seeds and other crop seeds. Hence, Tamil Nadu farmers normally change their seeds at least once in three years (Gnanadeepa, 1991); likewise, indigenous farmers in Eswatini are aware of seed borne diseases and their negative impact on food production.

2.4.3.8.1 Seed laws that criminalize farmers

The application of indigenous agricultural knowledge practices in maize production is key to food security in the country.

The United Nations Declaration on the Rights of Indigenous People (UNDRIP) that was adopted by United Nations in 2007 affirms that indigenous people have rights to own and develop their land and resources and must be allowed to follow their traditional ways of growing food (Perroni, 2017). The Declaration is an international human rights instrument that set standards for the protection of indigenous rights. The Declaration acknowledges that indigenous people have rights to land, informed consent, freedom on indigenous territories and self-determination to name a few (Perroni, 2017). A survey report by GRAIN (2015) reveals that seeds represent a rich cultural heritage of Africa's local communities.

Contrary to the aspirations of indigenous farmers, De Schutter (2015) reveals that the G8 (Burkina Faso, Benin, Cote d'voire, Ethiopia, Ghana, Malawi, Mozambique, Nigeria, Senegal and Tanzania) New Alliance for Food Security and Nutrition in Africa is pushing to transform traditional farmers into income generating private property.

The intention is to marginalize traditional grain varieties. Prospectively, the path will have profound implications on the capacity of African farmers to adapt to climate change. Western influence on indigenous farmers is pushing them into denouncing their indigenous seed materials and indigenous practices in maize production through local government structures. Change of lifestyle must be a personal decision.

The same GRAIN survey report (2015) indicates that more than 80% of all seed in Africa is still produced and disseminated through 'informal seed systems', that is on- farm seed saving and unregulated distribution between farmers. Moreover, there is no recognition in the G8 New Alliance for Food Security and Nutrition in Africa of the importance of farmer-based systems of saving, sharing, exchanging and selling seeds (De Schutter, 2015). African governments impose commercial seed policies on local seed possessing indigenous farmers to promote the marketing of expensive hybrid commercial seed varieties indigenous farmers cannot afford.

Some countries in Africa have started implementing policies on the use of local seed variety. According to De Schutter (2015), Tanzania's new plant variety protection (PVP) Act will increase seed imports and reduce breeding activity at the national level. Moreover, the same

report argues that the policy may facilitate monopolization of local seed systems by foreign companies. The report debates that the transformation may disrupt traditional systems upon which millions of smallholder farmers and their families depend for their survival. According to this study, this may disrupt the spirit of 'Ubuntu' entrenched in our indigenous system. According to Nkosi and Daniels (2007), the building blocks of Ubuntu/botho is a principle of the unity of humanity and co-operation in an effort to resolve companion problems.

De Schutter (2015) concludes that the entire process of drawing up these laws has been non-participatory, excluding the very farmers that the laws will purportedly benefit. If farmers use or exchange protected seeds without the authorization of commercial seed breeders, they face punishment by paying fines and are liable to imprisonment. According to the Grain and La Via Campesina report **(**2015**),** most farmers and indigenous peoples have resisted this take over in different ways. Some Government policies are a barrier towards the development of local seed processing technologies in the subsistence sector.

2.5 INDIGENOUS CLIMATE AND WEATHER FORECAST PRACTICES

Chepkoech, Mungai, Stober, Bet and Lotze-Campen (2018) conducted a study on farmers' perspectives on the impact of climate change on indigenous vegetable production in Kenya. The results revealed that farmers perceived higher temperatures, decreased rainfall, late onset and early retreat of rain, erratic rainfall patterns and frequent dry spells were increasing the incidence of drought. Dewar (2012) found that attitudes towards climate change and understanding of issues showed that many African citizens framed their views of the environment and their relationship with it through their faith.

Anandaraja et al. (2008) state that indigenous climate and weather forecasting practices are also used by farmers in India. Indigenous knowledge systems are dynamic, changing through indigenous mechanisms of creativity and innovativeness as well through contact with other local and intellectual knowledge systems. Moreover, traditional beliefs are abundant, particularly among the rural communities. As a result, indigenous knowledge is an environment responsive and rural community focused learning activity.

Anandaraja et al. (2008) add that traditional agriculture is indigenous knowledge that can serve as an alternative to modern agriculture. Indigenous technologies are numerous on various

aspects such as knowledge of seasons, climate, rainfall patterns, land preparation, crop varieties, organic manures and manuring, water management, plant protection, post-harvest operations including storage and processing of farm produce (Anandaraja et al., 2008). Currently, scientists throughout the world have started identifying, documenting and analysing indigenous technologies in an effort to recommend them to farmers (Anandaraja et al., 2008). Therefore, indigenous technology is an applied community of practice (field) that has not yet been explored for purposes of knowledge building.

2.5.1 Indigenous Climate and Weather Forecast by Observation

Anandaraja et al. (2008) conducted a study in an Indian rural society to find out the utility of recommended weather forecast information for agricultural operations and knowledge from indigenous weather forecast sources. The findings revealed several indigenous climate and weather forecast practices used by farmers. The respondents reflected that termites flying in the evening hours were an indication that rain will fall, frogs croaking in choruses was followed by showers, ants shifting their eggs to safe places foretold the occurrence of rain, when dragon flies flew low it would rain, a halo around the moon was an indication of rain to follow, dense fog in the early morning indicated no rain, continuous drizzling indicated more pest and disease incidence, morning clouds and evening thunder indicated the occurrence of rain and a rainbow in the East direction indicated the absence of rain. The conclusion of the study by Anandaraja et al. (2008) emphasized that available indigenous weather forecasting techniques may serve as alternative to modern technology. Observation of local environmental indicators such as animals, plants, birds' behavioural patterns and moon cycles assist indigenous farmers to predict the chances of rain using indigenous weather prediction forecasts. Scientists may develop and modify these local techniques (Anandaraja et al., 2008).

Mlipha (2004) found that in the Shewula community of Eswatini the indigenous farmers attach a higher level of trust and confidence on the indigenous ways of rainfall prediction than the modern conventional ones. Indigenous farmers engaged in maize production possess indigenous knowledge and well-developed observational skills for the interpretation and prediction of rains for maize production.

2.6 INDIGENOUS FARMING SYSTEMS AND THEIR DEVELOPMENT

Klee (1980) observed that traditional farming systems have been developed using experiential knowledge for self-reliance. Peasants have often used locally available resources to develop farming systems which result in sustained yields.

Indigenous crops have biological qualities that tolerate diverse local environmental conditions for subsistence farmers to meet their needs for survival in climate change variability. Shava et al. (2010) observed that traditional crops were important sources of community resilience to climate change in Zimbabwe. Commercial crops are not adaptable to local conditions and require high inputs such as mechanization, fertilizer and water supply. They are also vulnerable to climate change effects like drought and flooding in Zimbabwe. Traditional maize varieties possess traits which have evolved with time for resilience to drought and flooding to suit its agro-ecological requirement. The indigenous agricultural practices should be explored for their advancement.

Moreover, indigenous crops and vegetables enable farmers to increase crop diversity (Shava et al., 2010). They also assist farmers to match specific varieties to their own microclimates. The other advantage is seed sowing, processing and preservation through drying and smoke coating make communities to have a secure and reliable source of food during the off season (Shava et al.,2010). Seed sowing and sharing ensures community independence from commercially produced and expensive ones. Some of the indigenous methods of preserving food crops are still used for maize by indigenous farmers.

The researchers' rural maize growing communities associate the winter season with the kraal manure spreading operation in the field for plant nutrients restoration. Lwoga (2010) points out other traditional practices for soil fertility restoration in Tanzania. The farmers use manure, crop rotation practices, use of crop residues, organic materials, and leaving land under a long-term fallow. Malekani, Chailla and Wamoza (2014) claim that planting nitrogen fixing plants such as pigeon peas with maize are a common practice among indigenous communities. According to Lwoga (2010) other soil fertility techniques used by indigenous farmers include zero-tillage, mulching and cultivating in the nutrient rich valley bottoms. Remarkably most of the cultural methods are still applied in traditional farming by climate change vulnerable communities for improving the physical and chemical properties of the soil against drought.

A study carried by Mlipha (2004) in Shewula community of Eswatini reveals that the farmers apply various mechanisms to improve water retention on their agriculture plots. These are:

i. Ripping of the topsoil; since tillage is discouraged this encourages infiltration of the little rainfall that occurs.
ii. Building of terraces; Terraces are usually constructed on the fields to prevent the flow of rainwater (runoffs). Terraces prevent an immediate and free flow of rainwater from the field, thus encouraging water infiltration as well as preventing soil erosion. Terraces also worked as barriers for rainwater retention, particularly to soils downslope.
iii. Use of ridges; ridges are prepared where to trap rainwater (run-offs) and the crop is planted at the bottom of the ridge as it is commonly done in the humid regions. Under moist periods the crop is usually planted at the top of the ridge.

Indigenous farmers in Eswatini are therefore aware of some of the traditional agricultural practices for soil moisture retention capacity during harsh weather conditions.

2.7 INDIGENOUS PRACTICES AND AGRO BIODIVERSITY

Clawson (1995) points out that traditional agro-ecosystems based on the cultivation of a diversity of crops and varieties and space have allowed traditional farmers to maximize harvest security under low levels of technology and with limited resources and space. Altieri, Merrich and Anderson (1987) argue that preservation of these traditional agro-ecosystems cannot be isolated from the maintenance of the culture of the local people. Thus, in Africa, indigenous peoples' traditions and cultural activities do reflect the indigenous agricultural practices of crop and animal husbandry in the community.

2.8 INDIGENOUS PRACTICES AND CLIMATE CHANGE IN RESEARCH FOCUS

2.8.1 Agronomic and Cultural Methods

Literature on indigenous practices as climate change interventions confirms its significance for maize subsistence farmers' survival. Malekani et al. (2014) made some findings on application of indigenous knowledge by Tanzanian farmers to cope with vulnerability to climate change.

They used different methods as coping mechanisms to weather and soil fertility changes. Alders et al. (1991) articulate that farmers recycle nutrients and protect the soil against erosion. Accordingly, indigenous knowledge practices vary, with different community farming practices for both soil management and moisture retention against drought.

In similar findings Jaipal, Gopal, Prabhakar, Sudarshan and Bikash (2012) also found that rainwater harvesting, and soil conservation techniques were used by indigenous farmers to avert scarcity of water during summer.

Mutekanga's (2018) observations of indigenous knowledge practices employed by smallholder farmers in Uganda confirm the legacy of subsistence farming. The findings reveal that a majority (67%) of the Ugandan smallholder farmers still use indigenous knowledge in farming and the majority (62%) of the technical persons believe that food production and sustainability is due to use of indigenous agricultural knowledge by the rural community. The research revealed that indigenous knowledge is on staple crops such as maize, cassava and beans grown in diverse systems (either mixed farming or intercropping) for food security. The study concluded that, despite many changes in agricultural practices, most smallholder farmers still use indigenous knowledge in farming, mainly because this knowledge has been tested over generations.

Interestingly, local farmers in the Sahel have been known to conserve carbon in the soil through the use of Zero Tillage practices in cultivation, mulching and other soil management techniques (Schafer, 1998). Natural mulches moderate soil temperature and conserve soil moisture enabling maize crops to strive during drought.

Some researchers (Karjalaine, Kellomski & Pussinen, 1994; Stainback & Alavalapati, 2002) concur that local farmers are known to have practiced the fallow systems of cultivation which encourage forest regeneration. Again, the importance of forests reserves has been recognized by traditional institutions to the extent that community reserves were common in traditional societies.

2.8.2 Coping and adaptation

Stranger et al. (2009) say that adaptation is a process of deliberate change, often in response to multiple pressures and changes that affect people's lives. They perceive that humans can dictate and respond to life threatening events to increase their chances of survival in situations beyond their control in many ways.

Stranger et al. (2009) believe that subsistence farmers located in areas of high variability of rainfall or high risks of natural hazards are often characterized by livelihood adaptation and coping strategies that have evolved to manage their impacts. What starts as coping strategies in exceptional years can become adaptations for the household or whole community. Morton (2007) observes that many features of dryland livelihoods in Africa and elsewhere can be regarded as adaptive strategies to climate variability. Indigenous maize farmers engaged in maize production apply some of the climate change adaptive strategies to ensure food security during drought conditions.

Climate change adaptive strategies have noticeable key elements. Mortimore and Adams (2001) mention four major elements of adaptation: i) Allocating farm labour across the season in ways that follow intra- season rainfall variations 'negotiating the rain'; ii) Making use of biodiversity in cultivated crops and wild plants; iii) Increasing integration of livestock into crop farming systems (at a cost of increased labour demands); iv) Working land harder, in terms of labour input per hectare, without increasing external non-labour inputs and diversifying livelihoods.

Morton (2007) stresses that smallholder and subsistence farmers will suffer the impact of climate change that would be locally specific and hard to predict. Their resilience factors, such as family labour, existing patterns of diversification and possession of stored indigenous knowledge should not be underestimated. Indigenous farmers apply indigenous practices for maize grow successfully. These maize growing interventions in the rural areas ensure sustainable food security in a climate change dictated environment. indigenous farmers have the capacity to apply indigenous practices in response to the challenges of climate variability.

2.9 ORGANIC MATTER APPLICATION

Indigenous farmers still do possess indigenous agricultural knowledge to respond to the impact of climate change, which has been underestimated. According to Ajibade and Shokemi (2003), the value of local knowledge in climate change has received little attention. These include maintaining the soil fertility, restoring the natural properties of the soil togetherness and its moisture holding capacity. Poor soils lead to desertification and the rate is accelerated in the absence of rainfall due to climate change. The researcher has observed that organic matter application in traditional farming is common in Eswatini. Maize plants do strive in erratic rainfall during the planting season with positive outcomes where organic matter has been applied.

According to Dlamini et al. (2014) maize should be planted early, for best yields, during the first rains in mid-August. Early planted crops are less affected by the drought that often happens in December and January. Thus, the timing of planting maize increases the chances of obtaining good harvest when organic matter has been incorporated in the soil, considering the unpredictable changes of the weather patterns due to climate change.

2.10 ESWATINI PERSPECTIVE: MOON PHASES OBSERVATION FOR PREDICTION.

A few individual members of the Eswatini society are still able to interpret the moon phases. According to Simelane (2017) the indigenous knowledge perspective of predicting rainfall uses observation of the moon phases. These phases include the New Moon (Crescent), Half Moon and Third Quarter and Full Moon within the period of each month. According to Simelane (2017) there is a variation with the phases of the Moon. When the Moon is half full rainfall is less likely. During the period when both the Sun and the Moon is out of sight (an eclipse) there is a high chance of rainfall observed for 2-3 days before the appearance of the New Moon. Simelane (2017) stresses that the indigenous farmer's interpretation is that the rains at the new moon wash the previous moon phases which have died.

Moreover, the four seasons of the year in the southern hemisphere in Africa are the Spring (August to November - sprouting time); Summer (December to February - flourishing time); Autumn (March to May - time of food abundance); and Winter (June to July - less food or non-

available) depicts the community farming operations and consumption levels. Simelane (2017) projected that in autumn and winter seasons the chances of rains are slimmer because of the (overcast) thick cloud closer to the Earth. However, the spring and the summer seasons have higher chances of rains notwithstanding the moon phases. Generally, in Eswatini, early rains coincide with early planting of maize during the period of August to October. Late planting occurs during the period of November to February (Dlamini et al., 2014).

In Eswatini early rains signal the beginning of the maize planting operations by many indigenous farmers. Dlamini et al. (2014) point out that maize is planted from mid-August to end of December. The time of planting dictates that, seed sowing should be after the first good rains of 20mm that falls within two days. Noticeably, early planted crops are less affected by the drought that often happens in December and January. Applied cropping cultural practices ensure that stalk-borer pest; maize streak diseases and witchweed (*Striga* species) cause less damage in early planted maize crops. Hence, indigenous farmers plant their maize fields during the period of August and October to increase successes and chances of re-planting maize for food security during drought.

According to Simelane (2017) the indigenous farmers rain prediction perspective forecasted that on the 26th days before the appearance of the new moon it would rains. During this period of rain there would be a continuous downpour accompanied by fog for 2-3 days (Umvimbi) and then it will stop. Under normal circumstances, rainfall during the summer season is heavy (torrential) and accompanied by thunder and lightning.

There is a need to gather the details on observation of the moon phases for rainfall prediction (its application by scientific studies in relation to Government Meteorological Weather Warning Systems). Indigenous farmers use their observational skills successfully for indigenous agricultural practices concerning food security and climate chance resilience. Mlipha (2004), Zuma , Stigter and walker (2013) concurred that indigenous farmers possess traditional weather knowledge observed with rainfall prediction. Some of the examples include interpretation of the presence of ‘swarm of black swallow birds’ for arrival of the rainfall. Growing maize with pumpkins during intercropping for weed population control is an experiment that has to be acknowledged at subsistence level. The researcher’s observation was that Meteorological Weather Station prediction of rains has flaws, similar to indigenous knowledge weather predictions, due to human error. Therefore, both approaches can provide

useful weather information for indigenous farmers in maize production as both are manipulated by man who is fallible.

Indigenous knowledge rain prediction techniques have flaws just like any other weather data recording instrument designed by mankind. Both approaches require interpretation for subsistence farmers to access and utilize. The degree of errors in both modern conventional weather forecast equipment and indigenous knowledge rain prediction techniques have to be acknowledged for strengthening and advancing the science disciplines.

2.10.1 Rainfall Prediction by Farmers in Western Free State of South Africa

In a study conducted on the use of traditional weather /climate knowledge in the Western Free State of South Africa by Zuma, Stigter and Walker (2013) similarities were observed with traditional weather prediction in Eswatini discussed above. If the crescent appeared facing upwards, it meant that it could hold rainfall; while as the crescent appeared face down, it was an indication of releasing rainfall to mother earth and rainfall would be expected within 3 days. Farmers across the Western Free State region also commented that good chances of rainfall were expected around the date of the new moon but, in contrast, the full moon was usually associated with lower rainfall chances. If poor rain event occurred the time of the new moon, the following month was expected to be dry. Good rains at new moon indicated the following month would be wet. The traditional weather forecast knowledge for predicting the chances of rain precipitation is reliable but subjective in terms of numerical figures for quantification.

2.11 EARLY PLANTING AND USE OF DRAUGHT POWER

Animals could be harnessed to provide draught power to facilitate operations on maize production. According to Ngugi et al. (1990) a draught animal can pull about 10-20% body of its body weight as a draught load for 6 to 8 hours per day in good body condition. The animals must be properly trained and have a reliable starting, stopping and steering. The draught animals include oxen, donkeys and horses. Therefore, the use of draught power and facilitated the timing of farm operations and increased the possibility of early planting during the period of mid-August (Dlamini et al., 2014).

Water is now the number one food production limiting factor in many parts of Sub-Saharan Africa (Regional Land Management Unit Technical Report series, 2006). Ngugi et al. (1990)

argued that early planting using draught power allowed indigenous farmers to take advantage of the early rains, low pest and disease attacks on striving maize plants for early harvesting, hence guaranteed food security. Therefore, the month period during which the early rain is received should be captured in data to inform the indigenous farmer's calendar for maize planting at the right time considering the difference in regional locations. Indigenous knowledge practices use early planting as climate change adaptation intervention for subsistence farmers in maize production.

