

**FEW climate change adaptation strategies of rural women: A case study of Ndwedwe-  
Cibane, KwaZulu-Natal**

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## **ACKNOWLEDGEMENTS**

To God is the glory!!!

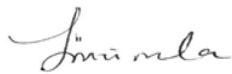
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## DECLARATION

I, Jabulile Happyness Mzimela declare that:

1. The research reported in this thesis, except where otherwise indicated, is my original research.
2. This thesis has not been submitted for any degree or examination at any other university.
3. This thesis does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.
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Signed:



Date: 21 September 2017

## **DEDICATION**

This study is dedicated to the loving memory of my father, Patrick Mcuphi Mzimela, Mnguni omkhulu.

## ABSTRACT

Climate change is documented to impact food, energy and water (FEW) resources. Rural women are vulnerable to climate change impacts due to their high dependence on natural resources. Despite numerous studies on climate change impacts, there has been insufficient examination of climate change adaptation with a focus on FEW resources using an intersectional lens. Focusing on women and using an intersectional lens, this study explores how marital status intersects with gender to influence FEW based climate change adaptation in Ndwedwe-Cibane. In addition, perceptions are explored, vulnerability is assessed and barriers and opportunities are determined. The sustainable livelihood and ecofeminist framework are used to explore the various concepts in this study. Data were collected using quantitative (meteorological data and climate projections) and qualitative Participatory Rural Appraisal-PRA research methods (three focus group discussions and two key informant interviews). First, women's perceptions of past climate change were sought by matrix scoring and meteorological data was analyzed using mainly the MK test and climate projections downloaded from the CSAG CIP website. Second, women's vulnerability was assessed using resource and hazard mapping and the vulnerability matrix. Third, climate change impacts were determined through trend diagramming. Fourth, adaptation strategies, barriers and opportunities for adaptation were explored during discussions.

This study makes four contributions to climate literature. Firstly, perceptions of temperature change regardless of marital status are fairly congruent, though there are divergences in rainfall perception. Both single and married women were found to have high temperature perception and low rainfall perception evidenced by contradiction of woman's perception of rainfall changes and meteorological data. Women's perceptions and meteorological data provide evidence for climate change. Climate projections reveal a warmer and wetter climate, which will affect FEW resources. Secondly, vulnerability appears comparable between the two groups of women. However, strong conclusions pertaining to vulnerability cannot be drawn. Thirdly, the results show that climate change impacts on FEW resources are negative and include crop failure, livestock death, and reduced water supply among other impacts. There was concordance of perceived climate change impacts between both groups of women. Fourthly, to adapt both single and married women employed multiple strategies including income and crop diversification, irrigation, use of fertilizer, collection of wet firewood and rainwater harvesting among other strategies. Notable differences in adaptation strategies indicate that single women are more concerned about crop adaptation while married women are more concerned about livestock adaptation. Despite adopted adaptation strategies, barriers to climate change adaptation were established. Barriers were similar between single and married women, whereas divergences were in financial barriers which affect only the single women. The findings reveal that no support pertaining to climate change adaptation was given to women. Women in Ndwedwe-Cibane want to opportunistically use development projects for adaptation purposes. The findings suggest that designing policies, plans and programs that focus on women as a homogenous group will not adequately address issues underlying climate change adaptation, and an intersectional perspective should be used when developing and implementing adaptation strategies.

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## **LIST OF ACRONYMS AND ABBREVIATIONS**

ABET	Adult Basic Education and Training
ATPS	African Technology Policy Studies Network
AIDC	Alternative Information and Development Centre
CIP	Climate Information Platform
CMIP5	Coupled Model Intercomparison Project Phase 5
CRiSTAL	Community-based Risk Screening Tool
CSAG	Climate Systems Analysis Group
CWP	Community Work Program
DAEA	Department of Agriculture and Environmental Affairs
DAFF	Department of Forestry and Fisheries
DDT	Dichlorodiphenyltrichloroethane
DEA	Department of Environmental Affairs
DOH	Department of Health
DFID	Department of International Development
DRDLR	Department of Rural Development and Land Reform
DSD	Department of Social Development
FAO	Food and Agricultural Organization
FEW	Food Energy Water
FGD	Focus Group Discussion
FGDs	Focus Group Discussions

GCM	General Circulation Model
HIV/AIDS	Human Immunodeficiency Virus infection/Acquired Immunodeficiency Syndrome
IFAD	International Fund for Agricultural Development
IFRC	International Federation of Red Cross and Red Crescent Societies
IISD	International Institute for Sustainable Development
IPCC	Intergovernmental Panel on Climate Change
KZN	KwaZulu-Natal
MK	Mann-Kendall
NGOs	Non-governmental Organizations
PRA	Participatory Rural Appraisal
PTO	Permission to Occupy
RCP	Representative Concentration Pathway
SADC	Southern African Development Community
SAWS	South African Weather Services
SLF	Sustainable Livelihood Framework
SMS	short text message
Stats S.A	Statistics South Africa
TEK	Traditional Ecological Knowledge
TV	Television
UN	United Nations

UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations International Children's Emergency Fund
USA	United States of America
WHO	World Health Organization
WMO	World Meteorological Organization



## **CHAPTER 1: INTRODUCTION**

### **1.1 Preamble**

Using a marital lens the study investigates rural women's perceptions, vulnerability to climate change impacts; the impacts of climate change on Food, Energy and Water - FEW resources; adaptation strategies adopted in response to climate change impacts; and assesses opportunities and barriers relating to climate change adaptation strategies. In so doing, it attempts to address the spatial and conceptual gaps in gender specific climate change adaptation research, through the development of a place-based case study, in Ndwedwe-Cibane, KwaZulu-Natal. This introductory chapter gives the background of the study focusing on climate change adaptation. It discusses climate change impacts, vulnerability and the gaps in related literature. The research problem is identified, the study motivation is discussed followed by the research aims, and objectives. The conceptual frameworks are discussed briefly, followed by the research methodology and methods, study assumptions and in closing the chapter sequence.

### **1.2 General context**

Researchers, policy makers, and civil societies are increasingly engaged “in a race against time to understand how adaptation can be facilitated, supported, and ultimately sustained, in societies at risk from climate change impacts” (Coulthard, 2008:479). Climate change is a natural phenomenon that is recurrent over geological time, however, over the past few decades the rate of change and the magnitude of global warming have accelerated dramatically (Warburton, 2012; Warburton and Schulze, 2006). Climate change is a multiscale (from local to global) and multifaceted (from droughts to floods) phenomenon with indefinite outcomes (O'Brien *et al.*, 2006). Davis (2011) adds that climate change is not just an increase in average global temperatures but changes in regional climate characteristics such as rainfall, relative humidity and severe weather extremes. United Nations WomenWatch (2009) further adds that climate change impacts have been felt in the short term and will be felt in future.

Climate change is an interdisciplinary issue because it has natural and socio-economic implications (Lorenzoni *et al.*, 2005). Climate change impacts negatively affect individuals, households, communities and the global economy (Ncube *et al.*, 2016). The negative impacts “are already felt in many areas, including in relation to, *inter alia*, agriculture, and food security; biodiversity and ecosystems; water resources; human health; human settlements and migration patterns; and energy, transport and industry” (United Nations WomenWatch, 2009:1). Climate change further exacerbates lingering environmental issues (Habtezion, 2013). Amongst these issues is land degradation, water scarcity and deforestation

(Habtezion, 2013). Development challenges such as poverty and gender amongst others render the poor more vulnerable to climate change impacts (Figueiredo and Perkins, 2013).

While climate change affects many facets of human lives, this study focuses on food (crop and livestock agriculture), energy (firewood) and water resources in relation to women's livelihoods. Mehar *et al.* (2016) notes that agriculture has been affected and will continue to be affected by climate change directly through changes in rainfall, temperature and carbon dioxide concentration and indirectly by changes in soil moisture, disease outbreaks and pest infestations. Agriculture importance in South Africa stems from its ability to satisfy rural farmer's dietary requirements and its contribution to the country's economy (Turpie and Visser, 2013).

Climate change impacts have and will continue to affect water resources, as a result water supply and security can no longer be assured (Urama and Ozor, 2010). Changes in water supply affect women's livelihoods either by disturbing their caregiver role, by impacting agricultural production negatively and by increasing the time spent collecting and storing water (Tandon, 2007; United Nations WomenWatch, 2009). Changes in water supply will make the daily lives of women more difficult since they may have to allocate more time and energy to water management (Figueiredo and Perkins, 2013).

According to the United Nations WomenWatch (2009) energy resources in developing countries particularly in rural areas come from biomass fuel resources (wood, charcoal and agricultural waste). Firewood is of interest in this particular study, as its supply in large regions in Africa and south-eastern Asia may change (Feenstra *et al.*, 1998). The impacts of climate change on firewood are not conclusive, however with temperature changes many areas may experience a shortage in supply (Feenstra *et al.*, 1998). As a result women will have to dedicate more time and walk even longer distances in search of firewood (Chikulo, 2014). In essence, climate change impacts will be amplified through the interdependence and interconnections between food, energy and water supply generally known as the Food Energy Water – FEW nexus (Carter and Gulati, 2014).

Developing countries are particularly vulnerable to climate change impacts because they heavily rely on climate sensitive sectors such as agriculture, forestry and fisheries (Thomalla *et al.*, 2006). Yet they contribute the least to greenhouse gas emissions (Van Aalst, 2006). Within Africa, geographically vulnerable areas such as coastal cities and rural areas will be adversely affected by climate change and its associated impacts (Meyiwa *et al.*, 2014). Moreover climate change impacts will hinder prospects of future development in Africa (Antwi-Agyei *et al.* 2013; Mertz *et al.*, 2009).

The poor in developing countries are adversely affected by climate change impacts due to low adaptive capacity (Solar, 2010). Figueiredo and Perkins (2013) add that development challenges such as poverty amongst others render the poor more vulnerable to climate change impacts. Women in particular will be

doubly affected by climate change impacts because they constitute the majority (70%) of the world's poor and are highly dependent on natural resources and climate sensitive sectors for their livelihoods, which are highly susceptible to climate change impacts (Hackfort and Burchardt, 2016; MacGregor, 2010; Oloukoi *et al.*, 2014; United Nations WomenWatch, 2009).

Agricultural production, firewood and water collection and management remain women's responsibility in rural areas, hence women will be impacted the most by changes in the availability of these resources (United Nations WomenWatch, 2009). Furthermore, women's risk exposure is increased during times of severe weather crisis and disasters (Phiri *et al.*, 2014). It appears that women are the most vulnerable group to climate change impacts not because of their biological status but because of socio-cultural roles ascribed to them as women because of their gender (Oloukoi *et al.*, 2014; Resurrección, 2013; Vincent *et al.*, 2010).

To manage the impacts of climate change, humans must increase their coping capacity, adapt and/or mitigate climate change (Wright *et al.*, 2015). It is no secret that climate risk has increased and will continue to do so in the future (Arnell, 1996). Hence the calls for climate change adaptation and mitigation (Adger *et al.*, 2007). However, due to lag times in the climate and biophysical systems, the positive impacts of current mitigation will only be noticeable in the next five decades (Jiri, 2016). In the meanwhile, adaptation is regarded as inevitable and a necessary response to current and anticipated climatic changes. Adger *et al.* (2005) assert that current impacts of climate change are negligible compared to what humanity will face in the future.

While studies on gender and climate change adaptation are available, it is evident that not enough studies have examined rural women's vulnerability to climate change at the local level, identified the impact of climate change on rural women's livelihoods in relation to agriculture, water resources and firewood. Furthermore, there are not enough studies that address women's adaptation strategies, opportunities and barriers to climate change adaptation. This study intends to fill the mentioned gaps. It is unwise to assume women are homogenous, they are individuals with varying degrees of access to climate change adaptation strategies (Van Aelst and Holvoet, 2016). In recognition of women's heterogeneity, the principle of intersectionality is applied this study.

### **1.3 Research motivation**

The success of top-down approaches (global and national studies) to climate change adaptation has been limited (Tunde, 2012). These approaches have failed to address regional and local climate change impacts and adaptation due to the lack of regional and local specificity (Tunde, 2012). De Stefano *et al.*

(2015) further reveal that top down approaches lack understanding of the causes and complexity of vulnerability since they are limited by the available data leading to questionable climate change adaptation decisions. Many of these studies are ‘blind’ and do not adequately recognize the impact of climate change on livelihoods, especially in rural areas (Ncube *et al.*, 2016). The Climate Change Adaptation Sector Plan for Rural Human Settlements is founded on a number of principles, one of these principles being that vulnerability to climate change impacts must be understood in the local context because climate change risks and vulnerabilities are location specific (Department of Rural Development and Land Reform - DRDLR, 2013). Therefore, this study adopts a bottom-up (use of local knowledge) approach on climate change adaptation by rural women.

It has been established that climate change will negatively affect the poor (Habtezion, 2013; Solar, 2010; United Nations WomenWatch, 2009). Seventy-five percent of the poor reside in rural areas (World Bank, 2008), hence this study focuses on a rural population. Of all the provinces in South Africa, KwaZulu-Natal – KZN has the highest rural population (Ngidi, 2007). Therefore, it was fitting for this study to be conducted in rural KZN, particularly Ndwedwe-Cibane. A full situational analysis of the Ndwedwe-Cibane community is discussed in Chapter three.

From literature, it is evident that climate change is generally a gendered issue in rural areas. Women’s household responsibilities include securing food, fuel and water and thus they face the greatest challenges (United Nations WomenWatch, 2009). Additionally, unequal access to productive resources and to decision-making processes, and limited mobility results in women being more adversely affected by climate change impacts in comparison to men (Habtezion, 2013; United Nations WomenWatch, 2009). Climate change impacts negatively affect women’s livelihoods thus rendering them incapable of sustaining their lives. Hence, the focus on South African rural women in this study. While the researcher focuses on women, she extends the role of marital status in climate change adaptation. Identifying similarities and/or differences between single and married women will shed light into challenges relating to climate change adaptation (Bryan *et al.*, 2013). In this study, a single woman is without a male partner either because she is widowed, separated, divorced or never married. The use of an intersectional analysis approach was motivated by increasing evidence of vulnerability of female headed households (implying there is no spouse) to climate change impacts.

As a prerequisite to assess women’s vulnerability to climate change impacts information must be specific to the community of study and women own assessments need to be considered (Van Aalst *et al.*, 2008). Studies on women and climate change adaptation have been done elsewhere (Deressa *et al.*, 2009; Mertz *et al.*, 2009). Yet to the researcher’s knowledge, no study has sought to explore issues pertaining to women’s climate change adaptation in Ndwedwe-Cibane. Hence, the importance of place-based

climate change adaptation analysis in Ndwedwe-Cibane. Thereafter it may be possible to confirm whether this case study resonates with literature or not.

The purpose of this study is to show that rural women are not only highly vulnerable to climate change impacts but are also invaluable actors in climate change adaptation. Women's resilience is attributed to their social and ecological knowledge derived from traditional gender roles and responsibilities (Figueiredo and Perkins, 2013). Chakrabarti (2014) further notes that women hold important information on natural resources since they are stewards of natural resources, such information can be used in the development of effective adaptation strategies and subsequently protection of livelihood strategies. Before the formulation of adaptation measures, livelihood strategies susceptible to climate change and climate change impacts need to be well understood to ensure effective adaptation (Ncube *et al.*, 2016). Hence the importance of vulnerability assessments. This study clarifies the impacts of climate change on rural women's livelihoods. Furthermore, steps women have taken to adapt are identified. Additionally, gaps where support is needed in order to enable, complement and supplement women's adaptation efforts are identified (O'Brien *et al.*, 2006), by doing so, their vulnerability to climate change impacts is reduced.

Previous studies on climate change considered barriers to adaptation, and overlooked opportunities available for adaptation. Given the aforementioned, this study addresses this gap by assessing potential adaptation strategies in Ndwedwe-Cibane. In the same way that socio-cultural roles lead to differences in vulnerability between women and men, they also open windows of opportunity for climate change adaptation (Vincent *et al.*, 2010). More needs to be done to encourage women's participation in climate change adaptation matters to ensure that policies and interventions are appropriate and draw on women's lived experience and knowledge (Brody *et al.*, 2008). Participation is critical since it empowers communities and supports their capacity to change their situation for the better (Van Aalst *et al.*, 2008). Participation of women in climate change adaptation will result in 'rooted' adaptation strategies which are likely to be based on water and soil conservation, biodiversity conservation and livestock protection (Ziervogel *et al.*, 2014). Furthermore, the use of women's knowledge will result in justice, equality and efficiency in climate change adaptation (Figueiredo and Perkins, 2013).

In contributing to the growing number of studies on climate change, this study documents using a marital lens the ways in which women residing in Ndwedwe-Cibane, a predominantly rural area, experience climate change impacts taking into consideration their vulnerability and the adaptation strategies adopted to secure their livelihoods in the face of change. Unique in this study, is the use of South African women's agency to identify climate change adaptation strategies. Another gap found in literature is the lack of intersection between South African rural women, climate change adaptation and

FEW resources. Studies generally focus on agriculture, water or energy and not all three at once, however these resources are intertwined and therefore are explored together in this study. Findings from this study may be used in future climate change adaptation initiatives by government and/or private organizations. This study may also be used to formulate more questions and in doing so, create a foundation for further research. The researcher aims not to only generate data from women in this study but more importantly to encourage women's agency in climate change adaptation, hence the use PRA.

#### **1.4 Aim**

Using a marital lens the study aims to investigate South African rural women's perceptions, vulnerability to climate change impacts; the impacts of climate change on women's FEW resources; adaptation strategies adopted in response to climate change impacts; and assess opportunities and constraints relating to climate change adaptation strategies.

#### **1.5 Objectives**

- To understand women's vulnerability to climate change impacts
- To explore the impacts of climate change on women's livelihoods in terms of agriculture, water and firewood resources
- To discover adaptation strategies used by women in response to climate change, and
- To assess opportunities and constraints faced by rural women relating to climate change adaptation strategies

Furthermore, the following questions are explored in this study:

- What are the past climates trends in Ndwedwe-Cibane and how are they perceived as well as explained by women? What are the future climate trends?
- How vulnerable are women to climate change impacts and for what reasons?
- In what way have women's livelihoods in terms of agriculture, water and firewood resources been impacted by climate change?
- How are women adapting their livelihoods to climate change impacts?
- Which constraints do women face when adapting to climate change impacts?
- What can women do to anticipate future climate change and adapt?
- Which organizations are active in women's climate change adaptation initiatives?

## **1.6 Conceptual framework**

The study is informed by the Sustainable Livelihood Framework – SLF in conjunction with the ecofeminist framework. The SLF was the framework of choice to analyze livelihoods and the vulnerability context of rural women. Paulo (2010) asserts that the SLF enhances livelihoods by removing barriers and assists people to sustain their livelihoods. Furthermore, Parizeau (2015) reveals that the SLF recognizes the poor's agency and offers approaches that can be employed to tackle any issues that affect their lives. Gender is often under looked and is not made explicit in the underlying principles of the SLF (Carney, 1999). Hence the importance of applying the ecofeminist framework, to ensure that gender is accounted for in climate change adaptation. The purpose of this study, seen from an ecofeminist perspective is to discover climate change impacts on women's FEW resources, including an analysis of how women are adapting to these changes. By employing the ecofeminist framework the researcher hoped it would assist in the analysis of what and how being a woman shapes or changes climate change adaptation.

## **1.7 Methodology summary**

This is a sequential, exploratory, and qualitative dominant study. The pragmatic paradigm is used to understand women's perceptions and experiences of climate change impacts. The researcher combined methods which gave greater depth (focus group discussions - FGD and key informant interviews) with a method which covers greater breadth (meteorological data trend analysis) (Kura and Sulaiman, 2012). Methods were mixed for complementary and expansion purposes. The adoption of mixed methods was also motivated by the gaps identified in literature. In particular, the limited climate change adaptation mixed methods studies conducted in rural areas. Hence, this study hoped to make theoretical and methodological contribution to existing climate change adaptation literature. The use of mixed methods allowed the researcher to capture not only the participants' perceptions but also their practices through different perspectives of rural women in Ndwedwe-Cibane and how these affect the process of climate change adaptation (Babbie and Mouton, 2001) and as such this study provides novel perspective on women's climate change adaptation within a rural context.

A range of Participatory Rural Appraisal - PRA techniques were used during FGDs. PRA techniques are essential, particularly in this study because they can build awareness and capacities for climate change adaptation (Van Aalst *et al.*, 2008). Furthermore, the use of PRA techniques in climate change adaptation studies has not been applied vigorously. This study draws on participatory research methods, as they lent themselves well to the research questions. While this study called for active involvement of

participants, it did not aim to yield actions but rather to inform future decisions concerning climate change adaptation. However, the researcher hoped that action would follow independently of the research process soon after participants have shared and gained the necessary knowledge.

The researcher opted for a single case study research design, which was influenced by the conceptual frameworks in conjunction the study aim. The use of a case study enables the researcher to establish how processes function under certain conditions to produce measurable observations (Jorgensen, 2012). The researcher selected Ndwedwe particularly isigodi Cibane under the jurisdiction of Cibane Traditional Council as the single case study. Ndwedwe-Cibane was chosen by purposive sampling with an aspect of convenience sampling. Participants were selected using purposive and snowball sampling. An inclusion criteria was developed and applied when selecting participants. The sample size varied between 20 and 21 participants.

Key informants were selected based on the role they play in the community. Purposively sampled key informant (Chief) held information that was important for the study (Mthethwa, 2012). The key informant (representative from the Department of Agriculture and Environmental Affairs-DAEA) that was identified through snowball sampling also held important information and was recommended by women in the study area. The use of snowball and purposive sampling improved the effectiveness of the research design (Nyiraruhimbi, 2012). Qualitative data was reduced by thematic analysis. Quantitative data was obtained from the South African Weather Service - SAWS and the Climate Systems Analysis Group - CSAG website. Additional sources of information included reports, journals and policies. Primary data in conjunction with secondary data was used to achieve the objectives.

### **1.8 Study assumptions**

According to Leedy and Ormrod (2010:62), “assumptions are so basic that, without them, the research problem itself could not exist”. Firstly, it was assumed that climate change is occurring in Ndwedwe-Cibane. Secondly, it was assumed that all participants would be active and give an accurate account of their perceptions. This assumption was probably true because participants were encouraged to participate in a number of ways and participant confidentiality was maintained. Thirdly, it was assumed that gender and marital status would influence the perceptions of participants. This assumption was probably true because women were participants in this study and were encouraged to share perceptions linked to their gender and marital status. Fourthly, it was assumed that historical meteorological data and climate projections were representative of Ndwedwe-Cibane climate.



## **1.9 Chapter sequence**

This thesis contains eight chapters. Chapter one, presents the background of the study, followed by the motivation for the research, thereafter the study objectives and questions, conceptual frameworks, methodology summary, study assumptions and chapter sequence are presented. Chapter two presents the conceptual frameworks, and reviews existing literature on climate change impacts, vulnerability, perception, adaptation, barriers and opportunities in relation to women's livelihoods. Gaps in literature are also discussed. Chapter three describes the study area and further expounds the methodology adopted to achieve the research objectives. Chapter's four to seven presents and discusses the research findings. They are organized in the following titles: past and future climate trends against women's climate change perception; women's vulnerability and climate change impacts on FEW resources; women's adaptation to climate change impacts; barriers and opportunities for climate change adaptation. Chapter eight presents the main conclusions, study recommendations, recommendations for future studies and concludes the study.

## **1.10 Conclusion**

This intersectional informed study seeks to better understand climate change adaptation from rural women perspectives. It moves beyond reinforcing prior assumptions of similarity among rural women. In this chapter, the reader has been acquainted with literature on climate change adaptation, study motivation, research aim and objectives, the conceptual frameworks adopted and the research paradigm, methodology and methods. The study assumptions have also been presented. This chapter concludes by presenting the sequence of the chapters. The following chapter provides the conceptual frameworks underlying this study and reviews climate change adaptation and gender related literature.

## **CHAPTER 2: CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW**

### **2.1 Introduction**

This chapter discusses the conceptual frameworks: SLF and ecofeminist framework and demonstrates their pertinence to this study. In addition, it reviews literature on climate change with emphasis on women's adaptation efforts within rural contexts. The different sections chronologically discuss intersectionality and its relevance in this study, climate change and its impacts on FEW resources, which are important for rural women's livelihoods. Additionally, the chapter explores literature on women's vulnerability to climate change impacts, including their perceptions of climate change, deemed critical in influencing their adaptation (or lack of it) strategies. The reasons for adaptation and types of adaptation strategies are also discussed. There is also a focus on barriers to adaptation and opportunities for adaptation. Weaknesses and gaps in existing literature on women's climate change adaptation efforts are highlighted, along with how this study aims to contribute to these gaps.

### **2.2 Conceptual frameworks**

A conceptual framework is a socially constructed set of basic values and beliefs that serve as spectacles through which to see the world around us (Siwila, 2014). A conceptual framework is important, firstly, because it enables the researcher to understand the main concepts in a given study; secondly, it provides the researcher with a general methodology; and thirdly it guides the fieldwork as well as the analysis of data (Imenda, 2014). The purpose of this study is to address questions on climate change adaptation. The researcher draws on the SLF to analyze climate change vulnerability and adaptation using participatory qualitative and quantitative methods. However, climate change impacts, vulnerability and adaptive capacity are gender differentiated. Since this study focuses on addressing questions specifically about women's FEW based climate change adaptation. The SLF in combination with the ecofeminist framework are used to provide a lens through which adaptation strategies are identified and analyzed. The researcher envisioned that employing ecofeminism would assist in the analysis of inadequacies in existing literature.

#### **2.2.1. Sustainable Livelihood Framework**

The SLF is used to analyze how individuals, households and communities make a living and in what ways their livelihoods can be made more sustainable in the long term (Smith, 2012). According to Ellis (2000), a livelihood encompasses assets, access to assets, capabilities, and activities required to make a living. The goal is to achieve a sustainable livelihood, defined as one, which can cope with and recover

from trends, shocks and seasonal cycles, maintain or enhance its capabilities and assets, both now and in the future, and which contributes net benefits to other livelihoods at the local and global levels (Chambers and Conway, 1992). The SLF promotes ecologically sensitive, economically sustainable and socially just livelihood strategies (Arku and Arku, 2011). It is based on six principles, namely, it is people centred, holistic, builds on strengths, multi-level, conducted in partnership, sustainable and dynamic (Department of International Development- DFID, 1999).

The SLF presents the main factors that affect people livelihoods, their importance relative to each other and the typical relations between them (Carney, 1999). This framework is a tool to expand our knowledge on livelihoods of the poor, particularly women who are among the most susceptible to climate change impacts, and when used with participatory research methodologies, it becomes useful to analyze complex rural realities (DFID, 1999). It is holistic because it considers the stresses that the poor might be very vulnerable to, the resources that help them strengthen their asset base, enhance capabilities and reduce vulnerability, and the transforming structures and processes, which have an effect on their livelihoods (DFID, 1999). Figure 2.2.1.1 below provides an overview of key aspects of the SLF and climate change and gender linkages which need to be understood. At its core it emphasizes a gendered analysis of entitlements, capabilities, division of labour, risk perception, climate interpretation, livelihood strategies and outcomes (Oxfam and United Nations, 2009).

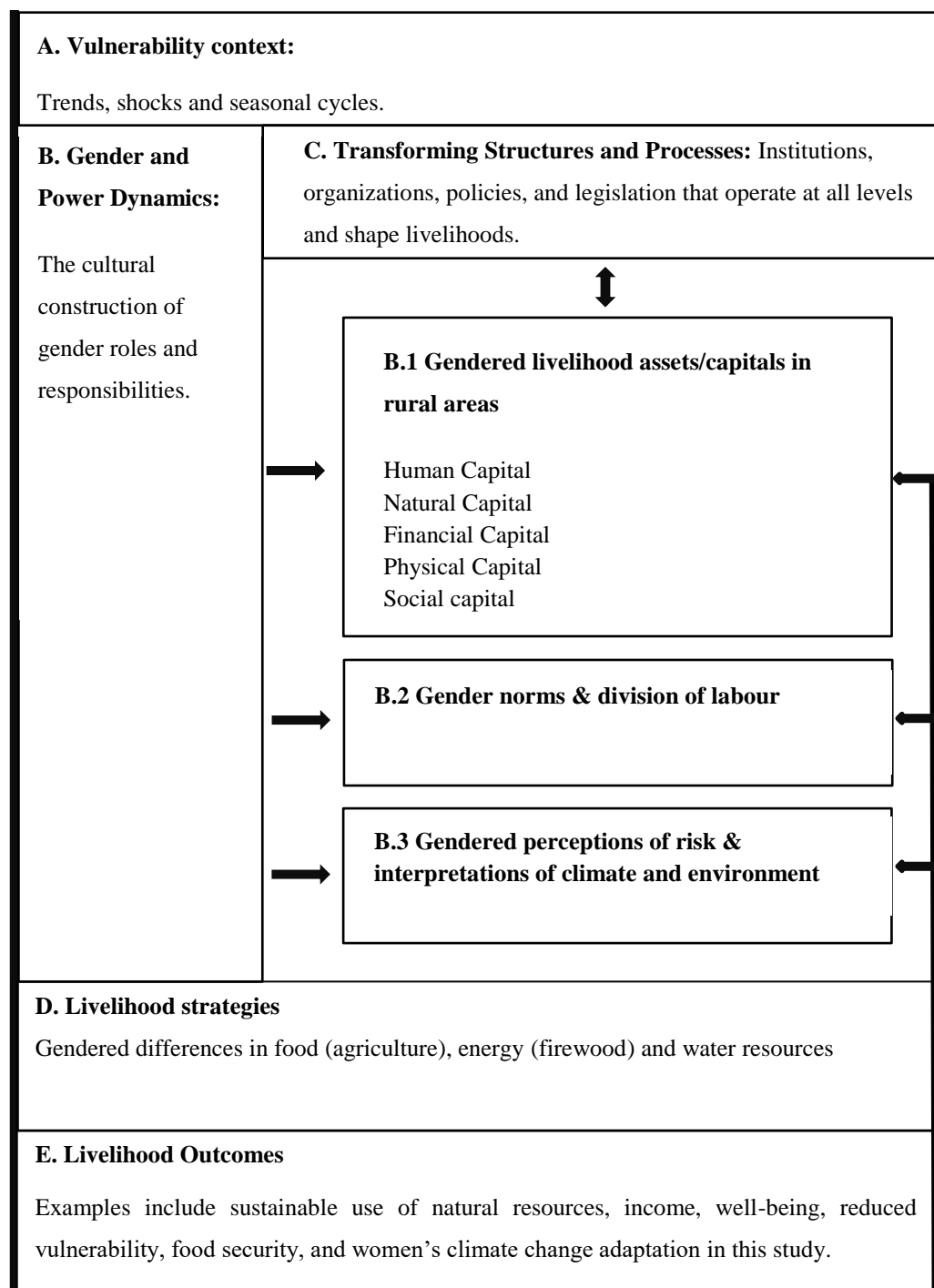


Figure 2.2.1.1: SLF and the gender and climate change analytical framework (adapted from Oxfam and United Nations, 2009:18 and DFID, 1999:1)

### A. The vulnerability context

The vulnerability context focuses on understanding the context that creates and perpetuates women’s vulnerability to climate change impacts, in order to support climate change adaptation strategies. The vulnerability context has two facets: an internal side of defenselessness and an external side composed of critical trends, shocks and seasonal cycles (Serrat, 2008). Critical trends may include but are not limited to, economic, demographic, environmental, governance and technological trends (Serrat, 2008). Not all

trends increase the vulnerability level, for example, technological trends may improve people's livelihoods (Haidar, 2009). Shocks may range from illness, to conflict and drought among other examples (Haidar, 2009). Shocks could force people to sell their assets, for example during a drought a farmer may be forced to sell his livestock (Haidar, 2009). Seasonality refers to cyclic change and includes changes in the price of stuff and employment opportunities (Serrat, 2008).

The external side of the vulnerability context is important because it has a direct impact on people's asset portfolios (it can either destroy or create assets) and the livelihood strategies that can be pursued to achieve positive livelihood outcomes (Carney, 1999). People either have limited or no control of the vulnerability context (DFID, 1999; Carney, 1999). According to Carney (1999) and Haidar (2009) most change in the vulnerability context is a product of activity at the level of transforming structures and processes. An alternative way to manage the vulnerability context is to support people efforts to build their asset portfolios (DFID, 1999; Haidar, 2009).

## **B. Gender and power dynamics**

The SLF expands our understanding of how rural dwellers make a living in developing countries, however it lacks specificity on what 'activities' provide a living (Arku and Arku, 2011). Hence, it is considered gender insensitive because there is a high risk of overlooking non-market activities such as women's domestic work (Arku and Arku, 2011; Pla Julián and Guevara de Molina, 2013) and reproductive role (Pla Julián and Guevara de Molina, 2013). Ecofeminist challenge the invisibility of women's non-market activities, which share many traits with the invisibility of resources and services provided by nature (Pla Julián and Guevara de Molina, 2013) such as climate regulation and food supply which are considered material benefits and recreational, aesthetic and spiritual value which are classified as non-material benefits (Polasky, 2008). This highlights the importance of the gender and power dynamics component in this framework. The relative vulnerability and/or adaptive capacity of women and men to comparable climatic shocks and stresses is determined under the gender and power dynamics component (Oxfam and United Nations, 2009). Gender and power dynamics shape gender roles and responsibilities, differences in resource access for women and men, and their varying capabilities (Oxfam and United Nations, 2009). They also influence women and men's perception of risk and interpretation of their climate and environment (Oxfam and United Nations, 2009). The researcher explores climate change adaptation by focusing on women and their marital status and how it affects other components of the SLF and more importantly how it influences climate change adaptation and how climate change influences their FEW resources.