2.12 INDIGENOUS MAIZE SEED VARIETIES.

In traditional agriculture, genetic diversity is created by a diverse array of local varieties or landraces. The use of landraces is justified by adaptability to local conditions of environment and inputs (Frankel et al, 1995). The researcher noticed that local varieties of maize are still preserved by indigenous farmers and planted for different personal reasons in Eswatini.

Maize is usually complemented with pumpkins during intercropping to strive in drought and persistent heatwaves-stricken field conditions. According to the Participatory Ecological Land Use Management (PELUM), Eswatini (2018), Emaswati traditionally practice intercropping, which can be seen in the maize fields where beans, pumpkins and wild vegetables such as Amaranthus (imbuya) are grown simultaneously.

Commercialization such as adoption of genetically modified technology is towards large scale mono-cropping, which threatens dietary diversity, the food and nutritional security (PELUM Eswatini, 2018). According to Vilakati (2018) local seed varieties of pumpkins (tintsanga dried from the previous harvest) and local maize varieties (umbila wesintfu) were still being used. Vilakati (2018)'s parents' named it the 'Rhodesian maize type', which was hard seed to bite, tasty, drought tolerant and less vulnerable to storage pests attack. The seeds produced tall plants whose stem was easily dislodged by strong wind and hailstorm, which then was common during the late and December season. The pumpkin seeds produced running stems on the ground that gave rise to broader leaves at intervals on its stem length keeping the ground covered, preserving the scarce moisture and reducing the weed population. A few weed plants were uprooted by hand. She pointed out that the white traditional maize seeds were bigger and flat in size. Some of the maize seeds were sourced from the neighbourhood. The maize variety would take a long time to reach its maturity. The family planted the maize and the pumpkins

at the same time in the early rains often in August. According to the Vilakati (2018)'s community (Southern High- veld region), planting started at the end of October-November. The spacing dimension during planting was not considered but they avoided overcrowding.

2.13 CHAPTER SUMMARY

The above literature review indicated that indigenous agricultural practices aspects are lived experiences worldwide. Indigenous people exist and contribute to the economic development of their country by exploiting the natural resources in the subsistence sector. The literature review gave the impression that some countries frame their agricultural projects on indigenous agricultural practices (organic matter application) for climate change resilience. The following chapter will focus on the research methodology of the study.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter will describe the research approach used in this research, including the qualitative research paradigm that supports the study, the phenomenological research theory and the qualitative research methods employed.

3.2 THE RESEARCH METHODOLOGY

McMillan and Schumacher (2014) refer to the research design as the plan that describes the conditions and procedures for collecting and analysing data. Creswell (2013) adds that research design refers to the entire process of research from conceptualizing a problem to writing research questions to data collection, analysis, interpretation, and report writing.

The purpose of the research determines the research design and the methodology that is appropriate for collecting the suitable data for the correct answers to the research questions intended. Yin (2009:1) commented that 'the design is the logical sequence that connects the empirical data to the study's initial research questions, and ultimately to its conclusions'.

This study falls under qualitative research. Qualitative research is exploratory in nature. Creswell (2013:44) observed that qualitative researchers use an emerging qualitative enquiry, collect data in a natural setting sensitive to the people and places under study, and employ data analysis that is both inductive and deductive to establish emerging patterns or themes. Qualitative research refers to in-depth study using face to face interviews or observation techniques to collect data from people in their natural settings (McMillan et al., 2014:5).

This study seeks to explore climate change adaptation interventions adopted by indigenous maize farmers for disaster risk reduction preparedness in Eswatini. The qualitative research paradigm was the most suitable for my research. The researchable area was subjective and provided opportunity for in-depth study to enrich my finding.

3.3 THE QUALITATIVE RESEARCH PARADIGM

3.3.1 Theoretical Framework for Indigenous Agricultural Knowledge

3.3.1.1 Phenomenological theory

The theoretical approach identified for my study is phenomenological in nature. Phenomenology is a broad discipline and method of inquiry in philosophy, developed largely by German Philosopher Edmond Husserl (1901) and Martin Heidegger (1927), which is based on the premise that reality consist of objects and events. 'Phenomena', as they are perceived or understood, are not of anything independent of human consciousness (Phenomenology Doctrine, 2008-2018). In this case maize subsistence farmers are the 'objects' and 'events' imbedded in indigenous agricultural practices, understood (tacit) in human consciousness.

The phenomenological approach is embedded in lived experiences, discourses and meanings of community individuals or groups on a common phenomenon (in this case indigenous agricultural knowledge and practices for adaptation to climate change effects). The focus area of the study was on the use of indigenous agricultural practices as climate change interventions for disaster risk reduction preparedness in Eswatini. Moreover, in the past, traditional farmers would survive drought and long heat waves using the indigenous seed varieties.

Traditional farming systems have been developed using experiential knowledge for self-reliance (Herwood, 1997; Klee, 1980). Washington, Downing, Ziervegel, Bharwani and Bithell (2005) confirm that, in Subtropical areas of Africa, climate variability, uncertainty and events such as drought are phenomena that some societies have coped with for many generations.

According to Haggblade and Hazell (2009) and Roling (2010) indigenous knowledge has sustained the farming operations in the traditional sector. McClure (1989, p.1) expounds that indigenous knowledge systems permeate all that indigenous people do, think and believe. Du

Plessis (2002), Ngulube (2002) and Ellen and Harris (2002) argue that, in the light of increasing temperature, more severe drought and short rainfall seasons affecting food crops, indigenous knowledge is increasingly used by local communities to adapt to harsh climatic conditions.

Ogawa (1995) proposed that every culture has its own science and refers to the science in a given culture as its 'Indigenous Science'. Brown (2004) declares that it is becoming increasingly important to interrogate our understanding of what uncertainty and variability mean to how people live their everyday life.

The impact of climate change on traditional farming is noticeable. Apparently, indigenous farmers rely on indigenous agricultural practices and natural water supply for crop production. Besides, subsistence farmers have applied some indigenous agricultural practices repeatedly, acquired an accumulation of experiences, informal experiments and intimate understanding of their lived environment (Anandaraja, et al, 2008). The study noted that internalized competences and the wealth of lived experience on the use of indigenous maize varieties and contextualized planting calendars in drought conditions have been applied before with success as means toward food security.

This research is on climate change interventions adopted by indigenous maize farmers that can be employed for disaster risk reduction preparedness in Eswatini. This study interrogated and 'discussed the essence of the lived experiences for several individuals of a phenomena' (the indigenous agricultural practices adopted for drought conditions due to climate change for indigenous farmers) on maize production (Creswell 2013: 76). Hence, the theoretical approach of the study is informed by the philosophy of phenomenology.

3.3.1.2 The phenomenological approach

A phenomenological study describes the common meaning for several individuals of their lived experiences on a particular concept or phenomena (Creswell, 2013:76). Jacobs (1997) articulates that a concrete lived experience is a key place from which to build knowledge and foment social change. In addition to lived experiences, participant's voices, accounts and narratives are transformed into theory. Phenomenological studies seek to transform lived experience into a description of its essence, allowing for reflection and analysis (McMillan et al., 2014). Napples (2003, p214) argues for the use of the term "…reflective processes, a

thoughtful process that does not invoke the often-unconscious responses". Consequently, the strength of reflection on phenomena depends on knowing well.

Creswell (2013:76) observed that different arguments on phenomenological philosophy rest on some common grounds: the study of lived experiences of a person, the view that these experiences are conscious ones (Van Manen, 1990), and the development of descriptions of the essences of these experiences for all the individuals (Moustakas, 1994). Therefore, in this research the lived experiences involved activities that indigenous farmers engaged in response to climate change effects such as drought. This is a shared community intellectual property with individual perspectives. Reflections by all participants who experienced the same phenomena give different meaning to the particular event concerned (Polkinghorne, 1989). Then and the new enriched community-based knowledge is created and assembled for social change.

3.3.1.3 The phenomenological procedure

Creswell (2013) adopted psychologist Moustakas' (1994) approach because it has systematic steps in the data analysis procedure and guidelines for assembling the textual and structural descriptions. Data are collected from individuals who have experienced the phenomena. Often data collection in phenomenological studies consists of multiple in-depth interviews with participants. Polkinghorne (1989) recommended that the researchers should interview from 5 to 25 individuals who have all experienced the phenomena. Other forms of data may be collected such as observations, journals, poetry, music and other forms of art. Van Manen (1990) mentioned taped conversations, formally written responses and accounts of vicarious experiences of drama, films, poetry and novels as types of phenomenological data.

While other open-ended questions may be asked in phenomenological interview questions, the participants are asked broad general questions that will lead to a textual and structural description of the experiences and ultimately provide an understanding of the common experiences of the participants' phenomena (Moustakas, 1994). Phenomenological data analysis involves going through the data (interview transcriptions) and highlighting the 'significant statements', sentences and quotes that provide an understanding of how the participants experienced the phenomena. Secondly, the researcher develops clusters of meaning from this significant statement into themes. These significant statements and themes

are then used to write a description of what the participants experienced (textual description). This research approach, as outlined by psychologist Moustakas (1994), is flexible to complement the interpretivist framework adopted by this study.

3.3.1.4 Interpretivist framework

Creswell (2013) perceived qualitative research as an intricate fabric composed of minute threads, many colours, different textures and various blends of materials. Like the loom on which fabric is woven, general assumptions and interpretivist frameworks hold qualitative research together.

Qualitative researchers use terms such as constructivist, interpretivist, feminist, postmodernist, among others for their research approaches. Within these assumptions and frameworks are approaches to qualitative research such as narrative research, phenomenology, grounded research, ethnography and case study research. The qualitative research field has many different perspectives, depending on the types of qualitative projects (Creswell, 2013). The phenomenological philosophy has been identified as fit for this study.

Phenomenological studies 'aim to capture the lives of the participants and to interpret the meaning' (Henning, Henning, and Van Rensburg & Smit 2013). Therefore, this is an interpretative process for meaning from the participant's point of view. Henning et al., (2013) state that generic descriptive studies have evolved, and many methodologies focus on more subjectivist work. The linguistic turn in research (where language is central to the interpretive process) reveals how data content (contextualization) changes meaning through every day common-sense reasoning.

Henning et al. (2013) observe that interpretivists construct knowledge by observing the phenomena and also by descriptions of people's intentions, beliefs, values and reasons, meaning-making and self-understanding. The phenomena and the events are understood through mental processes of interpretation in the social context. Therefore, the knowledge that drives the society is key to the interpretative project (Henning et al., 2013). Moreover, the knowledge systems are interrogated by the researcher during textual analysis for interpretation.

The traditional knowledge system dictates knowledge transfer to new generations through the established traditional structures. In response to climate change effects such as agricultural drought, indigenous agricultural practices are applied. This study argues that indigenous

farmers observe and attach value to indigenous agricultural activities or events that sustain their livelihoods.

The study sought to identify and describe the indigenous agricultural practices that were common among indigenous farmers in drought stricken rural communities in Eswatini. Different viewpoints that emerged as facts and evidence from all the selected participants were reflected upon by the researcher. The key participants were asked to narrate their applied indigenous agricultural practices for maize production in drought conditions and the ascribed meaning to the events. Interviews and focus group discussion methods were used for data collection. The different techniques for collecting data included, tape-recorded interviews and focus group discussions and field notes as data information sources for interpretation.

3.4 POPULATION AND SAMPLING

3.4.1 Participants selection and Sample size

This qualitative study did not cover the whole of Eswatini. Rather, the participants consisted of indigenous farmers in the community areas located in the Middle-veld of Eswatini's ecological zones which were accessible and convenient to the researcher in terms of time and funding. The indigenous farmers participated as 'Key Informants' from community members under the following authorized chiefdoms: Nhlambeni and Ngculwini in the Dry Middle-veld, and Vusweni and Zombodze within the Wet Middle-veld zones. The participating community members resided in the Middle-veld permanently. The sample size of the research study had 32 participants in total for individual and Focus Group Discussion interviews altogether. Firstly, there were twenty –four (24) indigenous farmers in the designated communities.

Maize farmers participated as permanent community members practicing on Eswatini Nation Land (SNL) under their independent chiefdoms. According to Kay (1988) about 70% of Emaswati people live on Eswatini Nation Land. The SNL is the land owned by Emaswati through the chief's council, where maize is the most produced staple food crop.

In addition to the indigenous farmers, Grade 6 and 7 primary school agriculture teachers from primary schools in the same studied areas participated. The agriculture teachers were interviewed to explore the possibilities for including indigenous agricultural knowledge for disaster risk reduction preparedness in the grade 6 and 7 primary school agricultural

curriculum. Four (4) teachers located in the Dry Middle- veld primary schools and another four (4) in the Wet Middle - veld primary schools, participated in this study to provide an educational perspective into the research. Eight (8) individual grade 6 and 7 qualified agriculture teachers' participanted respectively.

3.4.2 Purposeful sampling procedure

This study targeted indigenous knowledge holders and practitioners such as the elderly and community senior citizens as key informants. McMillan et al. (2014) suggest that qualitative samples can range from 1 to 40 only as guidelines. Firstly, the researcher conducted individual interviews with participants within the selected four chiefdoms. Secondly, the researcher engaged five participants from each of the four (4) chiefdoms in focus group discussions. The small sample was manageable for identification of emerging issues and thematic areas of the findings.

The selection of participants was based on the purposive sampling procedure (McMillan et al., 2014). The chief's headman and community members identified the individual elders or senior citizens who engaged in indigenous practices in their farming operations in each site (community sub zone or 'Sihlahla meeting centre' chaired by a delegated chief's appointee). The chief's headman runs the affairs of the concerned community in consultation with the chief.

According to Thrupp (1989, p.139-140), IKS are not possessed by only one sector of the society. In many cultures women and elders have impressive sight into certain aspects of culture. Sometimes, researchers have not been unaware of such perspectives among rural people due partly to their biased focus on land-owning male farmers, neglecting other members of the community. Indigenous knowledge is embraced by both female and male elders of the society.

Purposive sampling was also used in the identification and selection of primary school educators involved in teaching of the grade 6 to 7 agriculture curriculum. The study mainly focussed on the upper (senior) phase of the primary school's modern agriculture programme. The selected teachers were qualified agriculture teachers and had experience in the teaching of the subject. Creswell (2013) indicates that the enquirer selects individuals and sites for study because they can purposefully inform an understanding of the research problem and central

phenomenon in the study. The interest of the researcher is to establish more confidence and trustworthiness in the findings without generalization about the studied population.

3.5 DATA COLLECTION METHODS

The study focused on both primary and secondary data collection methods. The primary data collection method was based on in-depth individual interviews and focus group discussions with the key informants. The primary research involved formal consultation with maize farmers, indigenous knowledge holders and practitioners such as the elderly and community senior citizens in the rural areas. Primary data was also collected from interviews with primary school agriculture teachers. The researcher assumed the position of a non-participant observer on the research sites. The secondary data collection method comprised the review of related literature; capturing photographs of displays and artefacts of indigenous practices at the museum collection centre.

3.5.1 Data collection Procedure

The data collection methods employed in this study are discussed below.

3.5.2 Field Observations

Observation is one key tool for data collection in qualitative data. It is the sense of noting the phenomena in the field setting through the five senses of the researcher with an instrument or recording equipment for scientific purposes (Angrosino, 2007). The researcher developed an individual field observation schedule for capturing individual indigenous farmer's activities related to food security and climate change.

The researcher observed the types domesticated livestock for food security, kraals for manure procurement, indigenous seed materials, countour ploughing to mention a few as evidence of indigenous agricultural practices in practice in maize production.

The researcher assumed a non-participant observation role during data collection to allow watching and field notes taking without direct involvement (MacMillan, 2014), in order to explore issues that would reveal more data acquired through interviews or in documents and

artefacts (Henning et al.,(2013) in the field. Henning et al., (2013) reiterate that there are many researchers who observe in a site without real participation and explore issues that reveal more data than they acquire through interviews or documents and artefacts. The researcher developed an individual field observation schedule, focusing on specific indigenous knowledge individual activities related to farming of maize in response to drought climate conditions. The observations were based on the research purpose and the questions. The researcher watched the physical setting, participants, activities, interactions, conversations and their behaviour during the observation. The researcher started the observation broadly and then concentrated on the research questions (Creswell, 2013).

3.5.3 Focus Group Discussions

The key informants were indigenous farmers form Nhlambeni and Ngculwini (Dry Middle veld), and Vusweni and Zombodze (Wet Middle veld) to explore the problem on Indigenous Agricultural Practices (IAP) for climate change and food security. In addition, Grade 6 and 7 primary school's qualified individual agriculture teachers who had teaching experience participated. This approach seek to interrogate the teachers' opinions on integration of indigenous agriculture practices into the primary school's agriculture syllabus. The focus group discussion for teachers was interrupted by the ongoing Eswatini political demonstrations and compliance to Covid 19 1`protocols. The Eswatini Government closed schools indefinitely due to unsafe political disruptions and strict Covid 19 protocols. The Focus Group Discussion interviews for the Grade 6/7 agriculture teachers was then halted at the time of data collection.

The focus group interviews were used to obtain a better understanding of the problem or to assess the problem, concern, new product, program, or idea (McMillan et al., 2014). Moreover, a qualitatively sampled group of people with common traits (homogenous group traits) was interviewed together. The researcher facilitated discussions by posing initial and periodic questions. The researcher observed body language, tape recorded the sessions and interpreted the data. A focus group typically consists of 8 to 12 persons who are relatively homogeneous but maybe unknown to each other (McMillan et al., 2014). For complex topics, smaller groups of five to seven people are recommended. A typical session lasts lasted for one and a half to two hours. Individual participant's interviews were conducted for the four (4) selected designated area prio to the focus group discussions for understanding of the natural phenomena concerned. The researcher engaged a minimum of five participants for each focus group

discussion per chiefdom. The researcher observed and interviewed 24 indigenous farmers in the designated community areas in total.

According to McMillan et al. (2014) participant (and non-participant) observers and in-depth interviewers use focus group interviewing as a confirmation technique. The advantage of focus group discussions is that a social environment is created in which group members are stimulated by each other's perspectives and ideas to increase the quality and richness of the of data compared to a one-on-one interview (McMillan et al., 2014). The members of each group are encouraged to think more deeply about the topic and are in a better position to question each other to arrive at a group result, rather than an individual one.

3.5.4 Semi-structured interviews

The semi structured interview guide was administered to both individual and focus group discussion participants at predetermined schedules to avoid derailed sessions. These interviews covered both selected indigenous farmers and the primary school's agriculture teachers at Grade 6 and 7 in the country. The approach would provide different insight and opinions from multiple cases in the Dry and Wet Middle -veld participants in the designated areas.

In this study the interview guide was semi-structured, beginning with general questions and then further probing with more specific questions (McMillan & Schumacher, 2014). The researcher developed an interview guide as an instrument for soliciting the knowledge and experiences of the traditionalists and community elders as key informants on indigenous knowledge (Kvale & Brinkmann, 2009).

An interview guide approach is relatively conversational and situational. The topics are selected in advance, but the researcher decides the sequence and wording of the questions (semi-structured) during the interview (McMillan & Schumacher, 2014). It is a quest for subjective version of reality and non-interference from the interviewer (Henning et al., 2013).

The researcher conducted face to face interviews in Siswati to break the barrier of communication in the field, which were then translated into English. This helped with the community language tone when addressing the community elders with respect and conduct as anticipated in the field site.