## **B.1. Gendered livelihood assets/capitals**

The term assets refers to stocks of financial, human, natural, physical or social resources that can be acquired, developed, and improved by people to make a living and can also be transferred across generations (Chambers and Conway, 1992). The SLF is based on understanding people's access to assets (Chambers and Conway, 1992). Access to assets influences a household resilience to the impacts of social-ecological change and adaptive capacity to climate change impacts (Ahmed and Fajber, 2009). In agreement with Ahmed and Fajber (2009), Goh (2012) affirms that access and control of capital assets is important to achieve development goals and improve human wellbeing especially in the face of climate variability and change.

Assets are categorized as tangible or intangible (Chambers and Conway, 1992). Physical, natural and financial assets are tangible (Mersha and Van Laerhoven, 2016). Examples include resources such as land, equipment and machinery and stores such as food and money (Simiyu, 2012). Intangible resources include human and social capital (Mersha Van Laerhoven, 2016). Simiyu (2012:16) asserts that intangible assets include claims and access, "claims refer to the appeals that people may make on a variety of actors – other people, social groups and networks, organizations, private and public institutions, – for assistance when they are faced with adverse circumstances". March *et al.* (1999), further assert that skills, self-confidence, respect, status, leadership qualities and time especially for women constitute intangible resources. When people have few tangible resources, intangible resources play a greater role in shaping their lives (March *et al.*, 1999).

The SLF summarizes assets into five different types as mentioned above and as discussed below:

**Natural capital-** The stock of assets provided by the natural environment (Moser and Stein, 2011). Natural resources such as forests, land and water form part of natural capital (Goh, 2012; Moser and Stein, 2011). Key environmental services required for living are a product of natural capital moreover, natural capital is especially important to those who rely on resource-based activities for their livelihoods (Carney, 1999).

**Physical capital-** Examples of physical capital include *inter alia*: water supply and sanitation services; infrastructure and transportation; houses; agricultural inputs and consumer durables (Goh, 2012).

**Human capital-** Human capital includes skills, education, information, knowledge, nutrition, health, time and labour that jointly enable people to attain positive livelihood outcomes (Goh, 2012). Human capital in the form of labour is a major asset for rural dwellers (Ellis, 2000). Moreover, human capital is necessary to make use of any of the other categories of livelihood capitals (Carney, 1999).

Social capital- Social capital represents social norms and formal/informal networks that enable people to work together in pursuit of positive livelihood outcomes (Adger, 2003; Mersha and Van Laerhoven, 2016; Muthoni, 2012). Social capital is the most connected capital category to policies and institutions (Carney, 1999). In fact, there is a two-way relationship between the two. Social capital may be considered a product of policies and institutions, on the other hand policies and institutions may themselves be products of social capital (Carney, 1999).

Financial capital- Financial capital includes *inter alia*, income, access to credit, livestock (Mersha and Van Laerhoven, 2016) and savings (Moser and Stein, 2011). It is important to note that financial capital can be converted to other categories of capital depending on policies and institutions (Carney, 1999).

A single asset may have several benefits. For example livestock can be classified as natural capital, yet it can also be classed as a physical asset (think of ploughing oxen) and may generate social capital (symbolizes social status and connectedness to the community) and be a source of insurance during shocks (financial capital) (DFID, 1999). No single category of assets is enough to achieve positive livelihood outcomes (Carney, 1999). The more assets, the greater the livelihood options available to be pursued (Haidar, 2009). According to DFID (1999) and Simiyu (2012) the process of making a living combines assets in a multitude of different ways, and tradeoffs between an asset and several combinations of assets occur. In addition individual and/or household assets change over time as assets are depleted, transformed, replaced and gained (Meinzen-Dick, 2011 as cited in Mzimela, 2015). Livelihood assets are vulnerable to climate change impacts, yet they can also facilitate adaptation (Islam, 2013). However, women's access to assets is often constrained (Fletschner and Kenney, 2011).

### **C. Transforming Structures and Processes**

Gendered livelihood strategies and outcomes are not only dependent on access to capital assets or inhibited by the vulnerability context, structures and processes also transform them (Serrat, 2008). Transforming structures and processes are the institutions, organizations, policies, and legislation that influence livelihood strategies (DFID, 1999). Transforming structures and processes maintain a two-way 'influence and access' with men and women's assets and capabilities and a direct feedback to the vulnerability context (Carney, 1999; DFID, 1999). In summary, transforming structures and processes play a significant role by influencing access to resources, interaction among different resources, livelihood strategies, and decision-making (Carney, 1999; Scoones, 1998).

According to Bryan *et al.* (2009), institutions influence and shape adaptation. Dube *et al.* (2014) affirm this and states that formal and informal institutions (table 2.2.1.1) have an important role to play in climate change adaptation, since no adaptation exists in an institutional vacuum. Institutional roles in adaptation include assessing vulnerability; provision of climate change information; capacity building

and skills development; connecting communities to other support structures; building resilience; looking at potential adaptation strategies; funding or mobilizing of resources and allocating them; and management (Dube *et al.*, 2014). By looking at the context provided by transforming structures and processes, we can understand some of the constraints and opportunities for climate change adaptation, and develop strategies to build a more enabling policy environment.

Most of the existing institutions and processes do not tackle gender issues but instead lead to the (re)production of gender inequality (Lowndes and Roberts, 2013). Even more disturbing is the neglect of transforming structures and processes in most studies, as a result gender receives little or no attention in livelihood literature (Mersha and Van Laerhoven, 2016). To address this gap, the researcher adopted ecofeminist conceptual framework.

Table 2.2.1.1: Types of institutions in rural areas (adapted from Dube *et al.*, 2014:55)

Formal (state)	Informal (market)	Civic (civil society)
Extension officers	Farmer associations	Stokvels
Weather departments	Insurance companies	Kinship
Environmental offices	Seed companies	NGOs
Municipalities		Co-operatives

#### **D. Gendered livelihood strategies and E. Livelihood outcomes**

The term livelihood strategy refers to a combination of activities and choices women and men make in order to achieve their respective livelihood outcomes (DFID, 1999). A number of resources are pooled to create or improve livelihood strategies depending on their asset portfolio, experiences, needs and opportunities (Mersha and Van Laerhoven, 2016). Those with more assets have a greater range of livelihood strategies to choose from to achieve their respective livelihood outcomes (Carney, 1999). A livelihood is more than income generation, it includes access to resources and opportunities, averting risks, negotiating within the household and managing social networks and institutions around us (Scoones, 1998). Having established that transforming structures and processes have a direct feedback to the vulnerability context, they can also limit the number of livelihood strategies people can pursue and may have direct positive or negative impacts on livelihood outcomes (Carney, 1999).

A successful livelihood is the result of mixing assets that enable a household to withstand present adverse impacts without compromising their future ability to survive (Ellis, 2000). The results of



pursued livelihood strategies are livelihood outcomes (Carney, 1999; Haidar, 2009). According to Serrat (2008), there are several categories of outcome indicators, which can be used to assess the realization of people's livelihoods. These are more income, increased well-being, and reduced vulnerability, sustainability of natural resource base, improved food security and recovered human dignity and in this study, climate change adaptation. At times, there may be conflict between livelihood outcomes (Carney, 1999). To summarize, A (vulnerability context), B (gender and power dynamics) and C (transforming structures and processes) determine part D of the framework (livelihood outcomes). Livelihood outcomes may also have a feedback effect on the livelihood assets and the vulnerability context (Tang *et al.*, 2013). From a gender perspective, livelihood outcomes reveal gender gaps between and among women and men. Already women access to assets is constrained and livelihood strategies are limited, accordingly they largely exhibit weaker livelihood outcomes relative to men.

### **2.2.1.1 Sustainable Livelihood Framework Critiques**

The SLF has proven to be useful for studying livelihood strategies of the poor (Dasgupta and Baschieri, 2010). However, is not without criticism, it lacks culture – which influences the use of assets - and a focus on agency and empowerment (Dasgupta and Baschieri, 2010; Foresti *et al.*, 2007). Also people are invisible in the framework (Njagi, 2005). Recognition of historical factors is limited (Dasgupta and Baschieri, 2010; Foresti *et al.*, 2007; Njagi, 2005). Yet culture and historical experiences shape roles, responsibilities, rights and livelihoods (Foresti *et al.*, 2007). Furthermore, power relations are often under-looked and not made explicit in the underlying principles (Carney, 1999; Foresti *et al.*, 2007). Forest *et al.* (2007) and Njagi (2005) add that differences in socio-economic factors such as gender and class are often not made explicit. This highlights the importance of modifying and/or supplementing the SLF with other frameworks to ensure that these 'missing ideas' are reflected in practice (Carney, 1999). The SLF is appropriate for this study and its insights are combined with the ecofeminism theory (discussed under section 2.2.2.1) with the hope that it may palliate some of its limitations.

### **2.2.1.2 Sustainable Livelihood Framework and climate change**

In this study, the SLF is adopted to identify women's vulnerability to climate change impacts. Attention to the vulnerability context of women's livelihoods contextualizes the significance of FEW resources in a changing climate. In addition, climate change impacts on women's FEW resources are considered, determining the livelihood strategies available to rural women. Furthermore, the SLF is used to determine women's adaptation strategies and women's access to, and control over resources (International Institute for Sustainable Development - IISD, 2012). Thus, the SLF contributes valuable information to this study and can reveal entry points for sustainable/successful climate change adaptation interventions. In addition, the framework assists in the exploration of transforming structures and

processes that shape adaptation decisions (Burnley *et al.*, 2008). The SLF is dynamic and therefore allows the researcher to focus on a local study while being conscious of the influence of wider factors on the local level processes and institutions (DFID, 1999). Concerning methodology, the SLF allows the researcher to adopt both qualitative and quantitative methods (Allison, 2005) in order to investigate the ways in which women are vulnerable and adapted to climate variability and change.

### **2.2.2 Ecofeminist Framework**

Feminism is a response to exploitative and oppressive man-women relationships, which are intertwined with all other social relations (Muthuki, 2006). *“Feminist theories hope to develop effective ways to improve women’s conditions, sometimes by making women more similar to men as they are now. Sometimes by making men more similar to women as they are now, sometimes by validating women’s traditional characteristics, sometimes by working toward the abolition or minimizing of the categories of gender altogether, but all simultaneously transforming ideologies and institutions, including the family, religion, corporations, and the state”* (Gardiner, 2005:35). Feminism is not based on hatred for men but love for humanity as a whole (Perry, 2015). Ecofeminism is founded on feminism in particular, radical and/or cultural feminism (Schmonskey, 2012; Shrivastav, 2013). *“Which hold that identifying the dynamics behind the dominance of male over female is the key to comprehending every expression of patriarchal culture with its hierarchical, militaristic, mechanistic and industrial form”* (Shrivastav, 2013:3).

#### **2.2.2.1 Ecofeminism defined**

The term ecofeminism also known as ecological feminism was coined by the French author Françoise d’Eaubonne in 1974 (Pla Julián and Guevara de Molina, 2013; Rao, 2012). Ecofeminism is a response to the perception that women and nature are dominated and exploited by western capitalist patriarchy (Muthuki, 2006). As they are evaluated in regards to their usefulness as male resources (Paton, 2013). Women have been ‘naturalized’ (and described for example as chicks) while nature has been ‘feminized’ (for example, she is conquered, and controlled by men) (Muthuki, 2006). Feminization of nature and naturalization of women has led to the oppression of both (Muthuki, 2006).

Although no single definition of ecofeminism exists, the study adopts Birkeland’s (1993:18) definition, which defines ecofeminism as a *“value system, a social movement, and a practice (which) also offers a political analysis that explores the links between androcentrism and environmental destruction. It is an ‘awareness’ that begins with the realization that the exploitation of nature is intimately linked to Western Man’s attitude toward women and tribal cultures...”*

Ecofeminism combines insights from environmentalism, ecology, feminist movements and philosophy to get rid of the domination and oppression of women, which leads to the abuse of nature by men (Chircop, 2008). Ecofeminism draws from ecology and environmentalism based on its focus on the preservation of ecosystems and is feminist based on its recognition of male favoritism (Tøllefsen, 2011). In addition, ecofeminism as a philosophy holds that all forms of domination are based on patriarchy (Chircop, 2008).

There are several forms of feminism and accordingly there are a number of ecofeminism forms (Banford and Froude, 2015). Shrivastav (2013) categorizes these forms into radical, socialist, liberal and cultural ecofeminism. A complete look at the various ecofeminism forms is beyond the scope of this study. This study does not align with one particular form of ecofeminism, but draws from a number of forms in an effort to make visible social categories that oppress women during climate change impacts. According to Warren (2000:57) as cited by Seçkin (2016:12) *“ecofeminist philosophy, in general, agrees on three main claims. The first one is that there are connections between the domination of women and nonhuman nature. The second one is that it is crucial for ecofeminism to raise awareness in environmental philosophy about these interconnections between women and nature. The last one is that ecofeminism tries to replace unfair domination over women and nature with justified structure in the environmental philosophy. Thus, ecofeminism tries to make visible this unfair dualism by proposing interconnections between women and nature”*.

Ecofeminist postulate that women are closer to nature than men are and consequently are more caring towards the environment (Roy, 2015). Women’s connection with nature is attributed to several factors: firstly, because of their biological features, they are both fertile and are providers of life (Roy, 2015; Seçkin, 2016). Secondly, social features are cited, women are closer to nature because of traditional gender roles such as water and firewood collection (Seçkin, 2016). Thirdly, culture (Roy, 2015) and fourthly their shared history of oppression by a patriarchal society (Roy, 2015; Seçkin, 2016). Women are linked to nature and the realm of the physical while men are identified with the ‘human’ and the realm of the mental (Chircop, 2008). Whatever is connected to the former is inferior to whatever is identified with the latter (Chircop, 2008).

#### **2.2.2.2 Ecofeminism critiques**

Ecofeminism lacks clarity as a theory because of its several forms however, some scholars see this diversity as a positive aspect of ecofeminism (Manion, 2002). Manion (2002) further notes that it would be a mistake to assume that all women are working towards the same goal, and as such, it would also be false to assume the same amongst ecofeminism scholars. In fact, amongst ecofeminist, there is no consensus on how to forge progressive social change and cultural transformation (Nogueira-Godsey,

2013). Ecofeminism is said to be ethnocentric and essentialist (Hackfort and Burchardt, 2016; Rao, 2012), essentialist because it presents women as a homogenous group (Rao, 2012). Thus, neglecting the diversity among women based on social categories (Manion, 2002; Muthuki, 2006). The researcher departs from this form of essentialism by identifying a group of women and focusing on them and further extrapolates this analysis from gender to marital status, thereby encompassing a broad group of marginalized people. Another form of essentialism is the assumption that women have an innate deeper connection to nature, this assumption is a mere reduplication of the patriarchal fallacy (Fröhlich and Gioli, 2015; Muthuki, 2006). Furthermore, the linkage between women and nature assumes that women will always protect the environment, which may not be true, women may be responsible for environmental degradation due to the nature of their multiple and competing roles (Muthuki, 2006).

Ecofeminism is also criticized for being sexist and incoherent (Seçkin, 2016). It excludes men, glorifies women, and encourages biological and socially constructed differences between men and women (Seçkin, 2016). Ecofeminism is also considered to be spiritualist (MacGregor, 2010; Manion, 2002). The earth is portrayed as female and this is thought to be anti-intellectual (Brianson, 2016). Ecofeminism criticisms also include: blindness to socio-economic class, ethnicity, and other social stratifications, and is ahistorical and neglects the material sphere (Rao, 2012). Mee (2016) claims that ecofeminism is selective and detached from the actual practice of its supporters. Despite the above-mentioned criticisms, ecofeminism has a strong basis in democratic development and environmental issues are very important in the theory (Manion, 2002).

### **2.2.2.3 The significance of ecofeminism in climate change adaptation**

The domination of women and nature by men is a social construct and therefore has the potential to change (Schmonskey, 2012). The liberation of women requires the liberation of nature, and vice versa (Chircop, 2008) because they are under the same domination (Seçkin, 2016). Ecofeminism may overcome this domination (Chircop, 2008; Schmonskey, 2012) by prioritizing progressive social change (Brianson, 2016; Nhanenge, 2007). The linkage between women and nature is seen as a source of women's empowerment and environmental liberation (Muthuki, 2006). Ecofeminists believe that women work together to protect the environment. An example of ecofeminism at play, occurred during the mid-1970's in Uttarakhand, India when deforestation was practiced to make way for reforestation of commercial trees (pine and eucalyptus) thus destroying women's ability to provide forest goods and services for their livelihoods. In response, women protested by hugging trees in an attempt to influence the government to stop deforestation. This act led to the prevention of soil erosion and biodiversity loss (Manion, 2002).

Ecofeminism relevance is beyond a gender-nature connection to include all oppressions based on social categories such as class, race, religion and sexual identity among others (Chircop, 2008). Furthermore, Banford and Froude (2015) aptly note that ecofeminism recognizes women's voices, differentiated by social categories and therefore invites an extension to include intersectional analysis (discussed in section 2.4.2.1). Ecofeminists call "upon women and men to reconceptualize themselves, and their relationships to one another and to the nonhuman world, in non-hierarchical ways" (Agarwal, 1992:120). This will allow men and women to work together in the future, in the management and control of ecosystems (Agarwal, 1992).

Due to their roles as carers and provisioners, women are the first to suffer when access to sustainable livelihoods is compromised (MacGregor, 2010; Manion, 2002). For example, when water is in an unusable form, food stores are dry, trees have disappeared and the climate has changed, women are often the ones who need to walk longer distances and dedicate more time to labour to ensure their families survival (Manion, 2002). Additionally, due to their subordinate role in decision-making related to environmental programmes they suffer more (Muthuki, 2006). Therefore, environmental degradation affects women's survival activities disproportionately (MacGregor, 2010; Nogueira-Godsey, 2013; Roy, 2015). Under such conditions, ecofeminism becomes highly relevant (Bhalla, 2012).

Ecofeminism reveals the causes of humanity's current social and ecological problems. Moreover, ecofeminism promises solidarity among women and all others who suffer from oppression, as well as sympathizers (Schmonskey, 2012). The purpose of this study, seen from an ecofeminists' perspective is to analyze rural women's climate change adaptation strategies. An ecofeminists' perspective addresses climate change impacts, including an analysis of how women are adapting to these changes.

## **2.3 Background to climate change**

### **2.3.1 Climate change defined**

Climate change is a natural phenomenon, however it has become a threat to humanity because the rate of change is more rapid and the range is greater than anything humanity has had to adapt to in the past (Warburton and Schulze, 2006). This change has been attributed to anthropogenic greenhouse gas emissions (Koske and Ochieng, 2013). The global North (20% of the world's population) is responsible for 80% of the greenhouse gases already in the atmosphere (Gaard, 2015). The United Nations-UN (2007:30) as cited by Cihelkova (2011:437) defines climate change as "a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer".

Climate change can manifest as a shock or a stress (Ziervogel and Calder, 2003). Discrete, extreme events (rapid onset) such as floods and droughts are classified as shocks while gradual change (slow onset) such as long-term climate variability is classified as a stress (Daze *et al.*, 2009; Ziervogel and Calder, 2003). Climate variability is an important part of climate change (Smit and Pilifosova, 2003). Thus, adaptation to climate change includes adaptation to climate variability (Smit and Pilifosova, 2003). Climate change is driven by unsustainable human activities such as the burning of fossil fuels, deforestation, land use change and industrial pollution among other causes (Koske and Ochieng, 2013). Climate change is a threat because its effects are distant, intangible and delayed (Böckmann, 2015) and is termed the threat multiplier since it exacerbates existing trends, tensions and instabilities (Tadesse, 2010).

### **2.3.2 Past climate change**

Historical data reveals a rise of 0.74° C in global average temperatures over a period of 100 years ending in 2005 (Zinyengere *et al.*, 2013). On the other hand, Koske and Ochieng (2013) assert that the earth has experienced an average warming of roughly 0.6° C during the 20<sup>th</sup> century. Annual rainfall trends have showed a significant decrease in the number of rain days, an increase in rainfall intensity and increased dry spells (Department of Environmental Affairs - DEA, 2013). Other than changes in average temperature and rainfall, other aspects of climate change are evident including: increases in intensity and spatial extent of droughts; decreases in snow cover especially in the northern hemisphere; increases in the duration of heat waves; shrinking of the arctic sea ice pack and glaciers; increases in ocean temperature; and increases in sea level at a rate of 3.1 mm yr<sup>-1</sup> between 1993 and 2003 (Tadross *et al.*, 2008). South Africa has experienced climatic changes, amongst these changes are floods and prolonged droughts at small scales (Meyiwa *et al.*, 2014).

### **2.3.3 Climate change projections**

There are uncertainties associated with climate projections (Dube *et al.*, 2014; Nicholson-Cole, 2005) because they are based on the potential rates of resource use in the future, and associated greenhouse gas emissions (Nicholson-Cole, 2005). However, there is less uncertainty in temperature projections when compared to rainfall projections (DEA, 2013; Tadross *et al.*, 2008). Global projections reveal a rise between 1.1 and 2.9° C by 2100 for a low-emission scenario and between 2.4 and 6.4° C for a high emission scenario (Bal *et al.*, 2016). Africa's temperature is expected to rise faster than the global average increase by the end of this century. Africa's temperature will increase by 1.5 to 3° C by 2050

(Gemedda and Sima, 2015). Whereas South Africa's temperature will increase to 1.2° C by 2020, 2.4° C by 2050 and 4.2° C by 2080 (Kruger and Shongwe, 2004). Furthermore, Babugura *et al.* (2010) and Dube *et al.* (2014) state that the central region of South Africa will experience the highest increases in temperature while the coastal areas will experience the lowest increases because coastal temperatures are moderated due to the close proximity to the ocean.

Future rainfall changes are harder to detect because of greater rainfall variability, spatially and temporally (Tadross *et al.*, 2008; Zinyengere *et al.*, 2013) and across models such that there is no consistent global trend (Zinyengere *et al.*, 2013). Yet, some climate models predict that there will be a global increase in rainfall (Kruger and Shongwe, 2004) and rainfall variability (Thorlakson and Neufeldt, 2012). East and Equatorial Africa expect an increase in rainfall, on the contrary, the Mediterranean, north of the Sahara, western margins of Southern Africa and the winter rainfall areas will experience decreased rainfall in the future (Dube *et al.*, 2014).

Contrary to the global increase in rainfall, South Africa's rainfall is expected to decrease by 5.4% by 2020, 6.3% by 2050 and 9.5% by 2080 (Kruger and Shongwe, 2004). Dube *et al.* (2014) assert that central areas, northeast and eastern coastal areas of South Africa expect increased rainfall whilst most of the interior and western coastal areas are projected to receive less rainfall. The incidence and intensity of climate extremes, *inter alia*, droughts, floods and wild fires will increase (Böckmann, 2015; Davis, 2011; Dube *et al.*, 2014; Linkd Environmental Services, 2013). Additionally, the sea level will continue rising and ocean acidification will intensify (Böckmann, 2015), the snowpack will diminish and the evaporation rate will increase (Liu, 2016).

## **2.4 Climate change impacts**

### **2.4.1 General climate change impacts**

Climate change research has largely been framed as a scientific process and less in social realms (Parikh, 2007). This study is in line with Schellnhuber (2009), who postulates that climate change related research should be conducted by social scientists, and that there needs to be a shift from studying the causes and nature of change to the study of its implications for human beings. Evidence of past climate change impacts exists, currently impacts are observed and impacts will continue to be felt in both the short and long term (Innocent *et al.*, 2016). These impacts vary socially, spatially and, depending on the sensitivity and adaptive capacities, bear differing consequences on people's livelihoods (Hackfort and Burchardt, 2016). The economic, social, domestic and political lives of people are impacted by climate change (Christian, 2014). Several authors (Below *et al.*, 2010; Bob and Babugura, 2014; Ndaki, 2014) note that not all climate change impacts will be negative, some may be positive depending on the region

and ecosystems. For example, due to climate change some parts of south-east Asia that lack water may receive more rain (Bob and Babugura, 2014).

Global climate change is evidenced through: melting glaciers, shrinking lakes, reductions in Arctic sea ice in the summer season, shifts in habitat range of certain species and changes in the agricultural growing season (Dube *et al.*, 2014). Climate change impacts in Africa range from decreases in grain yields, changes in water availability in the Mediterranean and southern countries of Africa, to increased stresses resulting from increased droughts and floods; and significant flora and fauna species extinctions and associated livelihood impacts (Boko *et al.*, 2007 as cited in Christian, 2014:2). In addition, diseases such as malaria have been spreading, ice caps have been melting in the mountains (for example Mount Kenya), coral bleaching has increased along the coastline, and lakes have been shrinking including Lake Chad (Chigavazira, 2012). Climate change in Africa is considered a security threat since it may lead to social and political problems (Tadesse, 2010).

#### **2.4.2 Mapping the intersection of climate change impacts and women's livelihoods**

Climate change discourse is often critiqued for homogenizing humanity as an undifferentiated group of victims (Moosa and Tuana, 2014). Sultana (2014) asserts that climate change affects the poor uniformly in the southern hemisphere however gendered relations further complicate this. With reference to gendered relations, Goh (2012) and Karanja (n.d.) assert that climate change 'discriminates' between men and women. Therefore, integrating gender into climate change discourse is vital for development of effective adaptation/mitigation strategies that are not gender neutral (Bob and Babugura, 2014). Climate change impacts magnify existing gender inequalities reinforcing women's vulnerability (Danklelman *et al.*, 2008). Hence, staying with climate change impacts, but introducing gender, this section outlines climate change impacts on women's livelihoods.

Climate variability and change does not always disadvantage women however they are more likely to bear the negative impacts because of social structures and power relations (Bhattarai *et al.*, 2015). This is evident in Babugura *et al.* (2010) research, which revealed that women were disproportionately affected by climate change when compared to men in two local municipalities (uMzinyathi and uMhlathuze) within KZN. Climate change impacts affect sectors that form the basis of women's livelihoods, for example agriculture, water and energy resources (Huxtable and Yen, 2009). Alston (2014:289) further asserts that "*those charged with the responsibility to secure water, food and fuel for cooking and heating face the greatest challenges [and] when coupled with unequal access to resources and to decision-making processes, limited mobility places women in rural areas in a position where they are disproportionately affected by climate change*".



In essence, climate change impacts exacerbate the challenges of meeting FEW needs (Carter and Gulati, 2014). Yet, despite the overwhelming evidence of climate change in South Africa, the gender-FEW nexus is understudied and overlooked in climate change policies and adaptation plans. As a result, South Africa has made little contribution to gender and FEW resources literature. The researcher argues that understanding the gendered implications of climate change impacts on FEW resources is important to understand the meaning of adaptation for women in rural contexts, and makes a point that these findings can inform climate change policy and adaptation planning. The aim of focusing on women is not to disempower men but rather to empower women oppressed by social structures. Andersson (2006) supports this and further asserts that due to unequal power relations between men and women, paying attention to women has an emancipatory purpose. Furthermore, neglect of gender equality in climate change adaptation will increase global gender inequalities (Huyer, 2016).

#### **2.4.2.1 Intersectionality and its relevance in this study**

According to Djoudi and Brockhaus (2011) and Djoudi *et al.* (2016) women are not a homogenous group. Looking at women as a homogenous group with respect to needs and interests may generate and/or reinforce inequitable practices and outcomes intertwined with or reinforced by other structures of domination instead of reducing them (Hackfort and Burchardt, 2016). Furthermore, individuals who do not fit into static categories may be excluded (Kaijser and Kronsell, 2014). That is not to say that studies focusing on gender only are useless, on the contrary they are invaluable for illuminating power relations in the face of climate change (Kaijser and Kronsell, 2014; Van Aelst and Holvoet, 2016). However, it is important to transcend from this level of analysis and recognize diversity within the gender groups (Van Aelst and Holvoet, 2016).

Contemporary feminist research has moved beyond the narrow binary of man vs. women to demonstrate that gender categories gain meaning not just through opposition to one another, but also with reference to multiple social categories like age, income, and ethnicity (Carr and Thompson, 2014; Gonda, 2016; Mungai *et al.* 2017). The intersection of gender with other systems of power based on various social categories means that gender oppression is neither experienced nor enacted the same way for women everywhere (Gonda, 2015). Therefore women will not experience climate change impacts in the same manner because their roles, responsibilities, and expectations are not only shaped by their gender (Carr and Thompson, 2014). Goh (2012) asserts that even among women, differential climate change impacts may occur depending on, *inter alia*, race, class and marital status. For example in Pakistan single women, single mothers and women who were not first wives had less access to food and any other form of assistance during climate shocks (Goh, 2012). With this realization, academics have come forth and stressed the need for research that focuses on localized and interactive effects of multiple stressors on

livelihoods across gender and other social categories (Goh, 2012). Since gender takes meaning from intersecting with other social categories (Hankivsky, 2014).

One approach to understand the combination of social categories that lead to oppression is the principle of intersectionality. Intersectionality is a central component of feminist research and is important to understand gender processes and the lives of women (Deckha, 2013). Kaijser and Kronsell (2014) define intersectionality as the interaction of different social locations and other categories of difference in individual's lives, social practices, cultural beliefs and institutional arrangements and the outcome of these interactions in terms of power. Intersectionality says that social categories such as race, class and gender, must be studied in relationship to one another to better understand women's perspectives (Banford and Froude, 2015). Intersectionality attempts to avoid essentialism of identities, which advantage one form of oppression over another (Dirsuweit and Mohamed, 2016). From an intersectional perspective, humans cannot be reduced to gender categories, nor does intersectionality promote the inclusion of many analytical categories - for example., examining the collective impact of gender, race, sexuality, age and class - as the sum of their independent effects (Hancock, 2007 as cited by Hankivsky, 2014; Kaijser and Kronsell, 2014; Rouhani, 2014). However, for research purposes a researcher may select relevant intersections pertaining to the study, while keeping in mind the bigger picture (Kaijser and Kronsell, 2014).

#### **2.4.2.1.1 Intersectionality and climate change adaptation**

Climate change impacts will not be negotiated by gender only but also according to location (Andersson, 2006) and multiple social categories (Andersson, 2006; Gonda, 2016). Differences in access to resources, knowledge and power within gender group's influences vulnerability and adaptation to climate change (Hankivsky, 2014). Furthermore, research has shown that barriers and opportunities for climate change adaptation are shaped at the intersection of responsibilities and expectations attached to a wide range of social differences (Carr and Thompson, 2014). Therefore, climate change research will benefit from incorporating nuanced intersectional viewpoints.

Intersectionality allows researchers to understand differentiated vulnerability and adaptation due to the intersections of several social categories (Kaijser and Kronsell 2014; Ravera *et al.*, 2016). Applying intersectionality in climate change research can provide invaluable guidance in developing adaptation strategies inclusive of women's identities, roles, responsibilities and unique perspectives. In essence, intersectionality enables the development of more effective and efficient responses rather than 'one-size fits all' approach to solve social issues (Hankivsky, 2014). To summarize, the use of an intersectional approach *"can help to better target stress-specific roles and responsibilities, and therefore build tailored understandings of vulnerability that are specific to the stressor and one or more specific activities (e.g.,*

*farming of rain-fed crops), making it easier to identify appropriate adaptation based policy interventions” (Thompson-Hall et al., 2016:376).*

The reviewed literature on climate change adaptation pays minimal attention to intersectional analysis and as such this area of research is yet to be explored fully (Djoudi *et al.*, 2016; Kaijser and Kronsell, 2014). Van Aelst and Holvoet (2016) conducted one of the few studies that use an intersectional framework to examine how adaptation strategies are mediated through gender and marital status. Marital status is a social category that determines social relations, rights and duties, especially of women (Van Aelst and Holvoet, 2016). This study builds on Van Aelst and Holvoet (2016) research. It looks at the intersections of gender and marital status using PRA tools and techniques. The researcher envisioned that this would capture not only women’s experience as a group but also differences between women based on marital status in determining adaptation strategies.

### **2.4.3 Significance of FEW resources and climate change impacts on FEW resources**

Most studies on the likely impacts of climate change on livelihoods have focused on agriculture, particularly smallholder and commercial farmers (for example see Bryan *et al.*, 2009; Wiid and Ziervogel, 2012). As such, studies that are inclusive of other natural resources are important. Hence, this study focuses not only on agriculture but also water and firewood resources. As these are essential resources to sustain women’s livelihoods. Moreover, women perform 90% of the work pertaining to food processing, water and firewood supply (Nhanenge, 2007). Interdependencies exist between food, energy, water, climate change and human wellbeing (Ringler *et al.*, 2013).