At the interview site, the researcher provided information about himself and his organizational affiliation and what the data gathered would be used for, including the protection rights of participants. This was done for formal authorization and ethical research reasons to proceed to enter the field (McMillan & Schumacher, 2014). Transparency in a traditionally organized structure helped the researcher to persuade the community authorities to grant permission to partner freely with the community subjects.

Semi-structured interview questions allowed fairly specific follow-up interview questions and for the participants to provide open-ended responses compared to broad unstructured questions (McMillan & Schumacher, 2014). The participants were free to express their views. Therefore, semi-structured interviews of at least an hour in length were conducted following a predetermined interview guide.

Creswell (2013) points out that data collection means developing means for recording information both digitally and on paper, storing the data, and anticipating ethical issues that may arise. According to Henning et al. (2013) interviews may be scheduled for a specific time. The researcher used two audio recorders, a notebook, a suitable private venue with comfortable sitting space, spare batteries for the recorder and a signed consent form. Audio tape devices were used to record the interviews which were then transcribed and translated for contextual analysis. The researcher took notes to help formulate questions and probes, and to record nonverbal communications which facilitate data analysis (McMillan & Schumacher, 2014).

3.6 DATA ANALYSIS

Qualitative analysis takes place throughout the data collection process and connections. The researcher constantly reflects on impressions, relationships and connections while collecting the data. The search for similarities, differences, categories, themes, concepts and ideas forms part of the continuous process of data analysis. Qualitative data analysis elicits meaning from data in a systematic, comprehensive manner to explain or make sense of the enquiry through an analysis process (Henning et al., 2013).

Tesch (1990: p95) identified some principles appropriate for most types of qualitative research (QR) analysis processes, which guided this research project (Smit, 2001). The researcher commenced the analysis with reading all the data and then dividing the data into smaller and more meaningful units. The text from interviews, focus group discussions, observational notes

or memos were typed into word documents during transcription. Subsequently, the data units were organized into a system that was predominately derived from the data, inductively. The researcher used comparisons to build and refine categories, to define conceptual similarities and to discover patterns. The categories were modified during the analysis to reflect the participants' perceptions.

3.6.1 Data storage

The transcribed interview data, the audio tape records, and the observation schedules will be stored by the researcher for a period of five years locked in the researcher's hardware for future research or academic purposes in the researcher's safe lockers. Electronic information will be stored on a password protected computer.

3.7 RELIABILITY AND TRUSTWORTHINESS

According to Creswell (2013) many perspectives and terms exist regarding the importance of validation in qualitative research. Lincoln and Guba (1985) made use of alternative terms that apply more to naturalistic axioms. Similarly, Denzin et al. (1994) proposed criteria for evaluating qualitative findings and enhancing trustworthiness. These criteria can be incorporated into both research design and in assessing qualitative findings.

3.7.1 Credibility

The inclusion of member checking into the findings, that is, gaining feedback on the results from participants, is one method of increasing credibility. The processed interview transcript data record was shared with the participants. This process was intended to reduce the researcher's perceptions and assumptions in the results. The participants were presented with the outcomes before the final compilation of the thesis.

3.7.2 Transferability

This refers to the degree that findings can be transferred or generalized to other settings, contexts or populations (Guba & Lincoln, 1981). The findings and conclusions of the research study will be verified with existing documented literature and theories on traditional farming systems (practices) of maize, to interpret, corroborate data and to broaden one's understanding (McMillan et al, 2014).

3.7.3 Dependability

This pertains to the importance of the researcher accounting for or describing the changing contexts and circumstances that are fundamental to qualitative research (Guba & Lincoln, 1981). The researcher will identify new emerging themes from the collected data during contextual analysis and modify the research design. The new issues will be returned to the participants for further understanding during inductive reasoning (interrogation). This exercise will strengthen the reliability of the research findings because indigenous agricultural practices are less likely to be recorded by indigenous farmera .

3.7.4 Conformability

It refers to the extent that the research findings can be confirmed or controlled or collaborated by others (Guba & Lincoln, 1981). The Eswatini National Archives officers at the museum centre who document and preserve the historical traditional lifestyle on traditional ceremonies and farming practices be consulted to confirm the research findings and conclusions.

Cohen and Crabtree (2006) say that triangulation involves using multiple data sources in an investigation to produce understanding and provide the most insight. It is a method of collaborating findings and as a test for validity. It is checking out the consistency of findings generated by different data collection method. The observation and documented museum historic articles, as part of data collection, will be triangulated with semi structured interviews to provide collaborated evidence to shed light on a theme or perspective during data analysis (Creswell, 2013).

3.8 CHAPTER SUMMARY

This chapter gave details about the research method that was followed in this study on indigenous agricultural practices for climate change resilience and food security. The theoretical approach identified suitable for the study is phenomenology. The semi structured interview guide was developed and administered to both individual and focus group discussion participants. Twenty-four (24) indigenous knowledge practitioners and eight (8) primary schools' agriculture teachers were involved in the study. Their selection was based on the purposive sampling procedure. Face to face recorded interviews were conducted before transcription. The textual analysis approach was then used for analysis of the collected data.

An observation schedule, museum documents and notebooks were also used to complement the information on indigenous agricultural practices. The next chapter will be on the presentation of findings.

CHAPTER 4

PRESENTATION OF FINDINGS

4.1 INTRODUCTION

This chapter will present the findings of the study. The study explored the indigenous climate change interventions employed by Emaswati maize farmers as disaster risk reduction preparedness for sustainable food security in the rural areas. Moreover, the knowledge and views of interviewed primary school agriculture teachers for grade 6 and 7 on indigenous knowledge systems would be highlighted. The following are the research questions the study sought to find answers for based on the research objectives mentioned in chapter one. The questions include the following;

i. What are the local indigenous agricultural practices related to maize production that Swazi indigenous farmers are conversant with?
ii. How do indigenous farmers implement the indigenous agricultural practices during maize growing?
iii. What are the indigenous climate change preparedness strategies indigenous maize farmers possess for disaster risk reduction in relation to maize farming in the Dry and the Wet Middle-veld rural areas?
iv. What are the current climate change interventions adopted by Swazi indigenous maize farmers that can be employed for development of teachers' competencies for disaster risk reduction preparedness in Eswatini?
v. What is the implication and possibilities of integrating indigenous agricultural practices into the primary school modern agriculture curriculum for grade 6 and 7 levels in Eswatini for climate change disaster risk reduction preparedness?

The findings were grouped into thematic categories. According to Schumacher et al. (2014) categories (or themes) are entities comprised of grouped codes. A single category is used to give meaning to codes that are combined. Similar codes are put together to form the category because they represent a main idea during data analysis. The technique of comparing and contrasting is used in practically all intellectual tasks during analysis. The goal is to identify similarities. Categories may be derived from research questions, the interview guide or data, may or may not be retained in the final analysis.

DESCRIPTION OF PARTICIPANT CHARACTERISTICS

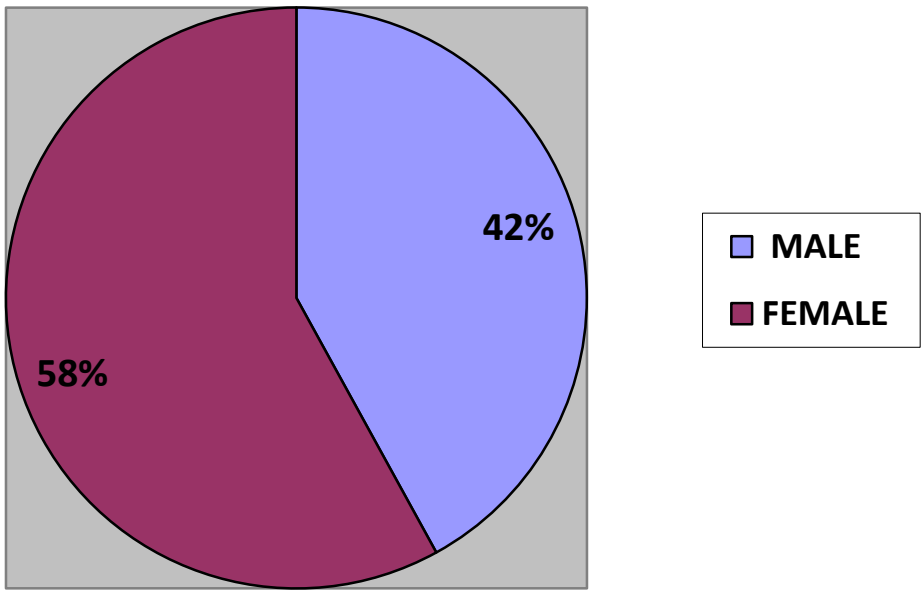

Figure 2: Classification of informants by gender in percentages

The pie chart (Figure 2) represents the indigenous farmer informants by their gender. The chart reveals that the studied participants comprised more females than males during the scheduled interview sessions. This in agreement with FAO (2020)'s findings that in developing countries most women's work is devoted to agriculture. Women are involved in every stage of food production. Naturally, females tend to dominate the agricultural activities in their community at subsistence level compared to their male counterparts.

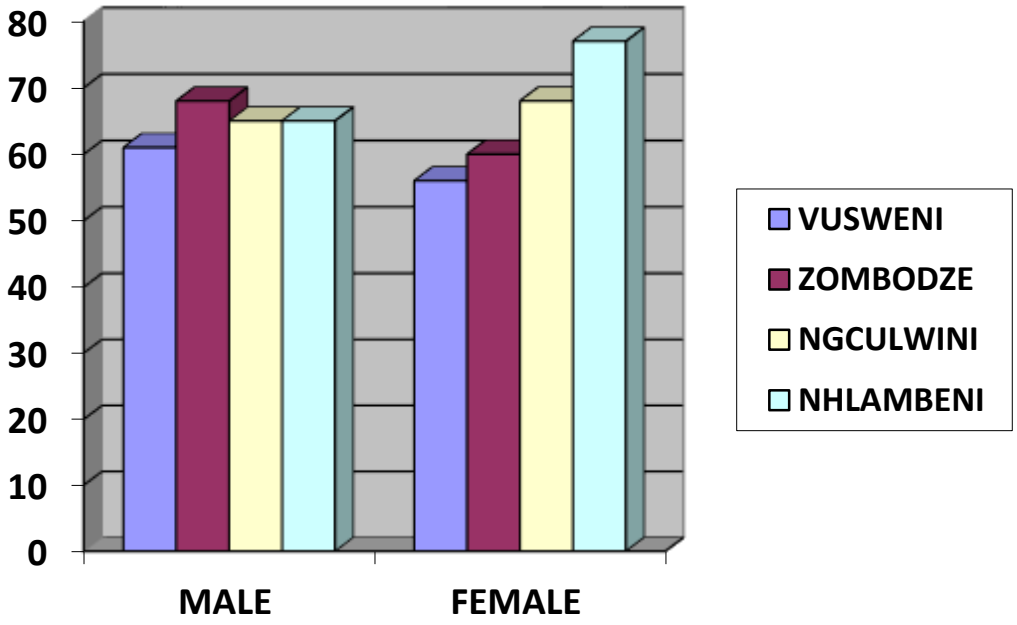

Figure 3: Classification of informants by their average age

The bar chart (figure 3) represents the indigenous farmer participants by their average age. Participating male and female informants were aged 64 and 65 years on the overall average respectively. When comparing their designation by average age, participants above 60 years were mainly located in the Dry Middle-veld of Eswatini at Ngculwini and the Nhlambeni communities. The rest of the participants in the Wet Middle-veld were either at or below 60 years of age.

In the Wet Middle-veld region there is evidence of strong subsistence farming and practice of indigenous agricultural practices. The data further reflected that some participants in both Dry and Wet conditions were either single, widowed or young adults without parents.

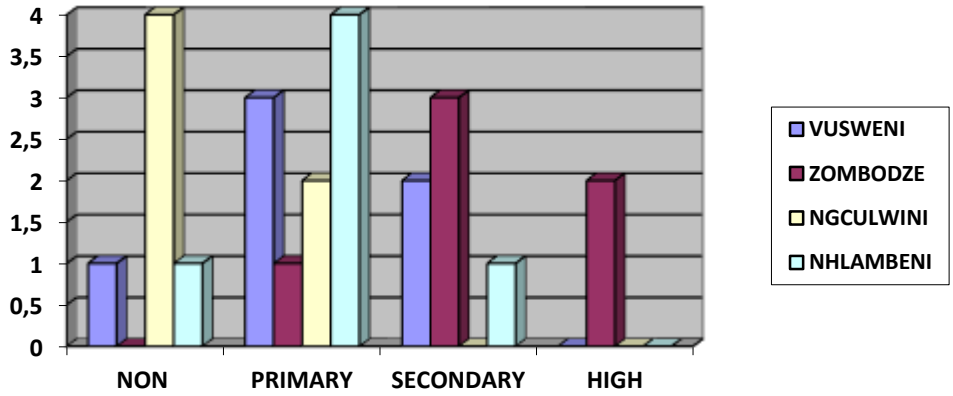

Figure 4: Classification of informants by education level

The bar chart (Figure 4) represents indigenous farmer informants by their education level. The majority of the farmer participants had either primary or secondary and high school education. In terms of education, on the average most (67%) of the participants had attained primary education and secondary school level and a few (8%) had completed their high school education. The reason being that the participants were in close proximity to two Eswatini National Schools in the Wet Middle-veld. However, 25% of the participants did not attend school at all and these resided in the Dry Middle-veld.

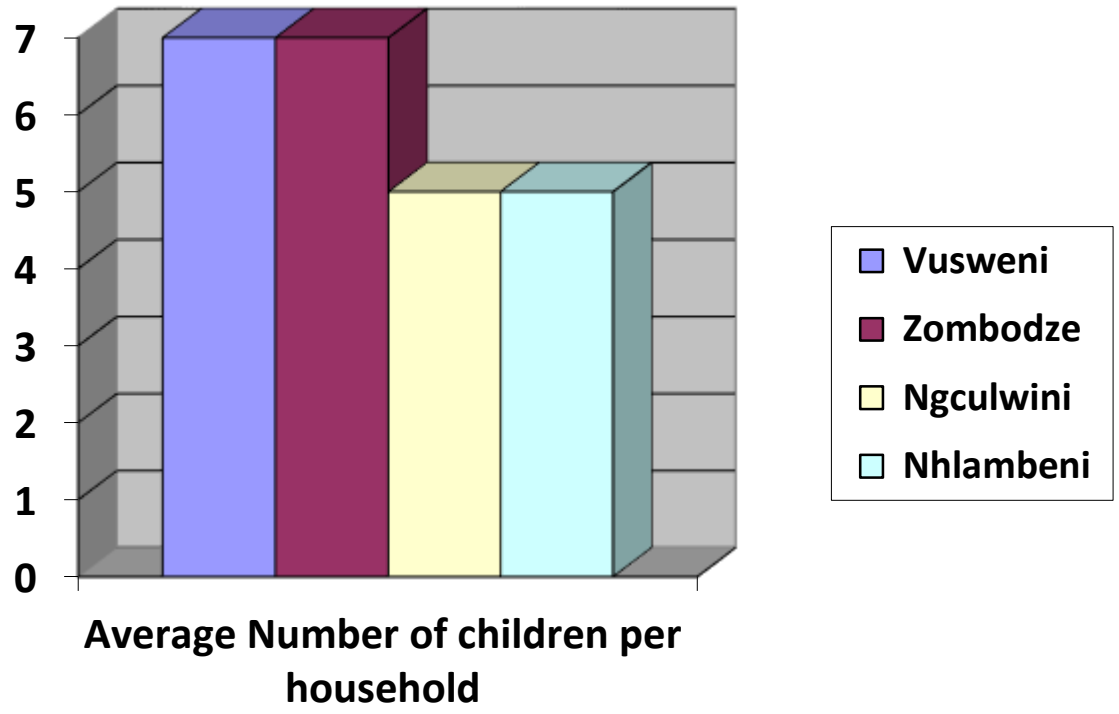

Figure 5: Classification of informants by number of children per household.

The bar chart (Figure 5) represents indigenous farmer participants by the number of children per household. Participants had different family structures, either single headed, monogamous or polygamous families. Each farmer participant family structure had between 5-7 children on the average per household. One unique family arrangement under the Zombodze chiefdom had 16 children from three wives in a polygamist structure. A Chiefdom *(umphakatsi*) is a Royal Kraal that has traditional structures where traditional practices and customs are practised in Eswatini. According to Dlamini and Manana (2014) there are approximately 56000 homesteads in Eswatini on Eswatini Nation Land , with about ten people living in each homestead.

4.1.1 FIELD OBSERVATIONS

The researcher observed that indigenous agricultural practices were still evident in the designated areas of the Middle-veld of Eswatini. The field observation schedule produced six main thematic categories, namely:

Theme 1) farm power, theme 2) moisture conservation, theme 3) information dissemination, theme 4) soil treatment and theme 5) traditional food crops.

Theme 1, farm power: The labour intensive farming activities included planting, weeding and harvesting by hand in all the designated communities. The operations were carried out by family units and/or community cooperatives (lilima).

In both Wet and Dry Middle veld communities, indigenous farmers had transformed the manual soil tilling operation by substituting it with tractor hire tillage services. Animal draught power included oxen and donkeys (few) for pulling weeding equipment for some household. Women generally dominated the operation of the subsistence sector on agricultural land use. However, the land was owned by the males as head of the family. Dlamini and Manana (2014) observed that the average size of a homestead's agricultural land is 2.5 hectares. In my view there is a gradual shift by subsistence farmers from manual labour to mechanization on the tilling (ploughing) farm operations.

Theme 2, moisture conservation: In the Wet Middle-veld designated communities, farmers planted near riverbanks or streams to facilitate furrow irrigation of their maize plants and to support plant growth. There was also intensive use of cattle kraal manure in maize production. Sanghi and Kerr (1991) observed that indigenous methods for conserving soil fertility and moisture enhance biological activity to take place in the soil instead of leaving it dry.

In the Wet Middle-veld, the farmers used wetlands during the dry period for vegetables and livestock grazing. The Wet Middle-veld had occasional drought conditions and the maize crop was rainfall fed. The Ngculwini farmers in the Dry Middle-veld had not cultivated due to drought during the time of the study. Their surviving animals depended on water reservoirs (tinkelebu) for drinking water. The Nhlambeni community (Dry Middle-veld) planted early during the first rains and experienced losses in December 2019 during the time of this research. Under more favorable weather conditions, the communities usually made a good harvest from early planting. Some of the Nhlambeni individual indigenous farmers had boreholes from a

reliable water-table for irrigation purposes. The same community (Nhlambeni) had a wetland in the valleys without reservoirs for water catchment and it also had access to clean tape water supplied by the Eswatini Water Cooperation Services water treatment plant. In the studied communities in both the Wet and Dry Middle-veld, except for Vusweni, the land for traditional agricultural production is now sold illegally by rural dwellers for residential purposes through the '*kukhonta* system'.

Theme 3, information dissemination: In both Wet and Dry Middle veld communities, indigenous farmers received information on farming through the news media (Television, radio, newspapers), within cooperative members, from leadership (*umphakatsi*), from the weather meteorological station and traditionally by observing animals and plants' behavior. In the Wet Middle-veld wild birds that traditionally signaled planting time (known as '*phezukomkhono*') were disappearing.

Chipungalelo (2015), in his research findings on indigenous knowledge sharing strategy indicated that farmers used a socialization approach to share indigenous knowledge. Indigenous farmers in the Middle-veld communicated using proverbs (tisho) to enrich and make conversations more meaningful during community interaction. The proverbs include 'inhlanyelo icelwa esininini' **(**Meaning that you seek support or help from a friend or relative). The museum had displayed pictures of calabashes made from traditional dried fruits as containers for drinking and preparing sour milk, '*emasi*'. According to the researcher's findings information dissemination is crucial for the preservation of indigenous knowledge practices.