#### **2.4.3.1 Climate change impacts on food security**

The relationship between food security and climate change is complex because climate change affects all four dimensions of food security (Tunde, 2011). Food security is defined as “a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (Food and Agriculture Organisation - FAO, 2010:8). In some regions climate change may lead to favourable crop growth conditions and accordingly increased yields, however at the global scale crops will be negatively impacted, and so will global food security (Goh, 2012; Lipper *et al.*, 2014). For example, northern countries may be able to produce more food, while southern countries are likely to produce less (Nhanenge, 2007). Projected higher temperatures, reduced rainfall amount and increased variability will reduce agricultural yields and threaten food security especially in countries where the economy is agriculture based (Deressa *et al.*, 2011). Projections show that agricultural yields could be reduced by as much as 50% in Africa by 2020 (Below *et al.*, 2010).

According to the International Fund for Agricultural Development - IFAD (2010), agriculture is where climate change, food security and poverty alleviation intersect. Stefanović (2015) further affirms the link between the climate, agricultural productivity and food security, and suggests that adapting agricultural systems to climate change is important to maintain food security. The role of agriculture in food security enhancement is multidimensional and multifaceted (Tibesigwa and Visser, 2015). Agricultural activities contribute to food security through the supply of crops and animal based foodstuffs for consumption, and through the creation of employment opportunities and access to other non-farm foods, which are bought using income from farm produce (Shisanya and Hendriks, 2011).

Climate change impacts affect agriculture directly and indirectly, directly through changes in weather variables (Sowunmi and Kintola, 2009) and indirectly through the increased incidence of diseases and pests (Ngigi, 2009). Climate change negatively affects food access by reducing agricultural production, and agricultural income, increasing risks and disrupting markets (Lipper *et al.*, 2014). Africa's food production systems are highly vulnerable to climate change because of intra and inter seasonal climate variability; recurrent floods, and droughts that affect crops; endemic poverty that limits adaptive capacity; and high dependence on rain fed agriculture (Ruppel *et al.*, 2014). More than two-thirds of Africans are dependent on rain-fed agriculture for their livelihoods (Connolly-Boutin and Smit, 2016) and about 20.7% of the households within South Africa are involved in agriculture, and 65% of these households use subsistence agriculture to meet household food demands (Tibesigwa and Visser, 2015). With pronounced climate change impacts, the use of agriculture to promote food security looks bleak (Tibesigwa and Visser, 2015). Gbetibouo *et al.* (2010) reveal that KZNs farming system is vulnerable to climate change because of the high population density, high number of small-scale farmers, dependence on rain-fed agriculture, and land degradation.

Rural households report food insecurity more frequently than urban counterparts (Tibesigwa and Visser, 2015). The KZN province is predominantly rural with food insecurity highest in the rural areas (Tarwireyi and Fanadzo, 2013). Hence, the focus on rural Ndwedwe-Cibane. Amongst the causes of food insecurity in rural areas is low agricultural production (Kirsten and Moldenhauer, 2006); low household incomes; high food prices; lack of land tenure; and the Human Immunodeficiency Virus infection/Acquired Immunodeficiency Syndrome - HIV/AIDS pandemic (Shisanya and Hendriks, 2011).

Men and women play complementary roles to ensure food security within the household however, women play a greater role to ensure nutrition and to manage natural resources (Brody *et al.*, 2008). Seventy percent of the world's crop producers are women and produce 60-80% of the world's food crops (Glazebrook, 2011). Yet they own less than 20% of the land globally (Constable, 2015). In Africa women are responsible for 80% of the food production (Glazebrook, 2011) and make up 80% of small-scale farmers in sub-Saharan Africa (Tibesigwa *et al.*, 2015). In rural households where subsistence

agriculture is practiced women play multiple roles throughout the processes of production, handling and food preparation (Sharaunga *et al.*, 2015). In view of their large numbers and contribution to agricultural production, women are disproportionately affected by any strains on agricultural production and face greater climate change risks (Karanja, n.d.).

The researcher has established that food security is threatened by climate change, and that this is particularly worrying for women because of their role as agricultural producers (Glazebrook, 2011). Furthermore, in female-headed rural households agriculture contributes more to food security in comparison to male-headed households (Tibesigwa and Visser, 2015). Subjective and objective measures of food security reveal that male-headed small-scale farm households are more food secure than female counterparts (Tibesigwa and Visser, 2015). Subsistence agriculture's contribution to household income and food availability remains low in South Africa, yet subsistence agriculture plays a vital role in reducing vulnerability to food insecurity at the household level (Sharaunga *et al.*, 2015). During periods of food shortage as a result of climatic conditions, women's workload is increased as they work hard in the fields to try and grow crops (Phillipo *et al.*, 2015). Moreover, women prioritize their male household members and children and consequently eat last and eat smaller portions (Tunde, 2011). Thus it comes as no surprise that globally 60% of the chronically hungry people are women, with climate change this number will increase (Vinyeta *et al.*, 2015).

Female-headed households in rural areas are said to be the poorest and are highly reliant on agriculture yet there is little research and understanding concerning the intersection of women, agriculture and climate change (Tibesigwa and Visser, 2015). This study addresses gaps in literature and builds by establishing climate change impacts on agriculture. In addition, the neglected intersectional principle is explored by extending the assessment of climate change impacts on women differentiated by marital status. It has been established that agriculture is adaptable to climate change however, the outbreak of pests and diseases and weather extremes will pose adaptation challenges. Agricultural production contributes to climate change but also offers cost effective mitigation options by direct carbon sequestration this in turn positively affects adaptation and mitigation strategies (Tubiello and Van der Velde, 2004).

#### **2.4.3.2 Climate change impacts on firewood resources**

The links between climate change, gender and energy supplies are strongest in countries with limited supply of basic electricity and consequently high reliance on biomass fuels (United Nations WomenWatch, 2015). For three billion people (approximately 40% of the world's population) biomass fuel is the main supply of energy for food preparation and heating (Jagger and Shively, 2014). Moreover, due to electricity backlogs, a great proportion of Africans residing in rural areas satisfy their energy

needs through traditional biomass fuels (Niu *et al.*, 2014). Similarly, 16 million South Africans, burn traditional sources of energy to satisfy their energy needs (Chikulo, 2014). Traditional biomass fuels include charcoal, agricultural waste and wood, the latter being the most used in rural areas (Chikulo, 2014). Approximately 2.8 billion people across the globe including the poorest and marginalized burn wood to satisfy their energy needs (Bailis *et al.*, 2015). Seventy-five percent of the fuel used in rural South Africa is wood (Wilson and Green, 2000) and rural KZN heavily relies on firewood for energy (Linkd Environmental Services, 2013). Hence, this study focuses on firewood.

In South Africa particularly in black rural communities women and children are responsible for energy provision (Brody *et al.*, 2008; Chikulo, 2014). The energy is used for various purposes such as lighting, cooking, and heating (Goh, 2012; Linkd Environmental Services, 2013; Niu *et al.*, 2014). The hardships faced by women when collecting fuel are well understood and documented in literature (Goh, 2012). For example firewood collection is a strenuous and time-consuming task (Linkd Environmental Services, 2013; Niu *et al.*, 2014) and may take up to six hours per day (Chikulo, 2014). In general more women (than men) are involved in firewood collection and walk longer distances in search of fuel (see figure 2.4.3.2.1) (Meyiwa *et al.*, 2014). Furthermore, firewood loads may weigh up to 35 kilograms (Chikulo, 2014). This in turn negatively affects public health (for example, physical health risks such as neck and back pain) (Bailis *et al.*, 2015; Chikulo, 2014). Additionally, firewood collection encourages deforestation and forest degradation and therefore contributes to climate change (Bailis *et al.*, 2015).

Firewood is becoming scarce due to climate change related stresses and shocks on forest resources (Chikulo, 2014). Fuel shortages either directly or indirectly result in considerable time and labour burdens for women (Goh, 2012). For example, women may have to travel longer distances in search of firewood (Chikulo, 2014). A case study validated this, decreased snowfall in Nepal for about six years contributed to a longer dry season, this change negatively affected crop production and increased famine. Increased famine prompted community members to rely on income-driven deforestation, which severely reduced the availability of trees for firewood. As a result, women had to walk much farther to obtain firewood, on average the walk took about six hours every three days (Leduc, 2008 as cited in Goh 2012). The case study demonstrates another gender differentiated climate change impact. Furthermore, reduced availability of firewood leads to the collection of low quality wood and changes in food preparation patterns (Jagger and Shively, 2014). Climate change impacts may also precipitate conflict between resource users, conflict in turn may harm social cohesion and informal institutions (Goh, 2012). For example, in Kenya increased incidence of floods and drought increased competition over resources and poverty leading to conflicts mostly in the form of armed livestock raiding (Goh, 2012).

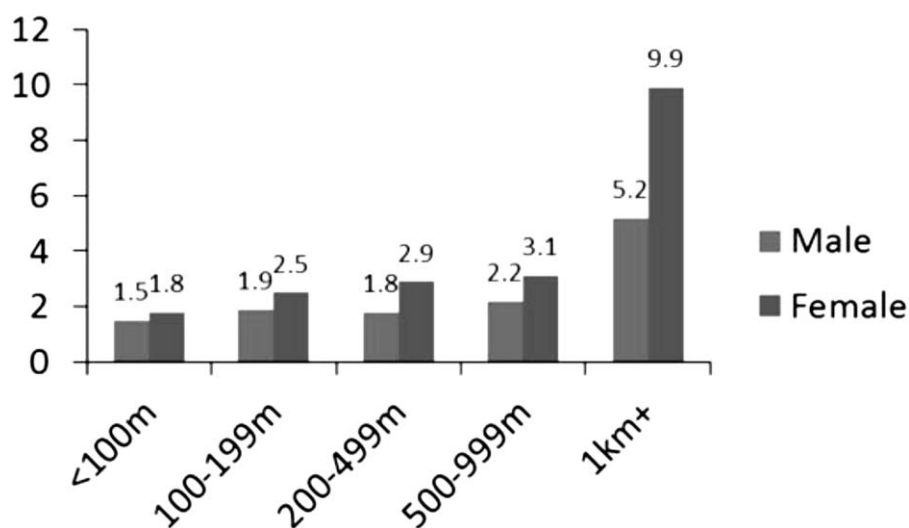


Figure 2.4.3.2.1: Distance travelled to collect wood or dung by sex (in %) (Statistics South Africa - Stats SA, 2012 - as cited by Meyiwa *et al.*, 2014:105)

### 2.4.3.3 Climate change impacts on water resources

Climate change affects the availability of water used for domestic and productive tasks by directly and indirectly affecting water resources (United Nations WomenWatch, 2015). Water stress undermines livelihood options and sustainability (Bob and Babugura, 2014). According to Misra (2014) between 1.5 and 3 billion people are dependent on groundwater for drinking water. This highlights the importance of understanding climate change impacts on groundwater quantity and quality (Misra, 2014). Christian (2014) predicts that by 2020 and 2050, between 75 and 250 million people respectively in Africa will experience increased water stress due to climate change. However, climate change impacts on water resources will vary across African continent, looking at the current situation northern and southern Africa will experience increasing water scarcity (Below *et al.*, 2010; Bob and Babugura, 2014; Ndaki, 2014; Ruppel *et al.*, 2014). Dube *et al.* (2014) and Urama and Ozor (2010) further affirm that climate change poses major risk to water resources namely through: drought prevalence, flood prevalence and having un-usable resource.

Water resources are the primary medium through which climate change impacts will be felt by South Africans (Schulze *et al.*, 2014). South Africa is one of the countries that could potentially experience chronic water stress by 2025 (Dube *et al.*, 2014). Within South Africa, KZNs water resources are vulnerable to climate change (Thornhill *et al.*, 2009). Understanding the climate change - water resource nexus provides Africans the opportunity to address the negative issues and chart the way forward for sustainable water use (Urama and Ozor, 2010).

According to Tandon (2007), more than 50% of the 1.2 billion people who do not have access to water worldwide are women and girls. Yet, women and girls are largely responsible for water collection and management in their communities (Brody *et al.*, 2008; Tandon, 2007). Vinyeta *et al.* (2015) note that the women - water relationship is evidenced in birth, during ceremonies, and in domestic activities such as cooking and cleaning. Therefore women are sensitive to changes in climatic conditions that affect water accessibility, quantity, and quality (Parikh, 2007). It is evident that access to water has gender dimensions (Aboud, 2011) in addition, to the spatial dimension. A great proportion of South Africa's rural residents do not have access to piped water (Otieno and Adeyemo, n.d.) and depend on natural water resources such as rivers and streams for water supply (Linkd Environmental Services, 2013). Natural water resources are characterized by unequal geographical distribution and accessibility, and unsustainable water use (Bates *et al.*, 2008). Figure 2.4.3.3.1.illustrates that more women than men are involved in water collection. Additionally, women travel longer distances in search of water supplies (Otieno and Adeyemo, n.d). This leads to physical health risks for women and time poverty (Tandon, 2007). It has been observed that girls and women spend on average eight hours a day travelling long distances of at least 10 kilometers to transport water between 15 and 20 litres on each trip (Tandon, 2007). Walking for miles in search for water is a feminist issue, the performance of this task by women, contributes to her subordination in society (Nhanenge, 2007).

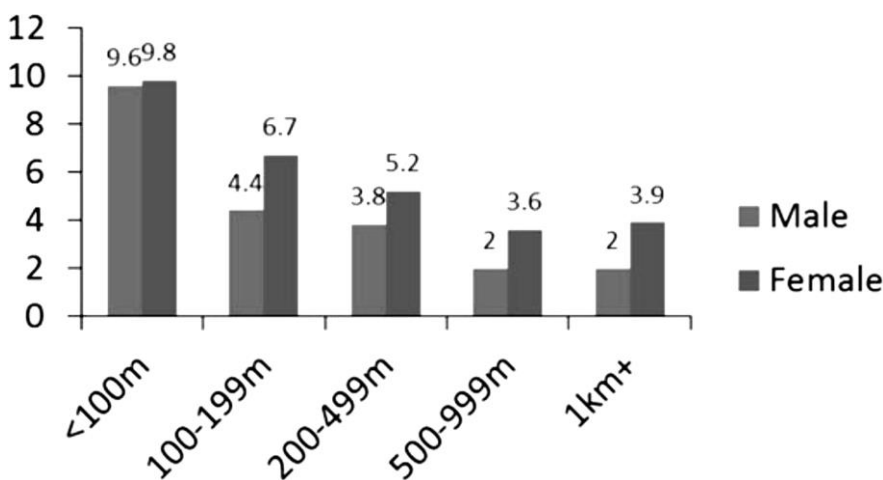


Figure 2.4.3.3.1: Distance travelled to collect water by sex (in %) (Stats SA, 2012 as cited in Meyiwa *et al.*, 2014:105)

Water shortages as a result of climate change impacts will result in considerable time and physical burdens for women (Goh, 2012). Women will have no choice but to spend more time and walk longer distances in search of potable water (Goh, 2012). This is already occurring in certain parts of the world, for example in Sonora, Mexico climate change has led to the depletion of water resources, and this has negatively impacted women's livelihoods and social connections (Goh, 2012). In addition, women walk



longer distances (ranging from 10 to 15 kilometers a day) to fetch water because of the increasing frequency of droughts in northern Kenya (Parikh, 2007). In addition to the increasing time allocated to water collection and the longer distances walked to access water, Bob and Babugura (2014) revealed that girls were exposed to gender based violence in the Eastern Cape and KZN as they walked further and further from home in search of water. The more time women spend searching for water means they have less time for other household tasks, increased time poverty, and may have to forego opportunities for economic development and other income generating activities (Goh, 2012; Terry, 2009). The differential impacts of climate change are also evident here (Goh, 2012). Moreover, water scarcity coincides with an increasing human population and the increasing practice of irrigation which may lead to increased risk of conflict over water resources (Besada and Werner, 2015). Thompson (2016) argues that gender cannot be the only category used to understand the social dynamics of water. She further notes that from an intersectional perspective water use, access, and control are determined by intersecting categories. Hence, the importance of the intersectional perspective applied in this study.

## **2.5 Vulnerability to climate change impacts**

### **2.5.1 Vulnerability explained**

The entire world is affected by climate variability and change because climate variables play an important role in our livelihoods (Ishumael and Godwell, 2015). Some communities are experiencing positive climate change impacts and will continue to do so in the future however far more are experiencing increased vulnerability (Ishumael and Godwell, 2015). The IPCC defines vulnerability as “the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with the adverse effects of climate change, including increases variability and downside risk” (Dube *et al.*, 2014:44). Vulnerability to climate change is a result of complex interrelations between institutional, economic and biophysical features, and is therefore socially constructed (Adger *et al.*, 2003; Meyiwa *et al.*, 2014).

According to several authors (Amos *et al.*, 2015; Arimi, 2014; Babugura *et al.*, 2010) there are three components to vulnerability namely: exposure, sensitivity and adaptive capacity (figure 2.5.1). Exposure refers to the extent, which a community is exposed to climatic events -for example, coastal proximity- (Amos *et al.*, 2015). It is a function of one’s location and environment (Thompson-Hall *et al.*, 2016). Sensitivity on the other hand refers to the extent to which a community is affected by climatic events - for example, economic dependence on climate sensitive sectors such as agriculture - and adaptive capacity is the ability of a community to resist or recover from the climatic events (Amos *et al.*, 2015). Exposure and sensitivity increase the vulnerability level whilst adaptive capacity decreases it (Islam,

2013). Vulnerability to climate change will create new vulnerabilities and intensify existing vulnerabilities (Meyiwa *et al.*, 2014). Dube *et al.* (2014) assert that vulnerability highlights the need for adaptation. Thus, the first step to planned adaptation is understanding vulnerability (Adger, 2006).

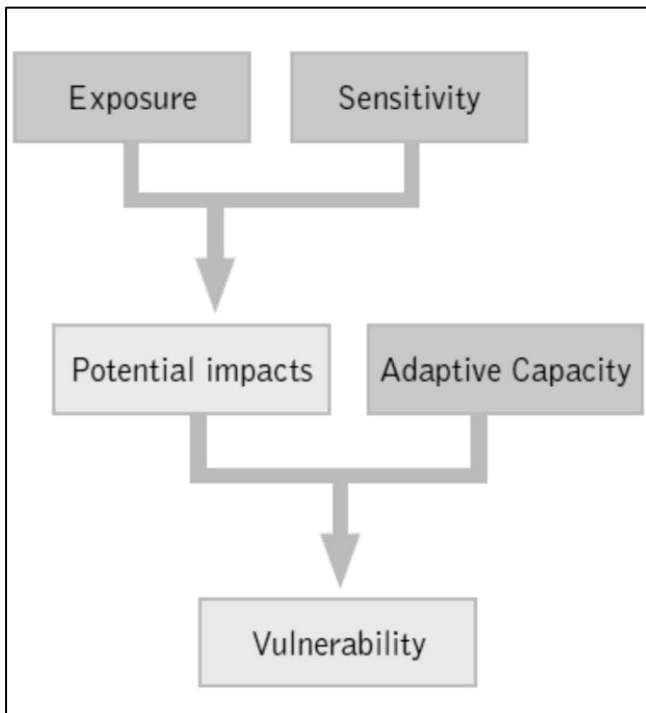


Figure 2.5.1: Climate change vulnerability (Lonescu *et al.*, 2005 as cited in Babugura *et al.*, 2010:15)

### 2.5.2 Low vulnerability = climate change victims

According to Gentle *et al.* (2014) higher vulnerabilities to climate change impacts exist in the following categories: developing countries; geographically remote areas; communities' dependent on natural resources for their livelihoods; the poor; and women in societies based on patriarchy. The southern countries and communities who have contributed the least to climate change will be worse off due to low adaptive capacity, while the major emitters, the industrialized northern countries, have greater resources to adapt (Gorman, 2016). Among the southern countries, developing countries are the most vulnerable to climate change impacts because of their reliance on climate-sensitive sectors (such as fisheries, forestry, agriculture) and limited adaptive capacity (Ford *et al.*, 2015). However, some level of vulnerability does exist in developed nations hurricane Katrina demonstrated this in the United States of America - USA (Eakin *et al.*, 2014).

Among the developing regions, Africa is believed to be the most vulnerable to climate variability and change due to its reliance on agriculture, over dependence on natural resources, poverty, prevalence of HIV/AIDS, conflicts, food insecurity and water shortages (Ndaki, 2014). Africa's susceptibility to climate change is further exacerbated by existing development challenges, *inter alia*, limited access to

capital, disasters, ecosystem degradation (Figueiredo and Perkins, 2013), illiteracy, weak technical institutions, limited and inadequate infrastructure and poor technological development (Ndaki, 2014).

Given that, South Africa lies in Africa - the continent identified as being amongst the most vulnerable to climate change – South Africa faces the same vulnerabilities (Schulze, 2011). In addition to climate change, South Africa faces environmental, economic, and social stressors (Pasquini *et al.*, 2013). Gentle *et al.* (2014) and Ndaki (2014) further assert that it is the poor and economically disadvantaged individuals, groups and communities in developing countries who are the most vulnerable and severely affected by climate change. Seventy-two percent of the rural population in South Africa is poverty stricken, with the poorest provinces consisting of the former homeland areas: Eastern Cape, Limpopo and KZN (Neves and Toit, 2013). The latter province is believed to be the most vulnerable to climate change impacts in South Africa (Shezi and Ngcoya, 2016). KZN's vulnerability is attributed to low adaptive capacity (Linkd Environmental Services, 2013; Shezi and Ngcoya, 2016) and biophysical sensitivity (Linkd Environmental Services, 2013).

Areas prone to climatic changes within KZN are the Midlands, the northeastern corner of the province, the south coast and areas subjected to poverty and high densities (Thornhill *et al.*, 2009). Rural inhabitants are particularly vulnerable to climate change because they depend on natural resources for subsist (Lookabaugh, 2015; Molnar, 2010). Climate change has already increased the probability of failure of some rural livelihoods (Dube *et al.*, 2014). Therefore, the rural poor are in greatest need of climate change adaptation initiatives to develop sustainable livelihoods (Goh, 2012; Sapkota *et al.*, 2016). Until recently climate change was viewed as a development issue and now it is increasingly recognized as a gender issue as well (Chikulo, 2014). Vulnerability is rarely uniform at the local level, across genders and even within a gender group (Goh, 2012). Contemporary literature reveals that vulnerability is largely shaped by roles, responsibilities, and entitlements associated with various social categories including gender, class and caste (Carr and Thompson, 2014).

### **2.5.2.1 Women's vulnerability to climate change**

This section focuses on women's vulnerability, it examines how and why climate change affects women. Climate change is said to affect the poorest populations the most, women form the largest group of the world's poor (UN, 2008). Specifically, women constitute 70% of the world's 1.3 billion people living in poverty (Hackfort and Burchardt, 2016; MacGregor, 2010). They are therefore unlikely to have resources to respond to climate change impacts (MacGregor, 2010). Furthermore, given the women-nature link, they are keenly affected by any environmental changes (Karanja, n.d.) and as such, this matter is of feminist concern (Cuomo, 2011) and gender analysis is justified in terms of distributive

justice (Edmunds *et al.*, 2013). Edmunds *et al.* (2013) further add that gender analysis is justified because of gender differentiated impacts of climate change and because climate change interventions affect men and women differently, and as such understanding gendered impacts can provide early warning about inequities and where change is needed.

Women's vulnerability is not attributed to natural weakness (for example, because of their sex) but rather because of gendered roles ascribed to them as women by feudal-patriarchal discrimination (Resurrección, 2013; Vincent *et al.*, 2010). Women's triple role as ascribed by traditional gender norms includes the reproductive, productive and the community-managing role (Tasli, 2007). Reproductive role includes domestic work, childbearing and rearing responsibilities and care of the current and future work force (Tasli, 2007). Women's productive role includes work done for payment in cash or kind and women's community managing role includes provision and maintenance of scarce resources at the community level (Tasli, 2007). Rural women are especially more vulnerable to climate change impacts due to increased household duties and agricultural work from male out-migration (Gaard, 2015; Huyer, 2016; Okali and Naess, 2013) and lack of knowledge on the potential dangers posed by climate change (Karanja, n.d.). In the face of climate change the sense of familiarity and predictability for rural women no longer holds true, because their environments are changing owing to circumstances beyond their control (Meyiwa *et al.*, 2014).

Vincent *et al.* (2010) expounds on women's vulnerability and attributes it to the following factors:

- Limited access to resources- Women either have no access or limited access to resources essential for their livelihoods such as land, livestock, credit and tools. When they do have access they have limited control over these resources, without ownership, they cannot make decisions regarding its use.
- Dependence on natural resources and gendered division of labour- As users and managers of natural resources women are highly reliant on resources at risk from climate change. Climatic changes will in turn change the availability of natural resources.
- Lack of formal education and access to information- Boys education is still a priority in developing countries. Due to this perception when resources are limited girls are pulled out of school. Consequently, girls receive fewer years of education than boys do. With no or limited formal education women are disadvantaged as they have less access to important information and fewer means to make sense of that information. This in-turn affects their ability to understand climate related information and act on that information.
- Limited mobility- because of their gendered roles and responsibilities women are restricted to their households, and cannot migrate, a coping strategy often used by men. In addition, with limited education, their chances of finding employment are less when compared to their male

counterparts. Accordingly, women stay behind in high-risk areas and miss out economic opportunities and development that migration affords men.

- Structural exclusion from decision-making- Women's voices are often sidelined in their households and at the community level. This is unfortunate given women's close relationship to nature and awareness of conservation and potential adaptation strategies. According to Röhr *et al.* (2008:6), "the degree to which women participate in decision making on climate policies is small".

Gender is not the only category to consider when analyzing vulnerability to climate change impacts. Vulnerability varies widely even between women. Differences in women's vulnerability can be attributed to a number of social categories including class, race, age, ethnicity (Djouidi and Brockhaus, 2011; Tandon, 2007; Hankivsky, 2014), indigeneity, sexuality, geography, religion, migration status, disability/ability (Hankivsky, 2014.) and other socio-economic categories (Djouidi and Brockhaus, 2011; Kaijser and Kronsell, 2014). For example in the context of vulnerability to the impacts of climate variability and change "wealthy women with diverse livelihoods might have more in common with wealthy, similarly employed men than they do with poorer women who are reliant on rain fed agriculture for their food and income" (Carr and Thompson, 2014:183). Therefore, simple binary gender analysis may group people with varying levels of vulnerability, making it difficult to identify and address challenges faced by the most vulnerable (Carr and Thompson, 2014). Several Asian studies confirm the intersection of multiple categories, such as caste, economic class and gender, shaping differentiated vulnerability to climate risks and disasters (Ravera *et al.*, 2016).

Within the group 'rural women' female-headed households will be disproportionately affected by climate change impacts (Constable, 2015). Studies conducted in South Africa, Ethiopia, Democratic Republic of Congo and Mozambique have found female-headed households to be more vulnerable (Tibesigwa *et al.*, 2015). Approximately 41.9% of households in South Africa are headed by females and this number seems to be growing in sub-Saharan Africa (Tibesigwa and Visser, 2016). Djouidi *et al.* (2016) explains female-headed household's vulnerability: Firstly, female heads of households generally have a lower level of education when compared to male heads of households this contributes to their vulnerability. Secondly, lack of or limited formal education and low social status of female heads of households limits their access to loans, thereby increasing their vulnerability. Thirdly, female headed households generally lack a reliable source of non-farm income and female heads engagement in resilient livelihood strategies is limited because of their social standing which is often on the edges of their community's social network. Adaptation research has to be informed by vulnerability research (Sapkota *et al.*, 2016). Hence, women's vulnerability in the context of climate change is explored in this

study using qualitative methods, particularly resource and hazard mapping, vulnerability matrix and FGD.

## **2.6 Perceptions of climate change**

### **2.6.1 Perception defined and its significance highlighted**

Models and long-term climate trend analysis are not the only means to determine changes in the climate (Davis, 2011). Climate variability and change may bring new conditions never experienced before, however local knowledge and perceptions remain the foundation for any response (Boissière *et al.*, 2013). “Perception is a process by which individuals receive information or stimuli from the environment and transform it into psychological awareness, in order to learn about the environment and respond to what is perceived” (Swai *et al.*, 2012:219). Rural societies possess knowledge of climate variability and change at the local scale as part of their Traditional Ecological Knowledge-TEK (Boissière *et al.*, 2013). For example, African farmers have been using several local weather indicators including insects, plants, animals, the wind and the solar system as part of their indigenous knowledge to forecast the seasonal climate (Elia *et al.*, 2014). Moreover, Africans residing in rural areas have always relied on indigenous knowledge to deal with the effects of climate variability and change (Davis, 2011). Yet researchers have undervalued and overlooked local experience and knowledge in their studies, even though a person can only adapt to climate change if they perceive climate change as a reality (Falaki *et al.*, 2013; Wiid and Ziervogel, 2012). Nonetheless, in the last five to ten years this area of research has grown both locally and internationally (Wiid and Ziervogel, 2012). Having established the importance of perception, studies exploring perceptions of mainly mitigation measures have been conducted in developed countries while developing countries have focused on perceptions of adaptation strategies (Swai *et al.*, 2012).

### **2.6.2 Typologies of climate change perception**

Assessing and explaining climate change perception is important because it defines local and global socio-political contexts within which decision makers and academics must operate and perceptions fundamentally compel or inhibit any form of local and/or global action in response to climate change (Crona *et al.*, 2013; Swai *et al.*, 2012). According to Lorenzoni and Langford (2001) as cited by Nicholson-Cole (2005:257) there are four typologies based on a study on public perceptions of climate change. People can either be ‘disinterested’, ‘doubters’, ‘deniers’ or ‘engaged’. An individual’s perception of climate change is influenced by climate experience, access to climate information and beliefs (Debela *et al.*, 2015; Van *et al.*, 2015). According to Deressa *et al.* (2011) a great proportion of the population in both developing and developed nations have perceived climate change. A study by

Hageback *et al.* (2005) showed that there was a strong correlation between climatic data and farmers' perception of climate change in Danagou watershed in China. Another study conducted in China by Byg and Salick (2009) showed that local experience and knowledge has contributed to the advancement of understanding of climate change and its impacts. On the contrary, Rao *et al.* (2011) in Kenya's semi-arid parts discovered that climate data could not be correlated to the communities perception of climate change. The main barrier to anthropogenic climate change perception is the natural variability of the climate (Hansen *et al.*, 2012). It is very difficult for an individual to discern long-term climate change, given the notorious variability of local weather from year to year and day to day (Hansen *et al.*, 2012).

Africans are aware of changes in weather patterns but their understanding of global climate change is poor (Acquah and Onumah, 2011; Koske and Ochieng, 2013). The low level of climate change awareness in sub-Saharan Africa can be attributed to limited climate change awareness programmes and the fact that Africans face many life stressors (for example, conflicts and poverty) as a result climate change is rarely seen as the most significant threat to them (Koske and Ochieng, 2013). For example, South Africans understand climate change to be 'changing weather' this influences the extent of adaptation (Taderera, 2010). Indigenous groups with no or limited information on climate change attribute changing conditions to a change in their rituals and cultural practices (Debela *et al.*, 2015). For example, a study conducted in Maphephethe by Mzimela (2015) found that community members attribute drought conditions to the non-practice of a ritual known as Nomkhubulwane (prayer to the water Goddess). This misconception about climate change may result in no adaptation or maladaptation (Debela *et al.*, 2015).

Local communities have the right to be informed about climate change impacts because they are capable of generating their own strategies to counteract the negative impacts (Van Aalst *et al.*, 2008). Indigenous knowledge/locals perceptions should be integrated into climate change policies and programmes and not prioritized at the expense of modern/western scientific knowledge, these forms of knowledge should rather complement each other (Ajani *et al.*, 2013). Sustainable/successful adaptation rests on the integration of both locals perception of climate change and scientific ideas (Amadou *et al.*, 2015). Indigenous knowledge contributes invaluable knowledge in climate change studies in the following ways: *"it creates a moral economy; indigenous knowledge is increasingly exhibiting a resemblance with scientific methods as many ideas in indigenous knowledge that were once regarded as primitive and misguided, are now seen as appropriate and sophisticated; indigenous knowledge systems provide mechanisms for participatory approaches; and indigenous knowledge systems can facilitate understanding and effective communication and increase the rate of dissemination and utilization of climate change adaptation options"* (Ajani *et al.*, 2013:27). This is further supported by Stefanović (2015), who asserts that it important to understand climate change perceptions in order to make climate

projections accessible and understandable to the local inhabitants. Understanding locals' perception is also important to prompt the need for adaptation and to facilitate support for climate change adaptation policy (Debela *et al.*, 2015). A study by Bryan *et al.* (2009) as cited by Amadou *et al.* (2015:49) highlighted the role of perception in understanding the significance of education and awareness building and in identifying available options to enable people to adapt to climate change.

### **2.6.3 Women's climate change perception**

Previous studies reveal that gender and education influence people's climate change perception (Crona *et al.*, 2013). One such study is by Thomas *et al.* (2007), it revealed that gender affects the type of climate risk perceived by farmers in three South African rural communities. The way in which gender affects perception has been an interest in ecofeminism literature (Crona *et al.*, 2013). Of the growing number of studies on perception, very few explore gender and climate change perception and of those that do, they disaggregate data sets along sex differences (Bee, 2016; Lujala *et al.*, 2015; MacGregor, 2010). As a result, these studies have reinforced the shortsighted view of gender as comparative differences between males and females, neglecting intersectionality and hence not capturing the complexity of men and women's lives (Bee, 2016). To bridge this gap, the researcher focuses only on women's perceptions using a marital lens.