Theme 4, soil treatment: In both Wet and Dry Middle veld communities, indigenous farmers used animal manure (mainly cattle, goat and chicken manure, and donkey manure in the least). The studied Middle-veld had animal kraals and home structures built on the upper side of the fields to shed slurry (manure) into the field for soil treatment. Winter was time for manual kraal manure distribution in the field in the Wet Middle-veld and the Nhlambeni communities. The Nhlambeni community grew traditional pumpkins *(litsanga*) together with maize. The Wet Middle-veld indigenous farmers kept legume seeds for planting with maize such as beans, peas, groundnuts and cowpeas. Some farmers rested part of their fields for 1-2 years. Alders et al. (1991) assert that farmers recycle nutrients by using nitrogen fixing and deep-rooted plants, fallowing and rotations. The Ngculwini community were involved in animal production and

other business-related activities involving non-governmental organizations such as sewing of school uniforms and bags.

Maize fields were also intercropped with tubers and calabash (*liselwa*). Night kraaling was found to be common practice with all the livestock rearing indigenous farmers. In both the Wet and The Dry Middle-veld communities' cattle, goats and indigenous chickens were reared for social significance, meat and as sources of manure for crop production.

Theme 5, traditional foods: The designated communities used different traditional foods. Legume seeds were consumed as relish with porridge made from maize meal. Farmers had cribs for maize drying. Wild plants such as '*emahala*' were harvested as vegetables. Other traditional foods included sweet potatoes, leaves harvested from amaranthus species and *ligusha* (okra). Some farmers also practiced traditional fishing for livelihood sustenance.

During drought conditions, the farmers rationed their foodstuff by reducing the size of the meal on the dish plate per day, or the number of meals from three to one per day during severe drought as a coping mechanism. In the dry areas of Ngculwini, water supply was sourced from stagnant reservoirs for drinking and cooking. A water tanker supplied water at a fee for a 5000ml tank capacity, but this was not sustainable. In both the Wet and Dry Middle-veld communities the majority women participants were more focused on the nutritional status of their families and vulnerable community members, especially the school going and orphaned children. In support of this observation, FAO (2020) studies have shown that women use almost all they earn from marketing agricultural products and handcrafts to meet household food needs.

4.1.2 ANALYSIS OF INTERVIEWS

4.1.2.1. Perception of Informants on Indigenous Agricultural Knowledge

The informants were asked to reflect their understanding of the concept 'Indigenous Agricultural Knowledge' within the fields of agricultural development and environmental conservation. The subsistence farmers were found to be knowledgeable and expressed similar views with those known by the researcher on the concept of 'indigenous agricultural knowledge' and used similar examples. The indigenous farmers indicated that it was a traditional lifestyle, a traditional method of agricultural production and a cropping system

which was dependent on natural rainfall for a livelihood. Examples of traditional seeding materials that they mentioned included traditional maize varieties, beans, cowpeas, sweet potatoes, sorghum, groundnuts and pumpkins (emaselwa, ematsanga) as some of the traditional food crops.

The indigenous farmers highlighted that traditional food crops were grown by adding organic fertilizer materials such as animal manure. Irrigation methods, when applied, were dependent on availability of natural water sources. Livestock rearing was considered the core business of men and most farming operations were performed by using manual labour done by women and children. They reflected that the indigenous agricultural knowledge embraced indigenous practices that were transferred orally or by hands-on experience to their children during farming interactions.

All the participants perceived that the indigenous knowledge was applied for livelihood sustenance such as to stabilize food security and good health status of the household within the community. The males (25%) in the Dry Middle-veld felt that in this century indigenous agricultural knowledge was now just a narrative to the youth. In consensual agreement, they pointed out that the education system in Eswatini was dominated by the Western education that encouraged adoption of modern technological practices. One (male) participant from the Wet Middle-veld was noted to have transformed the family field operations from using the indigenous agricultural knowledge practices to modern farming practices. This participant had adopted new technologies such as the application of commercial fertilizers, use of insecticides and tractor hire services for maize production. The farmer had seen a major change of output levels. However, a lack of financial support for inputs limited his farming operations.

Most women (58%) participants stated that they had positive results from the application of indigenous agricultural knowledge practices. They indicated that the addition of manure for local maize production gave them excess yield for sale and they were in favour of indigenous agricultural practices. All the women participants marketed their tasty organic maize product that was in high demand in towns and wished for less interference from the state through the Ministry of Agriculture advocating for the use of new technology. The applied indigenous agricultural practices in the communities were not documented.

4.1.2.2 Reflection of participants on climate change interventions

4.1.2.2.1 Climate change interventions related to indigenous agricultural practices adopted for maize production in the Middle-veld region of Eswatini.

The researcher asked the participating indigenous farmer to highlight examples of climate change interventions related to indigenous agricultural practices (IAP) adopted for maize production in the Middle-veld region of Eswatini. The results in Table 2 indicated some similarities in the intervention measures applied by indigenous farmers in both the Wet and the Dry Middle-veld regions.

Table 2: Summary of the Indigenous agricultural practices for Climate Change intervention

DRY MIDDLE VELD	WET MIDDLE VELD	SIMILARITIES
Climate change a new phenomenon to the elders in the Dry Middleveld (Drought a short span experience-water and heat stress period: Not the whole year	**Drought condition rare in the Wet Middleveld Except for year 2015/16.**	

• Store excess harvested maize in (underground) storage facility. • Rotate maize with groundnuts (to replenish soil nutrients). • Excess maize and cowpeas (mngomeni) harvest shared amongst households. • Diversify maize with sweet potatoes like a cover crop and complement with *sorghum* for food security (Drought tolerant crops) to add value to food chain.	• Prevention of deforestation of indigenous trees. • Draw water by canals for irrigation from perennial streams and rivers close by. • Deep ploughing. • Plant by riverbanks (to utilize fogs and dews to give moist to crops) • Cultivate and open continuous furrows to trap run-offs.	• Early planting. • Staggered planting until the end of rain period. • Plant indigenous seed varieties. • Observation and prediction of rain by interpreting behaviour of plants and animals. • Addition of animal kraal manure to crops. • Pray for the rains and the King performs sacred ritual on behalf of the community. • Intercrop maize (with pumpkins, soya beans, Pumpkins used as soil/ground cover).

The participants revealed that the application of indigenous agricultural practices derived from experiential knowledge that was shared during interaction within families, from heads of families and from interactions at community level.

One of the Vusweni community key informant in the Wet Middle-veld region argued that,

'Balimi kufuna kutsi bafundzisane ngekushintja kwesimo selitulu kantsi futsi nemimango ngalokunjalo ifundziswe ngetindlela ltikhona tekumelana nako kushintjashintja kwesimo selitulu. Kushintjashintja kwesimo selitulu kuletsa tehlakalo letifaka ekhatsi sagcotfo kanye nemimoya leta nelitulu lelinyenti. Timo letinjena ke tivame kusituma ngoba sisuke singakatigadzi". ('Farmers need to educate one another about climate change and communities should be empowered on climate change resilience practices. Climate change comes with disasters such as hailstorm and windstorms which are normally accompanied by heavy rainfall. Such weather often catches us off-guard because of its unpredictable nature').

Another participant from Nhlambeni community in the dry Middle-veld observed that,

'Balimi bangawusebentisa umcuba wetimfuyo tabo ekufundziseni umhlaba wabo, kepha mancoba ngulemvula ngobe umcuba utawushisa umbhila wakho emasimini uma libalela kakhulu. Kepha uma tibuya timvula uyavuka usimame ncono kunalowe silumbi'. ('Farmers could improve soil status by adding animal kraal manures, but adequate rain is very crucial hence without it your maize crop might get destroyed by such manures. However, with adequate rains maize crop planted using indigenous seed may have a better chance of recovering from elongated water stressed period').

Other participants from the Ngculwini community in the Dry Middle-veld articulated that,

'Somiso siyohlala sikhona, kepha tsine sikhule kute indlala, besingayati. Balimi abanganaki kuya emasimini kuphela, abafuye tinkhukhu, tingulube, netimbuti kuze kube nekudla lokwanele'. ('Drought is inevitable in the farming industry, even though we grew up not experiencing hunger ourselves, farmers need not only focus on crop production but diversify into livestock farming to include indigenous chickens , piggery, and goat production as means of ensuring food security').

One participant from Vusweni community in the Wet Middle-veld narrated that,

'*Bengikhala onke lamalanga ngoba bekusuke kuphume sishakato sembila lesincane kanjalo ngivune sivuno lesincane sembhila ngekweswela umncuba. Indzawo yami bekutsiwa ine sona, (Striga species or witch weed). Kojwa umuntfu wankulukulu wangisisela tinkomo. Senginemcuba lomuningi….lofike wanciphisa futsi*

utawulishabalalisa lelikhula le -sona (witch weed). Ngisebentise nje lomcuba wetinkomo ensimini yami sivuno sami sesiyandza nyalo. Ngatsela umcuba ngabona umbhila uphakama. Heyi!, ngikhipha tibhuluja letingaka (Avule tandla). Kulomnyaka lophelile ngivune ngatfola sivuno sembhila lengingazange ngisitfole (lesinengi) ngenca yekusebentisa umcuba wetinkhomo. Sivuno sami ngisifaka ethangeni bese ngiyawatsengisa lamanye emasaka embhila kutfola imali yekulima emnyakeni lotako'. ('I used to cry every day from experiencing poor tasselling and harvest due to not having manure. My field was also infested with striga species or witch weed before my neighbour loaned me some of his livestock. I now have plenty kraal manure that I have used in my field. Since then the parasitic weed has been reduced and will disappear. The yield has started to increase now. Hey! I am harvesting big cobs of maize now (gesturing with the palms of his hands). Last year I received a big harvest from which i sold some to generate money for the next farming season').

The findings revealed that Eswatini subsistence farmers conducted experiments in nature, were innovative, performed field trials and made risky decisions in maize production for the welfare of their households. Indigenous farmers are decision makers, which is congruent to good leadership skills.

4.1.2.2.2 Implementation of the indigenous agricultural practices

One research question asked the participants to describe the procedure involved in the implementation of indigenous farming practices. The procedure for implementation was mainly through narrative knowledge transfer and implementation of practices, as discussed in the sections that follow:

4.1.2.2.2.1 Indigenous seed selection

The indigenous farmer selects big reddish maize cobs bearing dried seeds, free from pest damage and shrinkage, having a broad surface and heavier in weight. When planted, huge seeds have striving strength in the soil before emergence. The good seed for planting is taken from the middle region of the selected cobs or from the whole cob as long as it has good weight. Local seed varieties are characterised by a mixture of dark (black, purple, red) and white seeds (variegated cobs). Farmers tie the husks and hang the cobs on the roof top rafters of the kitchen

hut for drying and protection from pest damage by smoking. Alternatively, they allow the cobs to dry in the sun in maize cribs for shelling by either beating the cob with wooden rods in sacks or brushing on portable rough sized stones by hand before storage. The seed for planting is preserved for hand planting that year using aloe ash in maize tanks and 20 litre containers (2 full spoons of aloe ashes are spread when half full and additional three spoons are sprinkled at the brim before closing the tank/container). Women would prefer broad size seeds for handling and good seeding (germination) rate when dropped in the planting furrows. The seeds have a higher germination percentage rate and are damage free. Males mostly use the small seeds from the other parts of the cob using oxen drawn planters.

4.1.2.2.2.2 Traditional storage facility

In traditional storage pits (Ingungu yembila), an appropriate site is located close to the house. The indigenous farmers avoid wetlands and land with a high water table to keep the stored produce dry. Traditional assessment methods were used to test the soil for its suitability before digging. The storage facility has a capacity of more than six bags of maize and the size varies depending on the number of the reared animals. Where there are many animals, about eight storage pits are possible, and the amount of kraal manure accumulated increases its suitability. An underground clay pot-shaped pit facility is dug in the centre of the cattle kraal. It has the same dimension on the floor width and height as a matured man's height and breadth. Its preparation involves smearing the floor and the wall sides with cow dung. Weaved grass is laid to cover the floor and the sides from bottom to the mouth. A thick flat stone sealed with cow dung covers the mouth of the storage facility after it has been filled with grain. The condition inside the storage pit is kept airtight to suffocate any pests by covering the storage pit with cow dung.

4.1.2.2.2.3 Animal manure application

When in abundance, kraal manure (*umcuba*) is taken to the field and left in heaps to cure in winter. This activity takes place from May to September, before it is spread evenly over the field by hand or spade at the appropriate time. This also prevents the kraal material from drying up and preserves the moisture and nutrients in it. Manure spread too early becomes hard clod and difficult to break. The heaped manure is spread evenly to cover the open field after the first drizzles and showers (*imbozisa emahlanga*), before the tillage operations. The October month is the latest in preparation for taking advantage of the early rains. Tilling to bury maize straws

and plants helps to add humus to the soil for holding moisture and soil nutrients replenishment in soil treatment.

When animal manure is not available in adequate quantities, the indigenous farmers request some from neighbours. They sprinkle a handful of manure in opened holes during planting or in shallow opened furrows left by an oxen drawn plough. The indigenous farmers avoided planting during the December month because maize was highly susceptible to long heat waves that result in stunted growth.

The animal kraals were usually built at the upper side of the maize fields. On rainy days, the slurry from the kraal gets washed down over the field below by run-offs to become manure. However, plants grown in water stressed soils rich in kraal manure tend to die easily from heat stress. Traditionally, animal kraals were relocated to new sites regularly. Such sites had the potential to produce a good maize harvest even after ten years.

Sometimes maize straws and remains of the standing hay were dumped in the kraal to mix with animal dung and urine. The fenced boundaries allowed grass strips (1-3 m wide) to grow between the contour ploughed maize fields. In summer the grass strips produced biomass which became additional material for compost making. The biomass in the grass strips was protected from uncontrolled bush fires. Often kraal manure material was added to the soil during planting or buried during cultivation.

Kraal manure is susceptible to cutworms (*umswenya*) and other insect pests (*tilwanakatana*). The kraal manure is left in half barrow size heaps in the field and indigenous chickens are allowed to pick the cutworms or the larva. Alternatively, the kraal manure was exposed to the full heat of the sun throughout the winter season. The sun heat exposure killed the pest population and destroyed young germinating weed plants in their early stages of growth. These pest population management tasks reduced the need for gap filling areas in the field where the seedling had been attacked. The task of spreading animal manure was done by household members.

In the Eswatini communities the house structures were built closer to the animal kraals for security and for ancestral worship, and below were located the fields for crop production. Often the location at the lower end of the kraal was fertile and favoured for the planting of maize and pumpkins.

4.1.2.2.2.4 Crop rotations

Indigenous farmers tended to rotate their maize fields with different field crops for 3 years and then follow this with maize crops on the 4th year. At first, they grow with sweet potatoes, which respond positively to kraal manure, followed by cowpeas, and lastly groundnuts before replacing them with the maize crops. The crop rotation enabled the household to change the family menu for building up a healthy body. Alternatively, the maize fields were allowed to rest to build up the soil for 2-3 years.

4.1.2.2.2.5 Maize intercropping with pumpkins

Hoes and continuous furrows were useful means for seed planting by the majority of indigenous farmers. The furrows for sowing (planting) were not in straight likes as in conventional agriculture. The furrow lines were either produced by following the ox-drawn plough or alternatively use of hand hoes. The informants from the authorized chiefdoms reflected that maize produced more in fields planted with beans but had no clue about the cause. The farmers had limited information on their intercropping maize experience with dry beans. The indigenous farmers who intercropped maize with pumpkins had weed populations smothered in the mixed stand.

The indigenous farmers increased the pumpkin seed population during intercropping with maize. The mixed stand responded positively to rich soil with kraal manure material. The spacing for pumpkin is 3m-5m intervals within the planting row for maize. The maize seed is normally placed at 20cm intervals (hoe width) within the row for weeding around individual plants. Farmers plant in opened furrows by hand using hoes (depth 7cm). After five paces, they then drop two pumpkin seeds per station and repeat the same procedure throughout. The first furrow is planted, then the soil from the second farrow is used to bury the seeds, the third farrow is skipped and then the forth is planted for the distance between the rows. The distance between the planted rows is estimated at 50cm -75 cm apart. Farmers would also alternate rows of maize and pumpkins. Traditional seed varieties and manure were used during planting. Manure was again added after germination, particularly to seedlings that exhibited nutrient deficiency. Pumpkins responded positively to kraal manure application. Early weeding allowed pumpkin crawlers to spread and produce broad leaf covers under the maize stand.

Alternatively, the seed was placed in the furrow floor at the planting depth equivalent to furrow depth using oxen span (20cm). The distance between the rows, was separated by 3-4 furrow

lines before the next planting row. Within the planting row the pumpkin and the maize seed were alternated in the planting stations with dry kraal manure applied in each station and then covered by soil furrow slices. The normal walking step was an instrument for measuring the distance within the rows during planting.

One of the participants from Nhlambeni community in the Dry Middle-veld alleged that,

> *"Lombila uhlanyelwa netinhlumaya letikudla kwesintfu lokusembili. Kuhamba kanye-kanye netingomeni nobe tindlubu nakute tinhlumaya. Tintsanga tona betingahlala! Kuyatsandzana nembhila kuyimvelo. Kepha tifuna usheshe uhlakule tingakacali kunaba. Tintsanga tatisita kunciphisa lukhula. Asilati libhotjisi."("This maize is intercropped with cow beans which constitutes a good traditional dish. You can substitute split peas with jugo beans or cow peas. Pumpkins also naturally grow well with maize however early weeding is required before plant tops start spreading under the maize plants. Pumpkins are known to decrease weed population. However ,we are uncertain with bean planting.").*

Other participants from Zombodze community in the Wet middle-veld concurred that,

> *"Kwakukunengi lokunnye kwakuhlanyelwa kanye kanye nembhila.Lenhlanyelo yembhila wawuyibhicanisa kanye nenhlanyelo yemajoti, nemaselwa nobe nemabhontjisi futsi. Kepha lombhila bewuvama kuba muhle uma uwuhlanyela kanye nemabhontjisi.Asati kutsi bekwentiwa yini."(Many field crops used to be intercropped with maize, such as melons, calabash or beans. The maize plants strive well when intercropped with beans. However, we're uncertain of the cause for such.")*

Another participant from Gculwini community in the Dry Middle-veld added that,

> *"Umbhila kanye nemantongomane nako kuyavuma. Kepha uma ukudidiyele bese kuyalwa. Ngiko bese kuba nemleyi lehlukene ngesilimo ngasinye ensimini yinye kulandzelane kuphidzeka njalo uze ucedze." ("Maize crop does well when intercropped with groundnuts. It should not be integrated in the same planting row with maize though since it does not thrive, but should be planted apart in single rows or double rows. The maize and the groundnut rows should be alternated.")*

The family farm activities ceased for a day when the community experienced a hailstorm disaster (*uyatila*). It was also noted that Sundays were also used for doing farm work.

4.1.2.2.2.6 Maize treatment with water.

During drier planting seasons seeds may be given a pre-treatment to hasten their growth. The procedure involved soaking the maize seeds in normal water for 3 days and then allowing them to drip under the shade. The treated seeds were then planted in holes. Farmers moisten the holes with a lot of water before sowing the soaked seeds to avoid adding more water in the afternoon. Such treated maize germinated early. This treatment sustained the growing plants until the arrival of first rains.