Research has shown that women are more fearful of the risks associated with climate change (Kellstedt *et al.*, 2008). While men are not, and according to Djoudi *et al.* (2016) and McCright and Dunlap (2011) this phenomenon is termed the 'white male effect' and is used to describe conservative white males who are more accepting of a wide range of risks, have a posture of extreme risk skepticism and are climate change deniers. These men dislike change, insecurity and simplify complex issues (McCright and Dunlap, 2011). Furthermore, climate change poses a threat to the industrial capitalist system that has historically served them well and therefore as a defensive response they deny climate change to protect this system (McCright and Dunlap, 2011) and their cultural identity as hierarchical and individualistic white males (Kahan *et al.*, 2007; Stevenson *et al.*, 2017). Visschers (2017), in support of McCright and Dunlap (2011) states that individuals skeptical about climate change want to keep the social order and economy as it is.

Women's heightened risk perception can be attributed to their gendered division of labour (Kellstedt *et al.*, 2008) because they are underemployed in primary industries, and therefore unlikely to consider economic tradeoffs in assessments of environmental risks (Kellstedt *et al.*, 2008). To date, studies examining climate change perceptions have been place based (Crona *et al.*, 2013). Crona *et al.* (2013) assert that place based studies are important because firstly, climate change vulnerability and impacts will be regionally and locally uneven. Secondly, people are natural observers, their knowledge can



provide understandings of climate change and thirdly, place based studies show that ecology and culture matters in how people perceive climate change.

This study contributes to the growing trend of examining perceptions of climate change based on traditional knowledge of weather systems by cross-checking women's perception with historic quantitative meteorological data to ascertain relevance for climate research. The researcher also presents downscaled General Circulation Models- GCMs. According to Ishaya and Abaje (2008) climate models provide estimates of the likely change in the climate based on future scenarios of human development. However, they are uncertain because the climate system has many unknowns and GCMs can never achieve a perfect simulation (Cheung, 2014). In addition, GCMs are not good at providing information on changes at the local level, hence the value of indigenous groups for this information (Ishaya and Abaje, 2008). The process of gathering and analyzing information with women in this particular study should build local knowledge on climate change issues and adaptation strategies. The concept of adaptation will be explored next.

## **2.7 ADAPTATION TO CLIMATE CHANGE IMPACTS**

### **2.7.1 Adaptive capacity defined**

Humans are responsible for accelerated climate change but are also capable of developing and implementing solutions to the problems of climate variability and change (Nduye, 2015). Dealing with climate change impacts will be one of the greatest social, economic, political and environmental challenges humanity has ever faced (Payne and Shepardon, 2015). According to Davis (2011), building adaptive capacity of communities is the most appropriate response to climate change to ensure that hazard exposure does not translate into severe impacts when it occurs. The IPCC (2014) defines adaptive capacity as the ability of humans and other organisms, institutions, and systems to respond to change by either taking advantage of the change or responding to the negative consequences.

Actions associated with building adaptive capacity include: maintaining economic growth, maintaining well-being, protecting land, communicating climate change information and building awareness and exploiting arising opportunities (Adger *et al.*, 2005). Boillat and Berkes (2013:1) have identified four factors which foster adaptive capacity, they are: "learning to live with change and uncertainty; nurturing diversity for reorganization and renewal; combining different types of knowledge for learning, and creating opportunity for self-organization toward social-ecological sustainability". Islam (2013) asserts that the development of adaptive capacity reduces vulnerabilities, improves adaptation and encourages sustainable development. According to Nielsen and Reenberg (2010) social norms, values, rules,

economic and technological developments influence adaptive capacity. Adaptive capacity has three dimensions, namely, mitigation, coping and adaptation (Stefanović, 2015).

## **2.7.2 The three dimensions of adaptive capacity**

### **2.7.2.1 The first dimension of adaptive capacity (mitigation)**

Mitigation, the first dimension of adaptive capacity discussed, refers to human interventions that aim to reduce the likelihood of climate changes by either reducing or eliminating emissions or enhancing greenhouse gas sinks (Böckmann, 2015). Examples of mitigation measures include, *inter alia*, carbon capture and storage, carbon sequestration, carbon trading, offsetting and renewable energy (MacGregor, 2010). Other examples of mitigation measures include afforestation, reforestation, and incorporation of emission reduction mechanisms in all forms of transport (Eriyagama and Smakhtin, 2010). In rural areas, women are involved in activities such as charcoal-making, brick-making, agro-processing and waste management where energy efficiency mitigates carbon dioxide (Alternative Information and Development Centre - AIDC, 2015).

Mitigation measures have been implemented for some time now, however there is evidence that the climate will be hotter and rainfall patterns will vary in the future long before we are able to slow down or reverse the current trend through mitigation (Dube *et al.*, 2014). Furthermore, developed countries have failed to reduce emissions as per agreement in the Kyoto protocol, and have not been ready to commit themselves to higher targets in line with available scientific information (Ndaki, 2014). Achieving set targets will involve social and economic changes that policy makers are reluctant to make (MacGregor, 2010). On the other hand developing countries are not required to reduce greenhouse gas emissions under the current climate change negotiations (Ifeanyi-Obi *et al.*, 2017).

### **2.7.2.2 The second dimension of adaptive capacity (adaptation)**

Climate change adaptation has always received less attention than mitigation, this was until the international and scientific community realized that mitigation alone would not be enough to address climate change (Ndaki, 2014). Even if emissions are brought to zero percent, the impacts of climate change will still be felt, as a result of past emissions and the inertia of the climate system (Bawakyillenuo *et al.*, 2016; Ndaki, 2014). This highlights the importance of adaptation to deal with certain climate change impacts and justifies why adaptation should be given priority (Bawakyillenuo *et al.*, 2016; Ndaki, 2014). Füssel (2007) highlights that the adoption of adaptation strategies is important because the positive impacts of mitigation will only be seen in several decades and as such adaptation buys time for mitigation; and adaptation can be implemented at various levels and is less dependent on the actions of others. In addition, adaptation is strongly justified because it reduces the vulnerability of

society to climate variables or weather extremes (Osman, 2015). Adaptation in Africa is not an option but a necessity (Amadou *et al.*, 2015). Adaptation is critical in Southern Africa because firstly, the magnitudes of climate change projections are great and secondly, adaptive capacity is low and vulnerability is high (Davis, 2011). Adaptation is meant to reduce the negative and exploit the positive impacts, adaptation does not solve the problem of climate change and has associated costs (Belay *et al.*, 2017).

Mitigation and adaptation are often undertaken independently from each other (Duguma *et al.*, 2014; KwaDukuza Local Municipality, 2013) by different institutions and at different scales (Duguma *et al.*, 2014). Yet, they should be accorded the same level of importance and pursued concurrently to complement each other (KwaDukuza Local Municipality, 2013) and to avoid tradeoffs (Kongsager *et al.*, 2016). Adaptive capacity is the precondition for adaptation to take place (Nelson *et al.*, 2007). The greater the adaptive capacity of individuals or society, the greater the probability of adaptation (Wiid and Ziervogel, 2012). However, adaptive capacity does not always manifest into real adaptation (Eisenack and Stecker, 2012; Ndaki, 2014). For example, during hurricane Katrina, the USA possessed adaptive capacity yet many people still lost their lives and assets due to the lack of real adaptation (Ndaki, 2014).

#### **2.7.2.2.1 Adaptation defined and its significance discussed**

The core theme of this review is climate change adaptation. Adaptation refers to “adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC (2007:72) as cited in Burton *et al.* (2002:146)). This study is restricted to adaptation strategies adopted by human actors. Adaptation is a learning process and not an end, hence there should be constant follow up and review of policies, plans and actions (Hinkel *et al.*, 2009). Adaptation to current climate risks is essential and not an alternative for adaptation to long-term climate change (Burton *et al.*, 1998). It is the first step that prepares and strengthens adaptive capacity to deal with future changes (Burton *et al.*, 1998). Climate change adaptation can be viewed from three temporal levels: responses to current variability; observed medium and long-term trends in the climate; and to model based scenarios of climate projections (Schulze, 2011). Temporal levels are connected and form a continuum (Schulze, 2011).

Adaptation strategies should reduce the potential negative impacts of climate change and simultaneously improve household well-being in the short term and accomplish development goals (Figueiredo and Perkins, 2013). Davis (2011) further suggests that the best way to adapt to climate change is through mainstreaming adaptation strategies into core development activities. If this does not happen, development initiatives may be inhibited by climate change or they may increase vulnerability to climate change (Davis, 2011). Environmental concerns regardless of their severity are often perceived as being

less significant in the planning processes (Faling *et al.*, 2012). Hence, mainstreaming adaptation into core development activities is limited because local governments are focused on pressing socio-economic development activities (Faling *et al.*, 2012). Climate change adaptation strategies may not always yield favorable results. For example, Thomas *et al.* (2007) showed that shifting from cropping to livestock management as a response to the dry spells reduced the amount of grazing resources available. This in turn had a negative impact on natural capital (Connolly-Boutin and Smit, 2016).

For successful and sustainable adaptation strategies, climate science, impacts and vulnerability studies and results from assessing previously implemented strategies are required to devise new strategies (Ziervogel *et al.*, 2014). Successful/sustainable adaptation strategies reduce vulnerability and enhance resilience to long-term climate change (O'Brien and Leichenko, 2007). Unsuccessful adaptation may just simply mean that the action did not accomplish its purpose. It does not necessary translate into maladaptation (Barnett and O'Neill, 2010). Maladaptation refers to changes that increase vulnerability to climate risks this often occurs when decisions are made in haste and when adaptation planning neglects the development context (Schipper *et al.*, 2010). On the other hand, Barnett and O'Neill (2010) define maladaptation as an action taken to avoid or reduce vulnerability to climate change, however this action may unintentionally increase the vulnerability of other social groups, sectors or systems to climate change. *“There are at least five distinct types or pathways through which maladaptation arises; namely actions that, relative to alternatives: increase emissions of greenhouse gases, disproportionately burden the most vulnerable, have high opportunity costs, reduce incentives to adapt, and set paths that limit the choices available to future generations”* (Barnett and O'Neill, 2010:211). An example of maladaptation is the construction of flood control and irrigation systems which are beneficial to crop production communities but have negative consequences on fishing communities (Islam, 2013).

Adaptation is not an independent process, in fact it is dependent on the role and influence of different aspects ranging from geographical, ecological, socio-economic, cultural, political and institutional aspects, each of which independently and/or collectively influences the human-environment interactions (Ndaki, 2014). Adaptation strategies must be designed in such a way that they do not essentialize certain categories while others are ignored (Kaijser and Kronsell, 2014). Furthermore, adaptation strategies need to be flexible to deal with uncertainty around climate and its impacts and the ever-changing socio-economic and political conditions within which the impacts and responses will take place (Ziervogel *et al.*, 2014). This is yet to be realized in the South African context.

#### **2.7.2.2.2 Evidence of historical adaptation**

According to Adger *et al.* (2009) adaptation to climate change is not new, neither as an empirical reality nor as a theoretical construct. Throughout history humans have had to adapt to changing climate conditions (Ndaki, 2014). However human induced climate change is bigger than any other change humans have had to face (Ndaki, 2014) and adds urgency to the adaptation challenge. For example, rainfall reduction by up to 25% in the late 1960s in the West African Sahel prompted farmers to adapt, they did so by herding their livestock south, away from the desert margins, grew shorter cycle varieties of maize and millet and dug up wells and constructed small dams to provide water for vegetable gardens (Tandon, 2007). South Africa is characterized by highly variable rainfall and dry spell periods (Dube *et al.*, 2014). Strategies South Africans have adopted to deal with these climate extremes should be extended to adapt to anthropogenic climate change impacts (Dube *et al.*, 2014). This situation may be identified as cultural adaptation, which considers societal long-range planning (Wiid and Ziervogel, 2012). Historical adaptation strategies were often discrete and reactive whilst ideally adaptation should be anticipatory, proactive and planned (Vincent and Cull, 2012).

#### **2.7.2.2.3 Dimensions of climate change adaptation**

Based on timing (the first dimension), adaptation strategies may be anticipatory or reactive (IPCC, 2001). Anticipatory strategies take place before climate change impacts are observed (Schulze, 2011). They are planned to come into effect in the future (Eisenack and Stecker, 2012). For example enacting rules and other legal measures for water resource management before any observed impacts is a typical case of anticipatory adaptation (Dube *et al.*, 2014). Conversely, reactive strategies are implemented after climate change impacts are observed (Schulze, 2011). Reactive adaptation strategies do offset climate change impacts however they are often unsustainable (Masere, 2011). An example of reactive adaptation is placing emphasis on water conservation when the water source has already dried up (Dube *et al.*, 2014). Very often adaptation to climate change impacts is reactive, rather than anticipatory (Schneider *et al.*, 2000).

The second dimension refers to actors, and therefore to the question of who adapts. Adaptation can either be public or private. Public adaptation is initiated and realized by national, provincial and local government for the community at large in anticipation of change, but usually as a response to individual events (Adger *et al.*, 2003; Schulze, 2011). It usually involves the provision of infrastructure and changes in policies and institutions (Osman, 2015). While private adaptation is initiated and realized by individuals, households or companies for their own benefits (Schulze, 2011). Public and private adaptation are not independent of each other, they reflect the relationship between individuals, their capabilities, social capital, and the government (Binh, 2015).

The third dimension depends on the degree of spontaneity (Smit and Wandel, 2006). Adaptation can either be planned or autonomous. Planned adaptation is a conscious response with preparation to return to the original state, maintain previous state or achieve a new state while autonomous adaptation is a spontaneous response carried out in response to changes in natural and/or human systems (Osman, 2015; Schulze, 2011). Engle (2011) adds that planned adaptation is usually initiated and implemented by adaptation planners for example extension officers while autonomous adaptation is initiated and implemented by individuals. Planned adaptation is considered anticipatory and effective while autonomous adaptation is considered reactive and less effective (Engle, 2011). However, Bawakyillenuo *et al.* (2016) assert that planned adaptation can be either anticipatory or reactive. According to Böckmann (2015), adaptation may also be incremental or transformational. Incremental adaptation refers to small-scale changes to existing adaptation measures while transformational implies large-scale systematic changes or the introduction of new strategies altogether (Böckmann, 2015). Example of transformational adaptation is an awareness campaign to strengthen gender equity (Böckmann, 2015).

#### **2.7.2.2.4 Climate change adaptation strategies**

Several measures may be adopted to respond to climate change. Burton *et al.* (1993) as cited in Burton *et al.* (1998) and Smit and Pilifosova (2003) distinguish these measures into eight classes:

- Bear losses - Occurs when there is no adaptive capacity or when costs of adaptation are too high in relation to climate risks.
- Share losses - This occurs when traditional communities share their losses with for example relatives or when high-tech societies share losses through rehabilitation/relief programs.
- Modify the threat - Some climate risks can be modified. For example, a flood can be controlled using dams and levees. Climate change mitigation is an example of threat modification, however according to the United Nations Framework Convention on Climate Change - UNFCCC this does not fit into adaptation measures.
- Prevent effects - This is a common response to climate change, it involves implementing strategies that will prevent the effects of climate change. For example, irrigating rain-fed agriculture.
- Change use - Change of use occurs when the continuation of an activity is risky or impossible. For example, cropland may be used for recreational purposes during a drought.
- Change location - A less common and extreme response to climate change. For example, a farmer may relocate away from arid areas to cooler areas favourable for crop growth.
- Research - Continuation and development of research on adaptation methods.

- Education - Educate, inform and encourage the change of behavior in favour of adaptation measures.

To understand climate change adaptation previous studies have investigated current and past adaptation strategies, barriers to adaptation and factors that have facilitated adoption of adaptation strategies (Islam, 2013). These studies have provided better insights into the social aspects of adaptation (Islam, 2013). Most of these studies have focused on agriculture only. Common adaptation strategies in agriculture include irrigation, crop diversification, use of new crop varieties, changing planting dates, livestock species suited to dry conditions, adaption to mixed crop and livestock farming systems (Deressa *et al.*, 2009). Other adaptation strategies include: low-no tillage agricultural practices, improved agricultural extension, development of independent networks of information exchange, disaster risk management, income diversification, and empowerment of marginalized groups including women (Tadesse, 2010).