The participants from Vusweni community in the Wet Middle-veld discovered that,

> *"Uma kunesomiso lombhila uwenya emantini emfula emalanga lamatsatfu ebhakedeni uwumbhonye .Uyawukhokha uwubeke esakeni utowuphompha elangeni lesine. Bese uyawuhlanyela umanti. Lokukwenta kutsi lombhila usheshe umile. Sikhuluma ngembila wesintfu lapha. Tsine sisetintsabeni letisenkhangala kuba netinkhungu kelapha ,kufike ematolo, lakhulisa lombhila wetfu."("During drought conditions, the indigenous maize seed is soaked in ordinary river water for three days in a covered bucket. On the fourth day it is put in a sack to drain before planting the seed engorged with water for quickened sprouting. Since we are located on the mountains of the Highveld we have the advantage of experiencing frequent fog and mist which produce dews (wetting) that sustain our maize fields").*

4.1.2.2.2.7 Observation and prediction of rainfall

Gugulethu, Stigter and Walker (2013) pointed out that traditional rainfall prediction refers to various environmental indicators that are locally used to interpret weather (climate) conditions to be expected. Such indicators included observation of the emergence of white ants to predict summer and the onset off early rains, and the behavioural patterns of birds and mammals.

According to Mlipha (2004) if winter rains occurred around the end of July, it meant the summer rainfall situation would be good for farming. '*Imbozi samahlanga*' means rainfall that occurs to facilitate the rotting of maize stalks. High temperatures in the summer seasons were usually followed by rainfall. In fact, building up and accumulation of clouds was always associated with imminent rainfall. Rocks on the cliff often 'sweat' and water filtered off the rocks and would flow down the face of the cliff sometimes assisted by indigenous trees such

as '*manono*', '*tikhwelamfene*' and '*spakusho*'. The amount of rainfall to be received was estimated by the amount of 'sweat' the rocks emitted. Plenty of 'sweat' implied heavy rainfall and minor 'sweat' signalled a drizzle. The study established that the farmers attached a higher level of trust and confidence on the indigenous ways of rainfall prediction than in the modern conventional ones.

The studied informants revealed that the birds known as 'lusoti' that sing the sound 'phezu komkhono' were becoming extinct. These birds signalled the beginning of actual engagement in tilling and maize planting operations. The Lusoti birds were now largely unknown. According to Mlipha (2004) when a swarm of 'black swallow' birds would start to fly around this coincided with the arrival of rainfall. The presence of frogs making continuous intense croaking noises and birds such as '*sangoli'* signalled the arrival of summertime in the local environment, and there would be rainfall. The sound of wild doves confirmed the beginning of summertime. The birds forecasted the actual pouring of the rains. The appearance of white clouds was associated with possible rainfall precipitation. Mlipha (2004) recorded that the abundance of fruits of '*Mncwaphe* trees' indicated there would be plenty of rainfall that year. Moreover, a majority of local trees flower early in the summer season if rainfall is going to be normal, including peach and cactus trees.

This study also established that indigenous farmers in Eswatini still observe the Moon phases to predict the possibility of rains during special national occasions. The full Moon coincides with the cutting of the sacred shrub (Lusekwane) by growing boys, and the *Incwala* ceremony (National prayer) is also celebrated during the appearance of the crescent moon where the chances of rainfall are higher. Mlipha (2004) recorded that it was stated that when the moon is facing downwards at its first and last quarter as well as when there is a halo around the moon and the sun indicated good chances of rainfall. In Siswati they say 'iyacitsa' meaning that the moon is pouring water due to its position. Moreover, when easterly winds meet with the westerly winds there was definitely going to be rainfall. Likewise, when warm winds are followed by cool winds rainfall was predicted to occur. Numerous small whirlwinds (*tishingitane*) also indicated imminent rainfall.

In the history of the Emaswati society, some clan names such as the Magagula and the Mnisi clan are still traditionally respected for their rain making ability. Some known Emaswati traditionalists have alleged competency in predicting rain weather conditions.

One of the participants from the Gculwini community in the Dry Middle- veld observed that,

> *"Tindlela tekubona kutsi litulu selidvutane kutsi kuvakale umsindvo wetinyoni 'Lusoti' lotsi 'phezukomkhono', kundiza kwetinkonjane letinyenti letimnyama kanye nemsindvo weticoco emifuleni." ("The imminence of the rainfall season is signalled by sounds of birds such as "Lusoti" or phezukomkhono, frogs in the rivers, and arrival of black swallows .")*

4.1.3 Indigenous climate change preparedness strategies possessed by indigenous maize farmers for disaster risk reduction in middle-veld rural areas.

The participants were asked to enlist indigenous climate change preparedness strategies they possessed for Disaster Risk Reduction (DRR) in the Middle-veld. The outlined strategies for DRR practices included:

a) Construction of small dams for traditional irrigation of family gardens and maize fields to facilitate early planting and escape from drought.
b) Information sharing on drought resilience practices amongst community farmers including rainfall observation and soil treatment practices
c) Preservation of drought tolerant seeds
d) Furrow irrigation for maize
e) Plant maize by the stream and river banks
f) Buying maize from other local producers for food
g) Early planting to take advantage of early rains.
h) Undertaking projects that complement maize productions such as domestication of indigenous chicken.
i) Storing excess maize harvest properly
j) Reducing food rations per day
k) Exchange sweet potatoes for maize with neighbours for food security.

4.1.3.1 Current climate change interventions adopted by Emaswati maize indigenous farmers for disaster risk reduction preparedness in Eswatini.

Participants were asked to outline current climate change interventions in operation for Disaster Risk Reduction preparedness in their communities. The following practices were listed as operational practices in the elapsed farming season.

Table 3: Current climate change interventions for Disaster Risk Reduction preparedness

DRY MIDDLE-VELD	WET MIDDLE-VELD	SIMILARITIES
	Drought not common except in year 2015/16	
• Diversifying maize with other drought resistant food crops • Correct planting space • Staggered planting of maize stands • Intercropping	• Prevention of deforestation • Reduced soil disturbance at planting to trap moist.	• Addition of manure (to soil to retain more moisture) • reducing maize stands/fields and increase bean and sweet potatoes acres • Planting drought tolerant- indigenous maize varieties • Planting early maturing crops to cushion risk involved • Early planting (bury crop remains) by riverbanks (to utilize fogs and dews to moisten growing crops).

		• Storing excess maize in traditional storage facility (underground pit, maize tank) for food security.

4.1.3.2 Implications of integrating indigenous agricultural practice into the grade 6 and 7 primary school modern agriculture curriculum.

Indigenous farmers were asked about the implications of integrating indigenous agricultural practices into the primary school curriculum in Eswatini. The farmers were excited and expressed interest in this transformation. They hoped that this could be helpful with good intentions for good outcomes in the society. The highlighted intentions and consequences, included mainly that:

a) The integration of Indigenous Agricultural Practices (IAP) would promote cultural exchange programmes and sharing of IAK practices amongst African and Western nations for promoting the tourism industry. (Umtfwana (or umfundzi) kutamusita kakhulu kwati ngetindlela tekulima tesintfu sakubo kute atokhona kushiyelana lugwayi nalabanye bantfu lahlangana nabo kulamanye emave ngenhloso yekutfutfukisa tekuvakasha kulamave. ikakhulu ekuhambeni .Ngingabekisa, lena ekuhambeni bayafuna kwati ngesintfu sakini .Ngaba nelitfutjana kubonwa kudla kwesintfu kwe Africa. Tindlela tesintfu matitfutfuke nato nalamagama akhona njengalesilumbi. Asitati natsi tintfo temdzabu.

b) Organic food production is possible with IAP to promote healthy eating habits. (Lombhila uhlanyelwa netinhlumaya, usebentisa umcuba. Tinhlumaya kwakungukona kudla kwetfu. Kwakukudla lokusembili .Nenganwa yayiphekelwa tinhlumaya).

c) Furthermore, there are business opportunities for learners to make a livelihood (Yetfu inhlanyelo siyayibamba. Labawulimile la bayabatsengela lombhila wesintfu kakhulu. Umnandzi ngobe uyanongotela. Futsi imphuphu yawo iyashuba nawupheka liphalishi ,hhayi lokwesilungu).

d) The IAP use indigenous spoken language, which is in support of language development in the education system and for the protection of the local language. (Tindlela tesintfu matitfutfuke nato nalamagama akhona njengalesilumbi. Asisati lesiswati,kutsi lapha ngesintfu , lapha ngesiswati kutsiwani).

e) Some of the IAP preserve and add value to the soil natural environment for sustainable food production. (Nawute umcuba insimi yembila wakho ikhipha imbhashana yetibhuluja kantsi letemcuba tibhuluja ukhandza timemekile).

f) The IAP and their applications should be recorded while the knowledgeable elders and senior citizens are still alive for the youth to access (such as intercropping maize with pumpkins or beans). (Ngobe labadzala bayaphela ngekusishiya emhlabeni kantsi lasikolweni bebatawufike bantfwana balutfole lolwati lwetekulima lwemdzabu. Nawutawufuna labadzala utophidze ubatfole kuphi?).

g) The subsistence sector utilise indigenous agricultural practices as an alternative to the commercial sector for food security at a small scale. (Batfwana batawukhona kutiphilisa ngalesintfu nabahluleka ngalesilumbi. Utawuba netindlela letinyenti tekutiphilisa).

h) Indigenous farmers have field experience and are innovative in stressful environments with the application of indigenous agricultural practices for climate change resilience. (Lokulima usebentisa tindlela temdzabu tiyamelana nelilanga, umbila wakho wesintfu awusheshe ushanywe kushisa kwelilanga. Lombila wesintfu awubese uyashabalala, Uyabuna emini bese ntsambama uyavuka. Ekuseni kusa usimile. Balimi banendlela yabo yekuwukwetisa umbila wesintfu.)

i) In contrast, some informants perceived learners would not consider IAP as their education system since learners are exposed to modern technology that is dominating. (Labantfwana lesinabo ngeke sikhone kubabuyisela emuva. Kungaba kuba cocela njena .Umcuba bayawusebentisa sesisho kepha ngeke bayogala njengayitolo ngalemfundvo yabo yesimanje manje.

4.1.3.3 Comments from farmers on climate change and disaster risk reduction .

- *Siswati text: 'Bokhokho bebadla kudla kwesintfu. Ikhona imphilo ekudleni kudla kwesintfu, nje kakhulu. Lokudla kwesintfu kusemuva, kute letinongo letinengi kakhulu. Futsi kuyakha'.* ('The elderly were in good health condition from consuming traditional food crops they produced').

- Siswati text: "*Bantfu baphiliswa kutsi labanye bahlanyela latakubamba esigidzini sakhe aphile aphumelele njenge kuhlanyela emabele lamela tindzawo letite litulu*". ('Rural farmers should focus on the production of indigenous food crops that favour their regions such as sorghum crops in water stressed areas,').

- *Siswati text: 'Hulumendi wetfu akanamali yekutsi atfutfukise tinhlelo tekulima ngetindlela tesintfu temdzabu*'. ('Our government is poor and does not have budget allocation for funding indigenous agricultural practices program').

- *Siswati text*: *'Singamutsemba hhulumeni kusingatsa indlela yekulima yesintfu ngobe seva kutsi sitakudla .Talukati tagcina tiholile imali yabogogo.Bebatsi labanye siyofa siphele singakaholi.Namuhla bangasho bantfu kutsi hulumende ngeke agucuke abuyele esintfwini mani. Kantsi encenye utowubuyela* **'.** (' We could trust the government with indigenous agricultural practices because she passed the elderly grants act and delivered the elderly grants. Perhaps the government would in turn finance the activities concerned with indigenous practices with time'**).**

- *Siswati text*: '*Kukhipha umcuba kanye nekuwusakata emasimini ngumsebenti longamlungeli longakaphili kahle emtimbeni. Kulabadzala lasebakhulile lokulima kubese kuba lukhuni. Nanginemali ngivele ngicele sigulumba kutsi sitsele emasimini*'.*(* 'The elderly practitioners who own indigenous agricultural practices are old and weak to sustain production in this sector without financial assistance for mechanization').

- *Siswati text: 'Tsina sati kutsi nkulunkulu nguye kuphela lophetse kuphila futsi uyasipha. Nalemihlangano yabo-Climate Change ita kusisisita ngani tsine? Lishona kukhulunywa ngayo. Batawentani, banamandla mani? Naba lahlala*

bamemeta simo selitulu bacambemanga. Imibiko iyaphambana nalabakushoko'. *(*'God is the only life giver. The organized climate change meetings have not produced any good results.').

4.1.3.4 Opinions of primary school agriculture teachers on integrating indigenous agricultural knowledge into the primary school agricultural curriculum in Eswatini.

4.1.3.4.1 Description of the participating agriculture teacher's characteristics

The key informants were selected based on the purposive sampling procedure. These were qualified primary school's agriculture teachers for Grade 6 and 7 with the subject teaching experience participants. In Eswatini, qualified agriculture teachers were assigned to teach these grades with respect to the primary school level. The statistics was to highlight that the subject is taught by both qualified female and male agriculture teachers.

Four (4) participants were located in the dry middle veld primary schools and another four (4) in the Wet middle veld primary schools. The study seeks to capture the knowledge and opinions of educators (teachers) on indigenous knowledge systems for the primary school modern agriculture curriculum review.

The demographic information was presented using statistics. The study revealed that a majority (63%) of the participants were males as compared to females (27%).This highlighted that the subject was taught by both qualified female and male agriculture teachers. The age of the participants ranged between 30 to 53 years with an average of 41 years. All the participants had tertiary education with either Diploma or Bachelor's Degree (B.Ed.) as an individual qualification attainment. On the average, the participating agriculture teachers with marital status (63%) had at least two (2) children and in addition 35 % of the single parents had at least two children. A few (2%) of the teachers did not have any social parenting responsibility. Most (63%) of the married participating agriculture teachers had established monogamy family structures.

The study indicated that the agriculture teachers could facilitate the integration of the indigenous agricultural practices into their school's modern agriculture programme. Therefore, they were a point of contact for curriculum review transformation.

4.1.3.4.2 Analysis of the primary school modern agriculture teacher's interviews

4.1.3.4.2.1 The opinion of grade 6 and 7 primary school modern agriculture teachers on indigenous agricultural knowledge.

The participants were asked to reflect their understanding of the concept 'Indigenous Agricultural Knowledge' in the field of agricultural development and environmental conservation. The primary school's modern agriculture teachers interviewed perceived indigenous agricultural knowledge (IAK) in different ways**.** They viewed IAK as local knowledge unique to a given culture and passed from generation undocumented. The modern school's agriculture teachers indicated that it was practising natural or traditional farming methods for food production such as use of draught animals other than modern methods of farming for environmental protection. The teacher participants pointed out that indigenous agricultural practices were depended on indigenous seeds varieties, manure and on rainfall for growing crops and animals to strive. The indigenous agricultural practices used organic products which were natural and free from contamination. According to Babbington (1919) the indigenous agricultural knowledge that peasant farmers have at any one time is constituted both by the empirical contents of that knowledge and by the principles that underlie its production, organization and meaning**.** Indigenous agricultural knowledge was based on created ideas in quest for survival and continuity of community live.

The authors pointed out that indigenous farmers created and preserved principle of indigenous knowledge practices with quest for the body of knowledge without any documentation. The research question was interrogating how and to what extend the school's modern agriculture curriculum was responding to the needs of the indigenous knowledge practitioners for food security and climate change. Ìndigenous knowledge practices should be regarded as intellectual property for the indigenous farmers.

The school's modern agriculture curriculum should be seen responding to the needs of the indigenous knowledge practitioners for food security and sustainable livelihood.

4.1.3.4.2.2 Eswatini government investment in indigenous agricultural knowledge for food security.

One research question asked the participating primary school modern agriculture teachers to share their views on government of Eswatini's investment in agricultural indigenous practices for food security. The findings revealed that a majority (75%) of the participants believed that the Swazi government should invest in indigenous agricultural cropping practices for sustainable food security. They highlighted that the practice impacted positively on the environment and supported good human health status. According to Reijintjes, Harverkort and Water-Bayer (1992), in early colonial times, perspective observers commended the intricate and careful cultivation methods of 'native 'inhabitants. The activities are an express of local creativity, hence a community legacy. Reijintjes et al (1992), revealed that modern technologies may not be the first option to improve agriculture where the small holders depend on local resources. The concept s of Low –External –Input and Sustainable Agriculture and Participatory Technology Development is a collaborative process in which indigenous knowledge and scientific knowledge are combined to find solutions to farmer's problems and to take fullest possible advantage of local opportunities.

The authors had observed that the improvement of agriculture was a community project undertaking which require community mobilization through collaborative effort from the grassroots level for the new change to be successfully accepted by the community. The content of the intended change must be informed by the wishes of the people the development seeks to improve. The indigenous farmers are adults who know what they need better than the consulting development agencies.

The curriculum content should be informed by those wishes of the community the development seeks to improve without any political interference for sustainable development.

One of the agriculture teachers made the following statement:

> '*Indigenous agriculture practices are reliable and resilient to climate change* and *significant in drought conditions for crop longevity'.*

Nonetheless, a few (25%) participants viewed indigenous agricultural cropping practices as outdated and yielding insufficient produce that did not meet the demand of the ever – increasing

population. The minority group (25%) cited biotechnology, particularly using Genetically Modified Organisms (GMOs), as one of the modern methods that seek to achieve self – sufficiency in food production. The majority (75%) of the primary school teachers were conscious of the health benefits associated with consumption of traditional food crops in indigenous agricultural practices and potential dangers of GMOs.

4.1.3.4.2.3 Engagement of indigenous farmers in decision making on agricultural knowledge practices for use in maize production in ESwatini.

One research question sought to explore views of the participating primary school agriculture teachers on the engagement of Eswatini indigenous farmers in decision making on agricultural knowledge practices for maize production. Half (50%) of the participants pointed out that the government educated indigenous farmers on good yield formation farming practices in Rural Development Areas, especially through the government input subsidy program. However, the government campaigns were biased towards the commercialization of the subsistent sector in contrast to the use of indigenous agricultural practices.

According to Mabuza (2020/2021) the Ministry of Agriculture continues to provide input subsidy and tractor hire services, which have resulted in significant increase in yields over the past few seasons, especially in the High-veld and the wet (moist) Middle-veld. Thompson (2017) revealed that, Eswatini Nation Land (SNL) farmers are encouraged to perform on a commercial basis because agriculture is the major source of employment for the rural households. One could sense a strongly pursued transformative agenda by the Eswatini government towards commercialization of the subsistence sector.

One of the agriculture teachers made the following statement:

> '*Integration of the indigenous agricultural practices into the modern agriculture curriculum is the way to go.'*

4.1.3.4.2.4 Indigenous farmer's preparedness for drought disaster risk reduction.

The primary school's modern agriculture teachers were asked their views on the readiness of subsistent farmers for Disaster Risk Reduction (DRR). A majority (75%) of the teacher participants expressed that they believed indigenous farmers were prepared for disaster risk reduction by themselves. They stated that evidence of disaster risk reduction preparedness

included timely planting to avoid drought, preservation of local seeds to produce drought resistant crops, proper storage of excess harvest to last for the next season, multi-cropping to reduce drought risks, water harvesting in summer and preservation of water in reservoirs.

One of the pro-modern agriculture teachers made the following statement:

> *'Irrigation is the best option and changing to planting of hybrid seeds could salvage the indigenous farmers from the impact of drought in maize production'.*

The minority (25%) of the participants revealed that currently there was no government-driven agriculture related DRR programme in place since the government responded to hazards of disaster rather than empowering the farmers for prevention.

4.1.3.4.2.5 The climate change interventions adopted by indigenous farmers to reduce the impact of climate change.

The participating primary school agriculture teachers highlighted some of the climate change intervention practices for resilience to drought conditions as listed below.

Table 4: Indigenous agricultural practices for climate change

DRR Intervention	Examples
Improvement of soil quality	• Use of organic fertilizer such as mulching • Crop rotation
Moisture preservation	• Conservation agriculture • Use of dam and reservoirs water for irrigation • Use more efficient irrigation system
Protection of natural environmental resources	• Bee protection by venturing into beehive projects • Avoid burning of natural vegetation
Partial farm mechanization	• Mechanization of the cultivation operation
Creation of opportunity for maturity stage attainment.	• Timely planting • Use drought resistant seeds

Most of the above-mentioned DRR preparedness strategies were already being implemented by indigenous farmers that participated in this study and could be integrated or highlighted into the existing primary school agricultural curriculum**.**

4.1.3.4.2.6 Current climate change interventions adopted by indigenous farmers to reduce the impact of climate change.

The participating agriculture teachers highlighted several current climate change interventions adopted by subsistence farmers to reduce the impact of climate change. The climate change intervention agricultural practices in operation passed by were mainly: 1). Use of organic fertilizers such as kraal manure 2). Partnership with meteorological weather stations for prediction of rains 3). staggered planting 4). Provision of irrigation systems 5). Planting of drought resistant crops 6). Use of hybrid seeds and 7). Crop rotations.

One of the agriculture teachers made the following statement:

> *'There are minimal climate change interventions in Eswatini as farmers are now using GMOs cotton seeds and put chemicals for weed control. We must plant early maturing crops to reduce the impact of climate change'.*

The participating primary school's modern agriculture teachers reflected an inclination towards modernization of the subsistent sector for climate change intervention practices.

4.1.3.4.2.7 Examples of indigenous knowledge practices for maize growing in the drought conditions.

The participating teachers were asked to highlight some of the examples of indigenous knowledge practices for maize growing in the drought conditions. These are listed in Table 5 below.

Table 5: Indigenous knowledge practices for drought conditions.

EXAMPLES	METHOD OF IMPLEMENTATION
• Early planting and timely planting	• Plant after the first rains • Shift from early to late planting
• Mixed cropping /intercropping ,crop rotations	• Planted maize seed stations alternated with pumpkins in rows
• Use of conservation agriculture practices	• Minimum tillage or no till
• Irrigation of planted crops	• Roof water harvesting • Trapping runoffs in reservoirs
• Use of indigenous maize seed variety.	• Suitable cobs are selected from the previous harvested crop • Nourish the soil with kraal manure.

The conversation with the primary school's modern agriculture teachers indicated a modern agriculture academic orientation on the issues of indigenous agricultural practices for climate change. There was textbook review reflection rather than sharing of lived or observed traditional farming experiences. This might be due to that the training of modern primary school agriculture teachers at the university and colleges in Eswatini focussing on modernization development processes.

4.1.3.4.2.8 The indigenous climate change preparedness strategies possessed by maize farmers for DRR in the middle-veld.

Table 6 below highlights the indigenous climate change DRR strategies of maize farmers in the Middle-veld.

Table 6: Indigenous climate change preparedness strategies possessed by maize farmers.

THE MIDDLE-VELD	PREPAREDNESS STRATEGY POSSESSED
• Wet middle veld	• Avoid use of herbicides to prevent water pollution. • Crop insurance to reduce impact of losses. • Adopted drip irrigation for conservation of irrigation water. • Improve soil quality by use of kraal manure.
• Dry middle Veld	• Soaking maize seeds before planting • Sprinkling ash over maize to repel storage pest invasion. • Use drought resistant local seeds. • Use early maturing hybrid seed variety to escape drought. • Water harvesting for irrigation.

4.1.3.4.2.9 Implementation of indigenous climate change preparedness strategies by indigenous farmers.

The participating agriculture teachers highlighted implementation of some of the climate change preparedness strategies in maize production as indicated in Table 7 below.

Table 7: Implementation of climate change preparedness strategy

CLIMATE CHANGE PREPAREDNESS STRATEGY	IMPLEMENTATION PROCESS
• Intercropping	No response
• Organic matter addition	• Network with community members for kraal manure procurement. • Engage Extension Officers in RDAs for assistance • Protection of natural resources such as forest vegetation
• Wet land water use	• Gardens used for vegetable and crop production

The primary school modern agriculture teachers revealed a few of the indigenous agricultural practices with little details which lacked response such as on the implementation process of intercropping. This only meant that some of the main syllabus content topic areas in indigenous agricultural practices prescribed for practicals strongly focused on theory rather than transferrable (hands on) experience to the learners for capacity building in maize production.

4.1.3.4.2.10 The implications of integration of indigenous agricultural practices into Grade 6 and 7 primary school modern agriculture curriculum.

The participating primary school's agriculture teachers were asked about the implications of integrating indigenous agricultural practices into the grade 6 and 7 primary school modern agriculture curriculum in Eswatini.

The participants highlighted several benefits from integration of indigenous agricultural practices into the primary school curriculum. They stated that integration of indigenous agriculture into the primary school curriculum would:

a) Provide learners with life skills to solve and live independent lifestyle to be self – sufficient.

b) Create awareness of things around the pupils for observation that are environmentally friendly.
c) Add meaning to the teaching and learning of indigenous practices that are documented in the primary school agriculture curriculum materials for critical thinking.
d) Capacitate learners on the essence of indigenous farming practices in the curriculum topic areas.

4.1.3.4.2.11 Comments and suggestions from agriculture teachers on climate change and disaster risk reduction

The participants made several comments and suggestions on climate change interventions for maize production. These were mainly to:

- Review and integrate the use of organic farming (IAP) and modern agriculture practices.
- Develop drought resistant seed varieties through the seed multiplication companies.
- Conserve, restore forests and other natural resources.

4.2 CHAPTER SUMMARY

In this chapter the findings of the study were presented and described. The researcher explored the indigenous climate change interventions employed by Emaswati maize farmers towards disaster risk reduction preparedness for sustainable food security in the rural areas. Notes from the observation schedule, individual participants' interviews and focus group discussions were analysed and used to compile the findings of this study. Furthermore, the perceptions of the participating indigenous farmers and primary schools' agriculture teachers were also noted and analysed in this chapter.

CHAPTER 5

DISCUSSION OF FINDINGS

5.1 INTRODUCTION

The purpose of this chapter is to present the discussion and interpretation of the findings obtained in chapter 4. Textual analysis method was used for analysis of the transcribed interviews, inductively. The transcribed text was organised into data units and the findings coded. The coded data was described by comparisons and similarities to build categories to discover the patterns. The emerging themes were discussed and the findings interpreted for conclusion.

5.2 INDIGENOUS FARMER'S PERCEPTION OF INDIGENOUS AGRICULTURAL KNOWLEDGE.

From the results of this study six major themes emerged. The six main themes namely were, 1) good health status, 2) manipulation of farming activities, 3) organic farming, 4) traditional irrigation, 5) family labour and, 6) oral learning.

5.2.1 Good health status

The participants indicated satisfaction with the production of indigenous food crops, dish preparation and consumption of the traditional foods for their health benefit. The reason related to prevention of hunger and the nutritive value attached to the traditional foods. All the informants indicated that traditional foods include maize, legume crops (soya beans, groundnuts, and cow peas), melons, pumpkins (litsanga) and the calabash fruit (liselwa). The pumpkin leaves and the legume seeds were useful as relish.

One of the Ngculwini community key informant pointed out that:

> 'Kunemehluko lokhona kumuntfu lodla kudla kwesintfu nekwesilumbi. Salukati sasedolobheni asifanani nami. Sasedolobheni asikhoni kuphakamisa

> lijeke sinatse.. Sifuna lelijeke kutsi utsele eglasini khani tikhona kunatsa. Kubangwa ngulemphuphu labayidlako, isheshe idliwe yingobolwane. Ingobolwane idle yena. Uyayibona lemphuphu yeligugu labayidlako lesilumbi ayibakhombi indlu 'lencane' ngenca yekugaya kwesisu, iyakhela. Lakhaya liphalishi lembila wesintfu lesilidlako likwenta kutsi uye endlini 'lencane' ncenye kabili nobe katsatfu. Kuyangikhulula. Kuyimphilo loko. Imphuphu yembila wesintfu iyayibamba indlala'. *('There is remarkable difference in body condition of traditional and modern food crop consumers. For instance, an old woman who lives in the city looks nothing like me in terms of physical fitness. Old women from the city can hardly lift a jar of water to drink from but would instead prefer to pour the water from the jar into a glass to drink. It is due to the mealie- meal they consume; it is more succeptible to weevil infestation and this in turn is harmfull to their bodies. You see this meali-meal from modern maize is not even processed well in the digestive system due to its very soft texture. The traditional maize meal consumed here at home improves regulation in the body; one is able to relieve themself at least 2 to 3 times a day. Such brings relief, it is a sign of good health. Morover, mealie-meal from traditional maize keeps your stomach full for longer').*

This theme brought in indigenous farmers' perspectives on healthy eating habits to counteract malnutrition, obesity and overweight in both children and adults. According to the World Health Organization Report (2016), one in five children are overweight, 13% of the adults are obese and 39% of the adults are overweight, which is a result of poor eating habits. These figures on obesity and overweight are a reason for concern. Communities prone to hunger stress are most likely to develop poor eating patterns to avoid starvation, which result in poor health.

Indigenous farmers consume unprocessed traditional foods for a healthy body at all age levels and are less prone to obesity and overweight body illnesses.

5.2.2 Manipulation of agricultural activities

The participating indigenous farmers revealed that they applied traditional methods of production and that crop growing and livestock rearing was the core business for their livelihood sustenance. These activities involved manual work to accomplish the field tasks.

This implied that indigenous agricultural experience required hands-on activities to develop the acquired experience and competencies. This accumulated exposure to fieldwork resulted in experiential knowledge. Moreover, indigenous farmers were motivated by the need to curb hunger, thus they pursued animal and crop production using indigenous means for food security. According to Lahey (2003), Maslow's hierarchy of needs argues that our motives are organized in a hierarchy arrangement from the most basic (hunger, thirst and safety) to the most personal and advanced needs. In consensual agreement, Ngugi, Karau and Nguyo (1990) pointed out that subsistence farmers are motivated by yield size for food security. Eswatini indigenous maize farmers endeavour to break the chain of dependency that is instituted by the government through donations from food relief programmes.

5.2.3 Organic farming

Participating indigenous farmers reflected that they used animal manure for their production of food crops. They pointed out limitations such as lack of financial support and loss of livestock used for draught power. However, they were able to produce enough for storage to meet their family needs for a prolonged period. The theme on organic farming was similar with theme one on the production of organic food crops for wellness.

One of the Vusweni key community informant perceived that,

> 'Kulima ngetindlela temdzabu kufaka kusebentisa nje umcuba kuze wakhe umkhicito, ikakhulu wekudla lokunemphilo. Bogogo basebentisa umcuba nabahlanyela lombhila. Tilwane letifuywako bese tiyasentjentiswa ngaphandle kwetinkomo, netimbongolo. Letinye letifuywako tinkhukhu kanye netimbuti. Hulumende wetfu angasitsita kulobuhlumgu betfu bekuswelakala kwemcuba. Labanyenti bafelwe tinkomo tabo ngesomiso. Ngiyachubeka kusebentisa tindlela tesintfu sami etukwaletingucuko te farmers subsidized input programme lensha yelitiko letekulima.
>
> Lomanyolo wesilungu asimati futsi tsine sesilwa nalobutsi bakhe .Tsine sesilwa nalobutsi lapha kumanyolo lobukhona lobutawungena lapha embileni wami lengitawudla.Nangiwudla lombila usenguwo yini? Buchamukaphi.Kuyini njani?Kantsi lomcuba wenkhomo bulongo ngiyabati.Angicabangi kutsi kukhona lushana lolungabulala lesintfu sami. Kubanekudla kwesivuno ekhaya'.

('The indigenous agricultural practices involve addition of manure for production of healthy food that is poison free. Our ancestors used animal manure for maize production. Donkeys, goats, and chickens were other animals reared alongside cattle and their manures used for agricultural purposes. Some of us lost our livestock during the previous drought. Our government could intervene in the painfull situation we are currently experiencing of manure shortage. Other farmers have lost their cattle through drought, but I am continuing to use indigenous agricultural practices in crop production because the current development on farmers input subsidy program does not deter us from doing so. The use of commercial fertilizers is new technology and its alleged that it has chemical impurities which may be absorbed by our food crops. We want to maintain the natural value of our maize food crops. What is the poison in this commercial fertilizer and its source? I know that kraal manure is from cow dung. Any attempt to dissuade me from my indigenous agricultural practices so far would not work. There is bound to be a harvest of food in the home with this method.

According to DFID (2009), Eicher (2009), Haggblade and Hazell (2009), African agricultural production has lagged behind, the reasons being disinvestment in agricultural research, extension and production systems from both governments and international donors. In the Eswatini agenda for food security, the country should turn its agricultural entities into producers to add value, no matter how small the profit margin is (Dlamini, 2019). Organic farming is a project that requires investment by indigenous farmers, the government and other stakeholders in order to produce at their level to meet the emerging demand for organic foods for food security.

5.2.4 Traditional irrigation

The participating farmers revealed that indigenous food crops were produced using traditional methods. Crops received natural moisture from different water sources such as rainwater, dew and fog from the riverbanks. Perennial streams flow across the Wet Middle-veld. Traditional furrow irrigation enabled successes in the gardens grown by the riverbanks in order to supplement rainwater and to provide food throughout the year. The water used for gardening purposes was obtained from the high water table in wetlands. Traditional furrow irrigation

presented a possible advancement of organic farming platforms at subsistence level. Gardening schemes need to be revived for each homestead within community boundaries while taking into consideration effective environmental management practices to sustain the wetlands.

The Zombodze community key informants observed that,

> 'Kulendzawo yakitsi somiso akusiso lesi~~m~~vamile kakhulu. Besiphumelela ngekulima ngasemfuleni kudvonswe emanti agelete ngemsele kuyonisela etingadzeni ngesikhatsi sesomiso'. (*'In our community the drought condition is not so frequent. During drought we have managed to plant near river banks by using canals for furrow irrigation to water our gardens').*

Several indigenous farmers in the Middle-veld produce maize in small gardens simultaneously along their field crops by (furrow) irrigation.

5.2.5 Family labour

The farmer participants reflected that traditional field operations to produce food crops engaged family members. Children and women were the dominant manual manpower for production tasks.

Table 8: The Maize Planting Calendar for the Wet & Dry Middle-veld.

PLANTING SEASON	2nd quarter							First quarter			
ACTIVITY	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Manure distribution												
Ploughing												
Early Planting												
Heat /water stress period												
Bean planting												
Maize harvesting												
Maize Shelling and Winnowing												

Table 8 above presented a summary of maize planting calendar and activity engagement for Wet and Dry Middle-veld in Eswatini. The maize planting calendar is depended on the indigenous agricultural activities.

Indigenous agricultural knowledge practices are visible in commercialized crop production endeavours. However, governments choose to ignore its contribution Ttowards food security and knowledge building.

One of the Vusweni community key informant moved that,

> ‘Tinenkani talukati atipheli emandla nganati tindlela tekulima ngesintfu. Sintfu siyakhosa, kantsi nakufika imvula kutfolwatfolwa sivuno. Nalabadzala bayafa. Nawufuna labadzala utophidze ubathtfolephi ngobe lolwati alufani nanalu

lwasetikoleni'. *('Older women farmers are very stubbon in their hold and belief in the use of indigenous agricultural practices.* Indigenous agricultural practice is sustainable and harvest is possible even with inadequate rains. *The practitioners of indigenous agricultural practices are diminishing and so does this knowledge with them hence it is different from the western education offered in the schools').*

In Eswatini agriculture, women are the dominating population in the production of maize using indigenous farming practices in the Wet Middle-veld. This finding concurs with a survey by an American agricultural chemical seed company Corteva Agriscience (2019) that found that African women on average make up 40 percent of the agricultural labour force and produce 70 percent of Africa's food, but their contribution continues to be barely recognized.

5.2.6 Oral learning.

The key areas on information dissemination on indigenous agricultural practices focussed on oral communication and the traditional structures within the community as communication channels. Family members, neighbours and community leaders in the traditional structures may be used for its communication.

This knowledge transfer happened during social interactions, events or engagement in agricultural activities. In the oral exchanges, experience on agricultural practices and ideas were shared and infused with proverbs to make the conversations more interesting and meaningful. The proverbs were in the context of siSwati, which related to their neighbourhood, sharing, preservation or accomplishment.

One of the Ngculwini community key informants made the following proverb statement:

*Imbewu icelwa esininini (*you ask for seed from a relative*).*
*Sisu sibekelwa ngaphandle (*one should learn to save food (for the stomach) for tomorrow in order to live*).*

*Inala ishanywe nasilima (*there was plentiful harvest (to the point that even those incapable also had a good harvest*)*

According to Barbuto (2016) subsistence farmers who are conservative, elderly and attached to oral tradition possess a wealth of knowledge on indigenous practices. Such farmers are considered 'resistant to change' and their accomplishments are not recognized because they are not recorded in writing or made known (The International Federation of Agricultural Producers (IFAP) in Atteh 1989, p.12). Subsistence farmers in Eswatini Middle-veld region are orators of indigenous agricultural practices and their knowledge and practices must not be marginalized in national maize project initiatives.

5.3 LOCAL INDIGENOUS AGRICULTURAL PRACTICES FOR CLIMATE CHANGE INTERVENTION POPULAR WITH SWAZI INDIGENOUS RURAL FARMERS.

5.3.1 The findings in the Wet Middle-veld

The results revealed that indigenous maize farmers in the Dry and Wet Middle-veld communities had different climate change interventions. However, they shared some similarities.

In the Wet-Middle-veld the main themes that emerged were as follows: Theme 1) utilization of available moisture sources, theme 2) water harvesting, theme 3) improved water infiltration strategy, theme 4) carbon reduction effort and theme 5) balanced plant growth environment.

5.3.2 Soil water availability

The farmer participants from the Wet Middle-veld generally indicated that their drought interventions focused on moisture availability to create a suitable growth environment for the plants to strive well to maturity. Indigenous practices that farmers ensured soil water availability for sustained plant growth through utilization of available moisture sources, water harvesting and strategies for improving water infiltration (such as farrowing).

One of the Zombodze community key informant reflected that,

> *'*Tsine ngalapha siyalima vele ngobe siyinkangala, kepha simo selitulu asivumi sonke sikhatsi kahle. Siba khona lesimo sesomiso. Satsitseka natsi ngemyaka wesehlakalo wa 2015/16 selive lonke'. *(* 'We never miss a ploughing season in *this Wet Middle- veld area, but the conditions for crop production are not always favourable in that we do experience a rainless period occasionally . The drought condition is rare as it was only experienced in the year 2015/16 when it was declared a national disaster ').*

Salas et al. (1989) laments that peasants societies have developed their own logic in the use of nature partly based on a wealth of local experimentation. Subsistence farmers have different indigenous agricultural approaches that ensure soil water availability for plant growth.

5.3.3 Carbon dioxide reduction effort.

With regards to carbon sequestration, only one participant reflected on the planting of trees to reduce the concentration of carbon dioxide in the air and damage to the ozone layer. However, this was related to deforestation massages from government through the national media. Not all the participants mentioned deforestation or tree planting. In Eswatini, tree cutting for sale of firewood is illegal. This is a challenge government has with subsistence farmers in the rural areas. According to Dlamini (1998) degradation and deforestation of indigenous forests is occurring at an alarming rate in Eswatini.

In addition to their agricultural DRR preparedness practices, subsistence farmers still need more education on climate change and intervention practices in order to effectively contribute and collaborate with government's effort on the reduction of carbon dioxide gas emission. This could include regional indigenous tree planting campaigns in the rural communities.

5.3.4 Balanced plant growth environment

Farmer participants in the Wet Middle-veld indicated that they engaged in practices for building the soil environment to enhance crop access to soil nutrients. Traditional soil treatment

practices included addition of animal manure and legume planting to balance the plant growth environment.

5.3.4.1 Findings in the Dry Middle-veld

In the Dry Middle-veld the emerging themes from the findings were as follows: theme 1) entrepreneurship/ marketing skills, theme 2) crop and soil management, theme 3) humanity - 'Ubuntu'.

5.3.4.1.1 Entrepreneurship /marketing skills

Participating farmers indicated that they bought maize from other producers for consumption and to replenish their consumed stored grain produce during drought years. The families also generated income from selling their cattle and exchanged sweet potatoes with neighbours for maize to alleviate the effects of drought. Therefore, traditional markets ensured that there was transaction of indigenous food crops between the traders and indigenous farmers during time of lack. The engagement by subsistence farmers in entrepreneurial activities points to existing and future economic opportunities that can bring relief to climate change effects on crop production. The farmers mentioned that business activities such as marketing of local maize, animal manure, production of indigenous chickens and domestication of guinea fowls and egg sale provided alternative means of livelihood sustenance when crop production failed due to drought. Moreover, markets played an important role in household sustainable food security and to alleviate hunger and poverty.

The GRAIN survey report (2015) indicates that more than 80% of all seed in Africa is still produced and disseminated through 'informal' seed systems (on-farm seed saving and unregulated distribution between farmers). Dlamini (2019: 6) points out that 'the Government of Eswatini must think seriously about turning its agricultural entities into producers to make food secure, no matter how small the profit margin.' Eswatini Indigenous farmers demonstrated that they have functional business skills for creating wealth from agriculture based entrepreneurial activities.

5.3.4.1.2 Crop and Soil management

Most of the participating farmers stated that they engaged in several indigenous practices for crop and soil management resulted in higher yield formation. These included addition of nutrients and soil building. Addition of animal manure, planting of legume crops and composting increased the soil's ability to grow crops. Other practices used for building the soil included crop rotation, early ploughing, fallowing or soil resting. Similar to the soil building practices among the Swati people, Lwoga (2010) points out that traditional practices for soil fertility restoration in Tanzania included use of manure, crop rotation practices, use of crop residues, organic materials, and leaving land under a long-term fallow. Moreover, Malekani, Chailla and Wamoza (2014) claimed that planting nitrogen fixing plants such as pigeon peas with maize were a common practice.

Highlighting the significance of traditional soil improvement practices on crop growth, one of the Nhlambeni community key informants said that,

> 'Usebentisa umcuba kutsi umbila ukhule kuze ungabi bovu. Manje nawute umcuba lombila uba yimbashana netibhuluja takhona tibe tincane'. *('You could add animal manure after germination to treat maize plants with nutrient deficiency symptoms such as stunted growth, leaf yellowing and development of small cobs').*

Indigenous farmers in the Middle-veld of Eswatini examined maize plants to identify nutrient deficiency in crops and administered soil treatment using indigenous agricultural knowledge skills. However, some of the farmers were not aware of the significance of some of these indigenous crop and soil management practices. This could imply that the positive effects observed were not deliberately planned for by such farmers but were rather a routine traditional practice that they had adopted.

5.3.4.1.3 Humanity 'Ubuntu'

The families of farmers in the Middle-veld exchanged agricultural products through sharing and bartering to alleviate hunger and food insecurity in neighbouring households during times

of drought. According to Nkosi and Daniels (2012), the building block of Ubuntu/Botho is the principle of the unity of humanity, which emphasises the importance of constantly referring to principles of empathy, sharing and co-operation in an effort to resolve companion problems. According to Fernandez and Salvaterra (1989), small scale farmers have access to a systematic and historic body of knowledge which may influence their food production practices. Indigenous agricultural practices embedded in the traditional communal structures promote the spirit of compassion and respect amongst community members.

5.3.4.1.4 Comparing similarity between Dry and the Wet Middle-veld

Both the Dry and the Wet Middle-veld shared had similarities which can be grouped into the following main themes 1) escapism, theme 2) indigenous seed material, theme 3) information dissemination, theme 4) soil moisture conservation and theme 5) decision making.

5.3.4.1.4.1 Escapism

Indigenous farmers revealed that they increased the chances of success in maize production through early planting and staggered planting. Indigenous seed material, information dissemination and soil moisture conservation were all dependent on decision-making. Indigenous farmers made decisions on what to do and when for timely action. Several emerging issues that farmers focused on included:

i. Timeliness

ii. Input rationing

iii. Faith in planting

iv. Information sharing and handling

5.4 IMPLEMENTATION OF THE INDIGENOUS FARMING PRACTICES FOR MAIZE.

Chapter four described the implementation of various indigenous agricultural practices by local farmers in the Dry and Wet Middle-veld areas of Eswatini . DFID (2009), Eicher (2009), Haggblade and Hazell (2009) presented that African science, which comprises indigenous knowledge and relevant traditional practices, has not been investigated and documented

properly as a discipline in natural science. They also disclosed that some of these indigenous practices for maize production have been forgotten and unused with time, nevertheless they are not outdated.

One of the Zombodze community key informant recommended that,

> 'Kutosita kakhulu vele kutsi labantfwana bafundze kutsi kulinywa njani ngalolwati lwekulima lwemdzabu. Labantfu labadzala labasaphila abanikwe litfuba lekufundzisa etikholweni kuze batfwana nabothishela bati kutsi kwentiwa njani. Bonke bantfu batositakala bese kutolodvoloteka kulima kwemdzabu. ('*Capacitating our children or learners on indigenous agricultural practice could be very usefull. The elderly who are still alive today should be given the opportunity to impart the knowledge and skill involved in this practice in schools to both teachers and learners. In this way the community as a whole would be able to practise such for sustainable food production').*

The implementation of the documentation process of indigenous agricultural practices may be long overdue. However, traditional farming remains an alternative for stable food security in addition to commercialization in Eswatini.

5.5 IMPLEMENTATION OF INDIGENOUS AGRICULTURAL PRACTICES

The list below is a summary of the indigenous agricultural knowledge application practices identified during data collection. According to Schumacher *et al.* (2014) the purpose of qualitative research is to; describe and explore and or to describe and to explain some phenomena. The previous chapter of this study described the following indigenous practices in detail:

i. Indigenous seed selection method
ii. Traditional storage facility
iii. Animal manure application
iv. Crop rotation.
v. Intercropping.
vi. Maize treatment with water.

vii. Observation and prediction of rainfall

These findings concur with Perroni's (2017) five indigenous farming practices that have helped shape sustainable farming system and practices all over the world, namely: Agroforestry, Crop rotations, Intercropping, Polyculture and Water harvesting.

The research results revealed that in the Dry and Wet Middle-veld of Eswatini, crop rotation, intercropping and water harvesting were three indigenous practices implemented that enhance food security. According to McClure (1989, p.1) indigenous knowledge systems permeate all that we do and think and believe. Indigenous farmers are competent in the implementation of indigenous agricultural practices for maize production at their level in face of the challenges associated with climate change effects.

5.6 INDIGENOUS CLIMATE CHANGE PREPAREDNESS STRATEGIES POSSESSED BY INDIGENOUS FARMERS FOR DISASTER RISK REDUCTION.

According to the European Commission on Humanitarian Aid and Protection (2013), preparedness refers to the knowledge and capacities developed by governments, professional response and recovery organizations, community and individuals to effectively anticipate, respond effectively to impacts of likely, imminent, or current hazardous events or conditions. Preparedness is one of the four DRR pillars.

The research informants reflected differing views on climate change preparedness strategies due to their different geographical locations in the middle-veld. In the Dry Middle-veld of Eswatini, the practices involved storing of excess maize harvested, reducing food ration per day, and exchanging maize with neighbours for other food crops. These activities revealed that indigenous farmers in the Dry Middle-veld had adopted coping mechanism strategies for livelihood sustenance during the drought conditions.

The Wet Middle-veld practices included the use of the traditional furrow irrigation method, planting beside perennial rivers and streams or early planting as examples of climate change preparedness strategies. These practices revealed that farmers had adopted strategies that ensured sustainable food security. When comparing Wet and Dry Middle-veld areas, both indicated the need for the establishment of an alternative livelihood sustenance practices that

complemented maize production to avert the effects of drought such as domestication of indigenous chickens**.**

Indigenous farmers in both Wet and the Dry Middle-veld had knowledge and capacity to respond to drought at subsistence level. However, this was only for a short time. They were equally vulnerable to climate change as were commercial farmers in terms of DRR preparedness.

One of the Vusweni community key informant in the Dry Middleveld remarked that,

> 'Tinini tenkhosi atiti ngalapha ngakitsi ngaloluhlelo lwabo lekwabela kudla emimangweni. Atisiniki lutfo nobe ngabe silambe sinjani. Vele abasibuki nekusibuka. Lesigodzi kantsi sinetindzadzane letiphekelwa ku care-point. Ledzawo lesikuyo isemkhatsini walaba labanako kudla. Bavele bacabange kutsi sonkhe sinako kudla kani siyashiyashiyana. Nyalo sesisitwa yi-radio kanye netagoma telitulu ngesimo semvula'. *('International agencies do not assist us with food aid relief despite our dire situation of hunger which is exerbated by the prevalence of orphaned and vulnerable children who solely depend on care-points for food in our community. Our community is a mixed bag of those who are food secure and those who are not and as such we easily get overlooked by these agencies. We depend on radio and TV broadcasting for meteorological weather forecast information').*

The informants revealed different current practices for climate change intervention in both the Wet and Dry Middle-veld areas. The farmers in the Wet Middle-veld only reduced soil disturbance in order to trap more moisture and then deforestation. This means they practised minimum tillage. However, in the Dry Middle-veld, the informants applied indigenous practices that improved the soil and plant growth environment to reach maturity. When the application of practices for both the Wet and Dry Middle-veld were compared, the farmers applied soil management practices and adopted coping several strategies for disaster risk reduction preparedness.

5.7 THE IMPLICATION OF INTEGRATING INDIGENOUS AGRICULTURAL PRACTICES INTO THE GRADE 6 AND 7 PRIMARY SCHOOL AGRICULTURE CURRICULUM IN ESWATINI

Most of the women participants engaged in traditional farming reflected positive outcomes from the proposed integration, which would yield good results in the school education system. In the Dry Middle-veld, all the male participants reflected that it would be fairy-tales to the youth because of the dominating Western education in Eswatini. However, a majority of the participants were positive about the outcome.

The positive implications of integration indigenous agricultural practices in the school curriculum included the following:

i. The integration of IAP would promote cultural exchange programmes and sharing of IAK practices amongst African and Western nations for promotion of the Tourism industry.

ii. Organic food production is possible with IAP to promote healthy eating habits.

iii. There is a business opportunity for learners to make a livelihood from organic farming practices.

iv. Some of the IAP preserve and add value to the soil natural environment for sustainable food production.

v. The subsistence sector serves as an option to the commercial sector for food security at a small scale.

vi. The IAP uses the indigenous spoken language, which is in support of language development in the education system for local language protection policy.

vii. The IAP and its applications should be recorded while the knowledgeable elders and senior citizens are still alive for the youth to access it. (such as intercropping maize with pumpkins and beans).

viii. Some Informants perceived IAP as a narrative since the education system is Western in nature and learners were exposed to modern technology that is dominating.

5.8 CHAPTER SUMMARY

In this chapter, the researcher presented the findings of the data collected in chapter 4 for textual analysis. The views of the participants were discussed in detail for deeper understanding of the indigenous agricultural practices with examples. The discussions of the presented results were guided by the research objectives that were designed to address the research questions. The following chapter presents the conclusion and the recommendations of the study.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

The previous chapter focusses on the discussion of results, and the current chapter will cover the conclusion of the study, comments from the farmers on climate change and disaster risk reduction, recommendations, and the limitations of the study.

This study was designed to address the following research questions:

i. What are the local indigenous practices related to maize production that Swazi indigenous rural farmers are conversant with?
ii. How do the indigenous farmers implement the indigenous farming practices during maize growing?
iii. What are the indigenous climate change preparedness strategies maize farmers possess for disaster Risk Reduction in relation to maize farming in the Dry and the Wet Middle-veld rural areas?
iv. What are the current climate change interventions adopted by Swazi maize indigenous farmers that can be employed for development of teachers' competencies for disaster risk reduction preparedness in Eswatini?
v. What are the implications and possibilities of integrating indigenous agricultural practices into the grade 6 and 7 primary school modern agriculture curriculum in Eswatini?

6.2 SUMMARY OF FINDINGS AND DISCUSSIONS

6.2.1 Climate change interventions adopted by indigenous farmers.

The participating indigenous farmers highlighted examples of climate change interventions related to IAP employed in maize production in the Middle-veld region of Eswatini. The findings revealed that Eswatini farmers applied agricultural practices that were amongst the five indigenous agricultural practices that enhance food security worldwide (Perroni ,2017).

The practices conserved soil moisture and or improved the soil nutrient status. These were mainly intercropping, crop rotation and water harvesting practices which were associated with addition of animal manure, early planting, planting of legume crops, and fallowing, observation and prediction of rain by interpreting the behaviour of plants and animals.

6.2.2 Implementation of the indigenous farming practices.

The findings showed some of the indigenous agricultural methods that had been forgotten or unused for a long time, such as the traditional underground storage facility (Ingungu yembila) and seed selection to some extent. The main practices listed below were described in chapter 4 of this study:

i. Animal manure application.
ii. Crop rotation
iii. Intercropping.
iv. Observation and prediction of rainfall

6.2.3 Indigenous climate change preparedness strategies possessed by maize farmers for Disaster Risk Reduction in the Dry and Wet Middle-veld rural areas.

The findings revealed only two informants were confident about their possession of climate change preparedness strategies in the Wet and Dry Middle-veld. The informants perceived climate change as a new phenomenon and that drought was a short-term period experience. Both the informants from the Dry and Wet Middle-veld areas revealed that participants' DRR preparedness included:

i. Application of coping mechanism strategy (food rationing, bartering, or buying maize from the market)
ii. Establishment of production entities for profit that complement well with maize production such as domestication of indigenous chickens and cattle production
iii. Observation and prediction of rains by studying the behaviour of plants and animals (related to early planting)
iv. Related the weather meteorological information to farming (Government early warning system)
v. Supplementing rainwater by traditional furrow irrigation in community or family gardens

vi. Afforestation of indigenous trees

Some of the above DRR preparedness activities were short term, while others were long term.

6.2.4 Current climate change interventions adopted for disaster risk reduction preparedness in the Dry and Wet Middle-veld region of Eswatini.

The results reflected the current indigenous climate change interventions for DRR as follows:

i. Reduced soil disturbance to trap more moisture (practising minimum tillage, timely ploughing).
ii. Afforestation
iii. Improvement of soil and plant growth environment to reach maturity (addition of animal manures, early planting, plant by riverbanks and valleys).
iv. Soil management practices (intercropping)
v. Utilization of the coping mechanism and adoption strategy (storage of excess maize harvest).

6.2.5 The implications of integrating indigenous agricultural practices into the grade 6 and 7 primary school agriculture curriculum in Eswatini.

The results from participating indigenous farmers indicated that the integration of indigenous agricultural practices into the education system would yield positive outcomes on the following aspects:

i. The cultural exchange programs with other neighbouring states.
ii. Promoting a wellness program focusing on indigenous food plants and indigenous cuisine
iii. Support of the local language policy.
iv. Archival preservation of indigenous agricultural practices (concerning intellectual rights).
v. Recognition of IAP as an alternative sector to commercialization for sustainable food security.
vi. Knowledge building by documenting traditional agricultural practices and experiences.

6.3 CONCLUSION

This study explored on using climate change intervention adopted by indigenous maize indigenous farmers for disaster risk reduction preparedness in Eswatini. The participants' views were collected from both indigenous farmers and primary school's modern agriculture teachers for grade 6 and 7 in Eswatini for conclusion.

In the Dry and the Wet Middle-veld of Eswatini, the rural communities' indigenous agricultural practices documented by this study were common among indigenous farmers during maize production. The traditional farming activities were dominated by females than males. This highlights feminization of subsistence sector in the rural areas of Eswatini in maize production. The study indicated that old aged participants above 60 years old were engaged in farming. The indigenous farmers placed less value on their education in their farming activities.

The indigenous farmers perceived indigenous agricultural knowledge as a traditional lifestyle, a traditional method of agricultural production and a cropping system which was dependent on rainfall for livelihood sustenance. Small-scale Swazi rural farmers in the Dry and Wet Middle-veld were practising early planting (to take advantage of the rains) or treatment of seeds with water, use of traditional seed varieties, addition of animal manure, intercropping (with pumpkins and legume crops), staggered planting, traditional weather observation and prediction of rain by interpreting behaviour of plants and animals, traditional rain ceremonies and maize preservation with ash.

The study revealed that indigenous agricultural practices were environmentally friendly and therefore sustainable. Some of the indigenous practices had been largely unused and can be forgotten with time such as the pit storage facility (*ingungu yembila*). The resilience of subsistence farmers to the impact of climate change on maize was evident on the household engaged seasonally in maize production. Indigenous maize farmers possessed indigenous climate change preparedness strategies for disaster risk reduction in relation to maize farming in the Dry and the Wet Middle-veld rural areas. The strategies for DRR practices included soil moisture restoration from available water sources, soil treatment using addition of manure and burying of crops remains in the field, increasing beans and potatoes acres and reducing the maize stands, planting drought tolerant maize varieties, early planting, traditional storage of excess maize harvest for food security, information sharing on drought resilience practices, preservation of drought tolerant seeds, taking advantage of the early rains, and exchanging sweet potatoes for maize. The current climate change interventions for Disaster Risk Reduction

preparedness have worked for the indigenous farmers in the designated regions. The study revealed that in the Dry Middle-veld where maize production was unpredictable farmers diversified into money making projects such as sawing uniforms.

Participatory programs for indigenous farmers in the communities should be established for commercial farmers and youth enrolled in the Western Education system to intern to increase the originality of our innovation in the field of science. In addition, any government envisaged plans for the development of indigenous maize farmer should be framed on the existing IAP for their empowerment at their maize production level.

The primary school curriculum in Eswatini should respond to the needs of the rural community. The indigenous communities have sustained maize production using indigenous agricultural practices for food security. This is a curriculum transformation that is anticipated by the farmers and would enable the decolonisation of the Eswatini school curriculum while also giving it contextual relevance. The IAP can be integrated into subject areas in life sciences, geography, agriculture, social studies and home sciences in a cross curricular school arrangement. For example, practical learning experiences in home economics would include incorporation of practical activities for learners relating to indigenous food preparation and dishes for hands on learning. In a stand- alone subject area, IAP could be incorporated into Environmental Education program on Education for Sustainable Development studies as an option where the school curriculum is loaded.

The conclusions on teacher's views was used to feed into (inform) the existing primary school modern agriculture curriculum for grade 6 and 7 in Eswatini. The conclusions were as follows:

- Indigenous agriculture practice was embodied in the primary school agriculture curriculum for sustainable continuous education. This means that the school's modern agriculture curriculum was framed on indigenous agricultural practices. Some topic areas that were taught on indigenous agricultural practices include mainly: early ploughing, early planting, kraal manure addition, cultural methods of disease and pest control to mention a few.

- The school's modern agriculture teachers used some of the indigenous agricultural practices to teach some aspects of the primary school modern agriculture curriculum. Instructional knowledge came from indigenous agricultural practices and modern knowledge in-cooperated.

- The principles on soil management in the syllabus manifested and linked to rabbit and chicken rearing as small animals, a community of practice in rural areas for animal manure production.

6.4 RECOMMENDATIONS

The recommendations of this study are based on the conclusions above as follows:

- An integration of IAK and DRR practices into the primary school modern agriculture curriculum for grade 6 and 7.

- The contribution of the subsistence sector should be recognized as an option to commercialization for its impact to stable food security, no matter how small the production margin.

- A research study should be conducted on the possible production entities (realities) and reliable sources of food in the country to assess their potential contribution to food security, climate change and economic recovery.

- The primary school agriculture teachers should be oriented on indigenous agricultural practices for climate change issues as primary school teachers were expected by the education policy to teach all the subject areas regardless of their area of specialization.

- Climate change issues should be added in the school's modern agriculture curriculum under contemporary issues.

- A research study should be conducted to assess the relationship between drought and climate change focussing on the new trends of the weather patterns on traditional farming for monitoring and evaluation.

- A workshop should be convened for indigenous and commercial farmers on farm operations and field practices using indigenous agricultural sciences deemed "traditional science'.

6.5 LIMITATIONS

The study was limited in its scope, generalizable only in designated areas that were accessible to the researcher. The period for data collection coincided with several traditional events , Covid 19 protocols restrictions and national political demonstration. Hence the study could have missed some indigenous farmers and agriculture teachers with advanced knowledge on indigenous agricultural practices due to their commitment to the socio –political events that coincided with data collection for this study.

Most of the males' participants in traditional farming avoided the organized focus group discussion sessions compared to female participants, therefore this study's findings were limited to the views of predominately female participants of this study. However, the majority of the participating primary school's agriculture teachers in the research compensated for the low male ratio observed in indigenous farming.

6.6 CHAPTER SUMMARY

In this chapter, the researcher presented the conclusions of the findings on indigenous knowledge practices that can be used for disaster risk reduction in the subsistence sector. The conclusions were based on the research questions the study sought to address for exploration of the climate change phenomena on subsistence farming. The findings concluded that Eswatini maize indigenous farmers in the designated Dry and the Wet Middle-veld rural areas had adopted and applied climate change interventions that relate to IAP in maize production for climate change and food security. The study proposed that the integration of indigenous agricultural practices into the primary school agriculture curriculum for grade 6 and 7 in Eswatini would yield positive socio –economic outcomes in the educational system. There was consensual agreement by primary school's agriculture teachers on the integration of the indigenous agricultural practices into the primary school modern agriculture curriculum.

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APPENDIX 1: INDIVIDUAL INTERVIEW GUIDE

SECTION A

Demographic data

Area……..…….……..

Region…….……..…..….

Sex: Male ……..……Date of birth……... …….

Female ……..…..Date of birth …….

Marital status…….……

Education level…….……..

Qualification……..

Number of children …….……..…

SECTION B: THE INTERVIEW GUIDE

1. What do you understand by the term 'Indigenous agricultural knowledge '(usho kutsini kuwe lomusho lotsi lwati lwetekulima lwemdzabu)?

   ……

   Why? (Usho ngani)?

   ……..……

2. Do you believe that the Swazi government should invest in indigenous agricultural knowledge cropping practices for sustainable food security in Eswatini? (Uyakholelwa yini kutsi hulumeni wa kaNgwane kutsi afake timali takhe elwatini lwetekulima lwemdzabu kute sibe nekudla lokwanele laEswatini)?

a)……

If yes, State the reasons?

(Shano tizatfu) ……..

b) If, No, State the reasons?

(Shano tizatfu)

……

3. Are indigenous farmers engaged in decision making on agricultural knowledge practices for use in maize production in Eswatini? (Baya bandzakanya yini balimi bemdzabu ekulawuleni tincumo tekusebentisa tindlela temkhicito wembila)?

   ……

   If yes, How (kanjani).

   ……

4. Are (you) indigenous farmers prepared for drought disaster risk reduction? Balimi bemdzabu balungele yini kuhlangabetana kanye nekunciphisa sehlakalo sesomiso.

   If No, why? (Cha, shano sizatfu)

   .....

   If yes, How (Yebo, kanjani)

   ……

5. What are the climate change interventions adopted by local maize indigenous farmers to reduce the impact of climate change (Taba tini balimi bemdzabu labatisebentisako kumelana nesimo selitulu sesomiso)? …….

6. What are the current climate change interventions indigenous farmers have adopted to reduce the impact of climate change in their maize fields? (Taba tini balimi bemdzabu labatisebentisako kwanyalo kuhlangabetana nekunciphisa kulinyatwa simo selitulu sesomiso)?

   ……

7. What are examples of some of the indigenous knowledge practices for maize growing in drought conditions? (Ngiphe **tibonakaliso** taletinye tindlela telwati lwesintfu letisentjentiswako ekulimeni umbila lapho kunesomiso)?

   ……

8. How do rural farmers implement these indigenous knowledge practices? (Labalimi basitakala nobe batisebentisa njani letindlela telwati lwemdzabu).

   ……

9. What are the indigenous climate change preparedness strategies maize farmers possess for Disaster Risk Reduction in the Middle-veld rural areas? (Ngutiphi tindlela balimi bemdzabu labatatiko kulungisela ngato kumelana nesimo lesigugcukako selitulu etindzaweni tasemakhaya letisenkhabeni yelive)?

   a) Dry Middle-veld (Letisenkhabeni yelive lenesomiso) ……

b) Wet Middle-veld (Letisenkhabeni yelive lemanti) ……..……

10. How do indigenous farmers implement these indigenous climate change preparedness strategies in maize farming? (Batisebentisa njani balimi besintfu lobuciko baletindlela labatatiko tekulungisela ngato kumelana nesimo lesigugcukako selitulu ekulimeni umbila)?

    .....

11. What is the implication of integrating indigenous agricultural practices into the primary school curriculum in Eswatini? Uyini umtselela wekufaka lwati lwekulima kwemdzabu eluhlelweni lwekufundza ebangeni letikole letincane lapha Eswatini.

    ……

12. Any other comments or suggestions on climate change interventions in Eswatini for maize production. (Tincomo nobe longakusho mayelana neludzaba lwetaba lwekumelana nekugucuka kwesimo selitulu kusebentiswa tindlela tesintfu bakhiciti bembila bakaNgwane.

    ……

13. What are the aspects related to climate change prevalent in your community?

    .....

APPENDIX 2: FOCUS GROUP DISCUSION INTERVIEW GUIDE

SECTION A.

Demographic data

Area…….……..…..……

Region…….……

Sex: Male ……..……. Date of birth ……

Female..……..….. Date of birth ……..……...

Marital status……..

Education level……...

Qualification……

Number of children…….

SECTION B: THE INTERVIEW GUIDE

1. What is your perception about 'indigenous agricultural knowledge' (Utsini umbono wakho ngelwati lwetekulima lwemdzabu)?
   State the reasons (Usho) ngani)?……..……

2. Do you believe that the Swazi government should invest in indigenous agricultural knowledge cropping practices for sustainable food security in Eswatini? (Uyakholelwa yini kutsi hulumeni wa KaNgwane kutsi afake timali takhe elwatini lwetekulima lwemdzabu kute sibe nekudla lokwanele laEswatini)?
   a) If yes, why

   ……

   b) If, No, state the reasons?
   (Shano tizatfu)

   ……

3. What changes would you like to see of indigenous agricultural knowledge practices applied in maize production in Eswatini? Ngutiphi tingucuko ngelwati lwetekulima lwemdzabu lolufisako kulubona)? .....
   State the reasons (Usho ngani)?……..……...
4. How do you feel about commercialization of subsistence farming for maize production? Kukuphatsa njani kubolekwa kwetindlela temdzabu ekukhicitweni kwembila nge*bugcwephesha?*
   .....
   Why? (Usho ngani)?.....
   a) What is your view about none-transformation versus modernization of indigenous methods of farming (Utsini umbono wakho ngekungacitfwa kwetindlela tesintfu tekulima umbila umatanisa netindlela tebucwephesha)?
      .....……
   b) Do you trust the Ministry of Agriculture in protection of the indigenous agricultural practices during the envisaged transformation? Lelitiko letekulima uya letekulima uyatitsemba yini kuba lihawu lekulima kwemdzabu?
      .....……..……

      Why?
      (Leni)?.....
   c) Has the Ministry prepared you for any changes into indigenous agricultural practices? If so, for how long? (Singakanani sikhatsi lelitiko linilungiselela lushintjo ngetekulima usebentisa tindlela tesintfu
      …….....
      How? (Kanjani?)
      ……
   d) What changes would you *lik*e to see of the indigenous agricultural knowledge practices (Ngutiphi tingucuko longatsandza kutibona ekulimeni ngetindlela tesintfu)?
      ……
   e) What changes would you *not like* to see of the indigenous agricultural knowledge practices (Ngutiphi tingucuko longeke utsandza kutibona ekulimeni ngetindlela tesintfu)?
      ……

5. What are the current climate change interventions indigenous farmers have adopted to reduce the impact of climate change in their maize fields? (Taba tini balimi bemdzabu labatisebentisako kwanyalo kuhlangabetana nekunciphisa kulinyatwa simo selitulu sesomiso)?

   ……

6. What are examples of some of the indigenous knowledge practices for **soil prep ration** for maize cultivation in drought conditions? (Ngiphe **tibonakaliso** taletinye tindlela telwati lwesintfu letisentjentiswako ekulimeni umbila)?

   ..……

7. What are examples of some of the indigenous knowledge practices for maize growing in drought conditions? (Ngiphe **tibonakaliso** taletinye tindlela telwati lwesintfu letisentjentiswako ekulimeni ummbila)?

   ……

8. How do indigenous farmers implement these indigenous knowledge practices? (Labalimi basitakala nobe batisebentisa njani letindlela telwati lwemdzabu)

   ……

9. What are the indigenous climate change preparedness strategies maize farmers possess for Disaster Risk Reduction in the Middle-veld rural areas? (Ngutiphi tindlela balimi bemdzabu labatatiko kulungisela ngato kumelana nesimo lesigugcukako selitulu etindzaweni tasemakhaya letisenkhabeni yelive)?

   a) Dry Middle-veld (Letisenkhabeni yelive lenesomiso) ……..
   b) Wet Middle-veld (Letisenkhabeni yelive lemanti) ……

10. How do indigenous farmers implement these indigenous climate change preparedness strategies in maize farming? (Batisebentisa njani balimi besintfu lobuciko baletindlela labatatiko tekulungisela ngato kumelana nesimo lesigugcukako selitulu ekulimeni umbila)?

    ……

11. What is the implication of integrating indigenous agricultural practices into the primary school curriculum in Eswatini? Uyini umtselela wekufaka lwati lwekulima kwemdzabu eluhlelweni lwekufundza ebangeni letikole letincane lapha Eswatini.

    ……

12. Any other comments or suggestions regarding the issue of climate change interventions adopted by indigenous farmers in Eswatini for maize production. (Tincomo nobe longakusho mayelana neludzaba lwetaba lwekumelana nekugucuka kwesimo selitulu kusebentiswa kwetindlela tesintfu bakhiciti bembila bakaNgwane?

    ……

13. What are the aspects related to climate change prevalent in your community?

    .....

APPENDIX 3: RESEARCH ETHICAL CLEARENCE CERTIFICATE

UNISA

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2018/07/18

Ref: **2018/07/18/34836799/41/MC**
Name: Mr DD Dlamini
Student: 34836799

Dear Mr Dlamini

Decision: Ethics Approval from 2018/07/18 to 2021/07/18

Researcher(s): Name: Mr DD Dlamini
E-mail address: Dambuzadla@gmail.com
Telephone: +26 87 631 7178

Supervisor(s): Name: Prof S Shava
E-mail address: shavas@unisa.ac.za
Telephone: +27 78 695 4153

Title of research:

Using climate change interventions adopted by Swazi maize subsistence farmers as a strategy for developing primary teachers competencies for disaster risk reduction preparedness in Swaziland.

Qualification: M.Ed. in Science and Technology Education

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2018/07/18 to 2021/07/18.

*The **medium risk** application was reviewed by the Ethics Review Committee on 2018/07/18 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the

Open Rubric

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

UNISA College of Education Ethics Review Committee.

3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
7. No field work activities may continue after the expiry date **2023/07/18**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number **2018/07/18/34836799/41/MC** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,

Dr M Claassens
CHAIRPERSON: CEDU RERC
mcdtc@netactive.co.za

pp

Prof V McKay
EXECUTIVE DEAN
Mckayvi@unisa.ac.za

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

APPENDIX 4: LETTER GRANTING PERMISSION TO NHLAMBENI UMPHAKATSI

GOVERNMENT OF THE KINGDOM OF SWAZILAND
MINISTRY OF TINKHUNDLA ADMINISTRATION AND DEVELOPMENT

P.O. Box 13
Manzini M200
Swaziland

Tel: 25052291
Fax 25052294

Our Ref:

Your Ref:

30th September, 2018

Nhlambeni
UMPHAKATSI

RE: LECTURER SEEKING RESEARCH INFORMATION IN YOUR CHIEFDOM

We kindly request and notify Indvuna and Bandlancane to please help Mr. Dambuza David Diamini who is a lecturer at Southern Nazarene University under the Faculty of Education who needs help in your Chiefdom.

He is doing a research on his studies he is pursuing at the above-mentioned University. As Umphakatsi, you are kindly requested that you help him especially on security as he will be doing the research around your community. This research is on a school project.

PRINCE GOOKOMA
REGIONAL ADMINISTRATOR - MANZINI

APPENDIX 5: LETTER GRANTING PERMISSION TO NGCULWINI UMPHAKATSI

GOVERNMENT OF THE KINGDOM OF SWAZILAND
MINISTRY OF TINKHUNDLA ADMINISTRATION AND DEVELOPMENT

P.O. Box 13
Manzini M200
Swaziland

Tel: 25052291
Fax 25052294

Our Ref:

Your Ref:

30th September, 2018

Ngculwini
UMPHAKATSI

RE: LECTURER SEEKING RESEARCH INFORMATION IN YOUR CHIEFDOM

We kindly request and notify Indvuna and Bandlancane to please help Mr. Dambuza David Dlamini who is a lecturer at Southern Nazarene University under the Faculty of Education who needs help in your Chiefdom.

He is doing a research on his studies he is pursuing at the above-mentioned University. As Umphakatsi, you are kindly requested that you help him especially on security as he will be doing the research around your community. This research is on a school project.

PRINCE GCOKOMA
REGIONAL ADMINISTRATOR - MANZINI

APPENDIX 6: LETTER GRANTING PERMISSION TO ZOMBODZE UMPHAKATSI

GOVERNMENT OF THE KINGDOM OF SWAZILAND
MINISTRY OF TINKHUNDLA ADMINISTRATION AND DEVELOPMENT

P.O. Box 13
Manzini M200
Swaziland

Tel: 25052291
Fax 25052294

Our Ref:

Your Ref:

30th September, 2018

Zombodze
UMPHAKATSI

RE: LECTURER SEEKING RESEARCH INFORMATION IN YOUR CHIEFDOM

We kindly request and notify Indvuna and Bandlancane to please help Mr. Dambuza David Dlamini who is a lecturer at Southern Nazarene University under the Faculty of Education who needs help in your Chiefdom.

He is doing a research on his studies he is pursuing at the above-mentioned University. As Umphakatsi, you are kindly requested that you help him especially on security as he will be doing the research around your community. This research is on a school project.

PRINCE GCOKOMA
REGIONAL ADMINISTRATOR - MANZINI

APPENDIX 7: LETTER GRANTING PERMISSION TO VUSWENI UMPHAKATSI

GOVERNMENT OF THE KINGDOM OF SWAZILAND
MINISTRY OF TINKHUNDLA ADMINISTRATION AND DEVELOPMENT

P.O. Box 13
Manzini M200
Swaziland

Tel: 25052291
Fax 25052294

Our Ref:

Your Ref:

30th September, 2018

Vusweni
UMPHAKATSI

RE: LECTURER SEEKING RESEARCH INFORMATION IN YOUR CHIEFDOM

We kindly request and notify Indvuna and Bandlancane to please help Mr. Dambuza David Dlamini who is a lecturer at Southern Nazarene University under the Faculty of Education who needs help in your Chiefdom.

He is doing a research on his studies he is pursuing at the above-mentioned University. As Umphakatsi, you are kindly requested that you help him especially on security as he will be doing the research around your community. This research is on a school project.

REGIONAL ADMINISTRATOR
AUG 2018

PRINCE GCOKOMA
REGIONAL ADMINISTRATOR - MANZINI

APPENDIX 8: LETTER REQUESTING FOR PERMISSION FROM REGIONAL ADMINISTRATOR

The University of South Africa

P.O.Box 392 UNISA

0003 South Africa

Tel:+27 12 429 3111

15th July 2018

The Regional Administrator

His Honourable Prince Gcokoma

MANZINI

Dear Prince,

RE: REQUEST LETTER TO CONDUCT A RESEARCH STUDY
(NHLAMBENI, NGCULWINI, ZOMBODZE AND VUSWENI AREAS)

I**, Dambuza David Dlamini** am doing research under supervision of Saul Shava, a Professor in the Department of Technology and Education towards a Master of Education (Environmental education Specialization) at the University of South Africa. We are inviting you to participate in a study entitled**:**

Using climate change interventions adopted by indigenous maize farmers as a strategy for developing primary school teachers' competencies for disaster risk reduction preparedness in Eswatini.

The aim of the study is to document some of the indigenous Agricultural knowledge practices on maize growing related to Disaster Risk Reduction for incorporation into the curriculum for

developing the competencies of teachers in training. The findings will be integrated during the teachers training curriculum review to respond to the needs of maize subsistence farmers with respect to climate change.

The aforementioned chiefdoms under your leadership have been selected because of their proximity to the researcher and minimal personal funding.

The study will entail site visitation of key informants involved in application of indigenous agricultural knowledge practices in maize production for focus group discussions at 'Esihlahleni meeting centres' through the Umphakatsi indvuna and bandlancane with the Chiefs' permission.

The benefits of this study are that indigenous agricultural knowledge will be integrated during curriculum review and development for relevance as a local science indigenous body of knowledge.

I anticipate no risk that are man-made, and intervention have been made to contain damage to the participants.

There will be reimbursement or incentives for participation in the research for travelling costs.

Feedback procedure will entail presentation of the findings to the participants for confirmation of the results in the meeting centres "esihlahleni".

Yours sincerely,

……..……..

MR DAMBUZA D. DLAMINI