Literature reveals that studies on adaptation have taken a top down approach, for example moving from global climate models to sectoral impact studies and then recently to adaptation monitoring and assessment of adaptation strategies (Van Aalst *et al.*, 2008). This form of adaptation is termed ‘decontextualized’ because it disconnected from the people’s needs and is technocratic (Hackfort and Burchardt, 2016). Adaptation strategies implemented at the national or provincial level are not often not in sync with the people they are intended for because of unequal exposures and constraints, instead vulnerabilities are reinforced because gender differentials are not considered so is class and body based inequalities in access to resources (Hackfort and Burchardt, 2016). Thus, adaptation is conceptualized as a site-specific phenomenon, hence the call for local level analysis into adaptation processes and strategies (Below *et al.*, 2012). Gentle *et al.* (2014) further affirm that climate change adaptation should be at the local level and requires local knowledge. ‘One size fits all’ tactics to address climate change will not work, each country should consider their native environment when creating adaptation strategies (Maryam *et al.*, 2014). Working from the bottom up includes: involving local people, examining present day vulnerability, as well as the current adaptation strategies (Van Aalst *et al.*, 2008).

#### **2.7.2.2.5 Gender and the climate change adaptation link**

The gender and adaptation link is complex, with that being said it requires a nuanced view of the interplay between gendered forms of knowledge, power and decision-making (Bhattarai *et al.*, 2015). From a gender perspective there is limited literature that focuses on South African rural women in relation to climate issues including adaptation (Meyiwa *et al.*, 2014). Involvement of women in climate change adaptation is critical since they possess invaluable local knowledge which can be shared and applied when taking decisions pertaining to adaptation (Figueiredo and Perkins, 2013). An increasing

number of studies highlight gender differentiated climate change impacts (Djouidi and Brockhaus, 2011; Terry, 2009). These studies are justified because a gendered approach to adaptation is required if not gender inequality will be overlooked and women's vulnerability to climate change relative to men's will be reinforced (Vincent *et al.*, 2010).

The dominant perspective in climate change studies and policies is narrow whereby women are framed as poor, marginalized and vulnerable (Kaijser and Kronsell, 2014; Okali and Naess, 2013; Mee, 2016) tasked with reproductive and productive activities (Okali and Naess, 2013). In addition, women are framed as custodians of nature (Kaijser and Kronsell, 2014) with the lightest ecological footprint (Mee, 2016). This perspective does not take into consideration that differences are socially constructed and context specific and will change with climate change (Kaijser and Kronsell, 2014). Ecofeminism discourse reveals that in addition to the provision of food, water, energy and caring for family member's, adaptation to climate change impacts falls under women's responsibilities (Gonda, 2015). Evidently women are targeted in climate change and environmental projects, without due consideration of the time, effort and responsibility they have to invest and consequently inequality and injustices, which are responsible for climate change in the first place are not addressed (Bob and Babugura, 2014; Gonda, 2015; Mee, 2016; Moosa and Tuana, 2014). In essence, private patriarchy is transposed to the public sphere when climate change adaptation falls under women's responsibilities (Gonda, 2015). Moosa and Tuana (2014:684) affirm this and note that "a generalized belief in women's vulnerability silences contextual differences. Gender gets treated not as a set of complex and intersecting power relations but as a binary phenomenon carrying certain disadvantages for women and women alone".

Gender mainstreaming seems to be the solution to gender inequality (Bob and Babugura, 2014; Muthoni, 2012; Vincent *et al.*, 2010). Vincent *et al.* (2010) postulate that effective gender mainstreaming will consider both the rights, responsibilities and opportunities of women and men and their priorities and needs. This study falls short since it only focuses on women's climate change adaptation efforts. Future studies need to look at both men and women's climate change adaptation issues. However, Carr and Thompson (2014) note that there are adaptation programs in place that have been informed by mainstream gender analysis that still fail owing to the limitations of binary gender analysis since it does not consider other critical social differences that shape actions and outcomes in peoples livelihoods. In addition, Bob and Babugura (2014) assert that caution should be taken since gender mainstreaming can become a technocratic exercise that reinforces patriarchal structures. In recognition of this, this study explores intersections of gender and marital status as mentioned in previous sections. This study is in line with Eisenhauer (2016) who states that adaptation strategies must consider the intersectionality of identity. For example, Ravera *et al.* (2016), note that from previous studies household head gender, class and age among other categories of stratification determine women's response to water scarcity.



Similarly, in Africa determinants of climate change adaptation include the joint effects of gender, access to education, credit and land (Ravera *et al.*, 2016).

Previously studies on vulnerability and adaptation to climate change impacts have employed quantitative methods (Binh, 2015). Quantitative approaches to gender analysis include disaggregating data sets based on sex, this is not sufficient to reveal norms and roles that underline gender dynamics in particular sociocultural contexts or to identify entry points for intervention for effective climate change adaptation (Jost *et al.*, 2015). This study utilizes both quantitative and qualitative methods with the hope that a broader picture of past and current vulnerability and adaptation will be realized.

#### **2.7.2.2.6 The role of government and organizations/institutions in climate change adaptation**

Government support in relation to climate change adaptation is very limited in Africa (Tadesse, 2010). Most societies are unaware of the increased risk they face as a result of climate change, according to Van Aalst *et al.* (2008) the climate change issue is therefore something that is likely to be introduced and addressed by outside agencies. Without doubt, human societies are able to adapt on their own however, intervention in the form of resource provision from political and local authorities is essential (Meyiwa *et al.*, 2014). The government is responsible for addressing climate change yet local government that is closer to the people cannot act on climate change because there is a lack of authority and climate change is an unfunded mandate with the larger metros seeking funds internationally for climate change adaptation efforts (Ziervogel *et al.*, 2014). Local government is also under-resourced (lacks manpower) and employees workloads are already high due to the devolution of responsibilities from higher levels of government (Picketts *et al.*, 2014). Local government is the most suited to address climate change adaptation because people can be proactively involved in devising strategies that address local impacts and these strategies will be beneficial to them (Picketts *et al.*, 2014).

According to Adger *et al.* (2003), the relationship between stakeholders (government, civil society, researchers, practitioners, private sector) in climate change adaptation is important yet under-researched. This relationship in the South African context appears weak and hinders climate change adaptation (Ziervogel *et al.*, 2014). Successful/sustainable adaptation strategies require involvement of multiple stakeholders, including communities, policy makers, Non-governmental Organizations-NGOs, extension officers, and the private sector (Amadou *et al.*, 2015). Government at the national level has initiated to address climate change adaptation through the development of a few national projects and policies (Shezi and Ngcoya, 2016). As mentioned before, KZN is identified as one of the most vulnerable provinces in South Africa. To reduce this vulnerability and take advantage of the beneficial impacts of climate change the KZN cabinet through the Department of Agriculture and Environmental Affairs has carried out a study titled 'Development of a Status Quo Analysis Report on the impacts of climate change in

KwaZulu-Natal' (Thornhill *et al.*, 2009). It envisioned that this study would improve the understanding of projected climate change impacts, vulnerabilities and inform future adaptation efforts (Thornhill *et al.*, 2009). Reviewed literature does not highlight any role played by traditional councils in climate change adaptation efforts. Yet local institutions including traditional councils are important in adaptation to climate change impacts at the community level (Padigala, 2015). This study explores the role played by this structure in climate change adaptation in Ndwedwe-Cibane.

### 2.7.2.3 The third dimension of adaptive capacity (coping)

There is often confusion concerning the terms adaptation and coping, here the differences are presented (table 2.7.2.3.1). Coping mechanisms are reactive, short-term responses to immediate climate events (Boissière *et al.*, 2013), and may undermine the possibility of long-term adaptation (Schipper *et al.*, 2010). Conversely, adaptation strategies are often proactive and anticipatory (Boissière *et al.*, 2013). Some scholars postulate that coping with short-term climate variability may facilitate long-term climate change adaptation (Burton, 1997). On the contrary, Ziervogel *et al.* (2008) assert that coping measures adopted in response to short-term climate variability may increase vulnerability to long-term climate change. According to Stefanović (2015) adaptation is an iterative process and as such the boundary between coping and adaptation is often blurred.

Table 2.7.2.3.1: Differences between coping and adaptation (Source: adapted Huxtable and Yen, 2009:14)

Coping	Adaptation
Short-term and immediate	Oriented towards longer term livelihoods security
Oriented towards survival	A continuous process
Not continuous	Results are sustained
Motivated by crisis, reactive	Uses resources efficiently and sustainably
Often degrades resource base	Involves planning
Prompted by lack of alternatives	Combines old and new strategies and knowledge
	Focused on finding alternatives

## 2.8 Barriers and opportunities for climate change adaptation

### 2.8.1 Barriers to climate change adaptation

In order to implement sound and appropriate strategies barriers and opportunities for adaptation should be understood at all levels (Komba and Muchapondwa, 2012) this section looks at the barriers in detail. Adger *et al.* (2007:733) as cited by Nielsen and Reenberg (2010:142) defines barriers as “the conditions or factors that render adaptation difficult as a response to climate change”. In this study, barriers will constitute any factor that can stop, delay, or divert the adaptation process (Moser and Ekstrom, 2010). Barriers may lead to less efficient and ineffective adaptation and to missed opportunities or higher costs (Eisenack *et al.*, 2014). Barriers are not static they change over time (Eisenack *et al.*, 2014). Research on barriers to climate change adaptation has been conducted extensively in a number of regions including the USA, Canada, Australia and Europe (Antwi-Agyei *et al.*, 2013). However, not enough research has been conducted in sub-Saharan Africa and where research is conducted it is fragmented and context specific (Antwi-Agyei *et al.*, 2013). Focus among academics has shifted from is there a need to adapt towards how to adapt and what barriers may inhibit adaptation (Biesbroek *et al.*, 2013). The exploration of barriers to climate change adaptation is necessary as a form of adaptive research (Antwi-Agyei *et al.*, 2013).

Eisenack *et al.* (2014:867) states that barriers to adaptation arise from three main sources, namely “the actor (s) making adaptation-related decisions, the context (for example, social, economic or biophysical) in which the adaptation takes place or the system that is at risk of being affected by climate change (called ‘system of concern’)”. Barriers to climate change adaptation are categorized into three groups (figure 2.8.1.) namely: ecological and physical barriers, which are attributed to natural limitations due to environmental conditions; human and informational resource-based barriers due to technological, economic and knowledge restrictions; and social barriers that influence individuals and societies response to climate change (Jones and Boyd, 2011). On the other hand, Moser and Ekstrom (2010) distinguish between natural, technological, economic, social or formal institutional barriers and limits. Moser and Ekstrom (2010) further identify values, beliefs, norms, communication and information as barriers to adaptation. Nielsen and Reenberg (2010) assert that barriers to adaptation may also be cultural. Most barriers to adaptation are said to be the outcomes of social processes (Burnham, 2014).

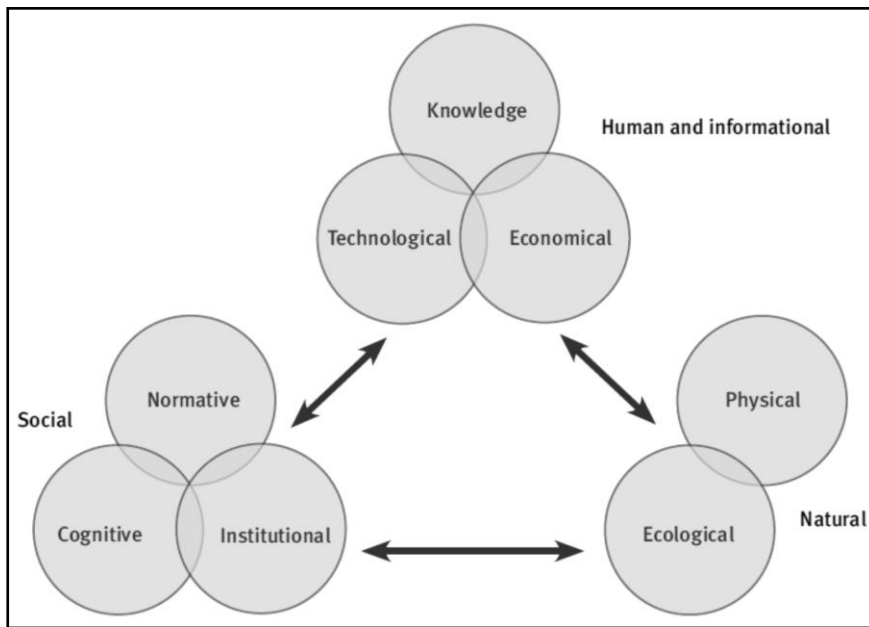


Figure 2.8.1: Grouping of the three main barriers to climate change adaptation (adapted from Jones and Boyd, 2011:1263)

Many studies have examined barriers to climate change adaptation throughout the world in various sectors using different methodologies (Biesbroek *et al.*, 2011). Barriers identified and documented include: the cost of adaptation strategies, unawareness, lack of data, uncertainty, fragmentation, rigidity, pre-existing beliefs, lack of national attention to climate change and poor understanding of the possible effects of climate change (Biesbroek *et al.*, 2011). Barriers identified by Van *et al.* (2015) include poverty, societal hierarchies, lack of information when a threat is looming and on adaptive measures, lack of access to credit, maladaptation, and the lack of perception of the importance of climate change and adaptation. Several author's (Eisenack *et al.*, 2014; Moser and Ekstrom, 2010; Van *et al.*, 2015) suggest that barriers can be overcome, avoided or reduced through concerted effort, creative management, new thinking, political will, prioritization, and related shifts in resources, land uses and institutions. However, overcoming barriers does not mean successful adaptation (Moser and Ekstrom, 2010).

### 2.8.1.1 Women and barriers to climate change adaptation

Women are no exception, they also face barriers when adapting to climate change impacts, these barriers in concert with unequal access to resources and decision making, as well as limited mobility places women, especially in rural areas in a position where they bear the brunt of climate change impacts (Chikulo, 2014). Most studies on limits and barriers focus on agricultural producers (for example, Jones and Boyd, 2011; Vincent *et al.*, 2011) but none according to the researchers knowledge have examined barriers women face when adapting water and firewood resources to climate change in rural contexts. In

this study, the goal is to explore barriers with a focus on FEW-based adaptation within a rural context. The researcher examines barriers in order to understand how to better facilitate adaptation mainstreaming within a rural context. If you understand the barriers, you can find suitable measures to overcome them in order to facilitate planned adaptation (Adger, 2003).

### **2.8.2 Opportunities for climate change adaptation**

Adaptation inaction is usually justified because climate change is surrounded by a lot of uncertainty (Howden *et al.*, 2007). However, decision makers need to accept that uncertain knowledge is better than no knowledge (Nelson *et al.*, 2009). Potential opportunities created by climate variability and change are often overlooked (IFAD, 2010). Yet they exist in Africa because Africans have been exposed to extreme climate events and have overtime developed ways to deal with associated impacts using indigenous knowledge and technologies (Ndaki, 2014). According to Ruppel *et al.* (2014), Africa's strengths that can be used in adaptation planning include: the abundance of natural resources, strong social ties, and longstanding traditional mechanism of managing variability for example through migration and livelihood diversification. This section examines opportunities for women involved in climate change adaptation.

#### **2.8.2.1 Women and opportunities for climate change adaptation**

In the same way that gendered roles and responsibilities lead to differentiated vulnerability between women and men, they can also create opportunities for adaptation (Vincent *et al.*, 2010). Thus, highlighting vulnerability and ignoring women's knowledge would be a missed opportunity for adaptation (Tibesigwa and Visser, 2015). Women are adapting to climate change impacts on their own (Carr and Thompson, 2014; Lookabaugh, 2015) especially in agricultural practices (Constable, 2015). However, very often women's knowledge on mitigation and adaptation is not respected nor is it considered in decision-making processes (Alcid, 2013). Thus, it is important to identify opportunities for climate change adaptation in order to be able to address sources of any particular vulnerability (Carr and Thompson, 2014; Lookabaugh, 2015). In addition, to reduce the risk of designing and implementing adaptation strategies that are the same as existing strategies or even compromise existing viable strategies (Carr and Thompson, 2014; Lookabaugh, 2015).

Women are often portrayed as victims, while they are also key agents of climate change adaptation because of their role as nurturers of the environment, managers of natural resources (as highlighted in ecofeminism discourse) and their involvement in climate sensitive work such as farming (Bob and Babugura, 2014; Terry, 2009; Vincent *et al.*, 2010). Furthermore, rural women's knowledge and skills are one of their greatest strengths (Molnar, 2010). They possess critical knowledge that can enhance

climate change adaptation in areas related to food security, energy, water, agriculture, biodiversity services, health and disaster risk management (Alston, 2014). “For example, in mapping exercises of changes in Fiji’s coral reef, women identified changes such as coral bleaching, the spawning period of certain fish species, algal blooms, and the extent of the dry and rainy periods” (Huyer, 2016:108). Due to the knowledge they possess, women have been instrumentalized, while cultural limitations of the women-nature connection have been overlooked; men’s potential role neglected, and the ways that gender as a system constructs economic and material resources that produce ‘victims’ (Gaard, 2015).

As established in literature, women’s vulnerability to climate change is attributed to their socio-economic status and gender roles which undermine their ability to adapt to climate change impacts (Figueiredo and Perkins, 2013). To build women’s adaptive capacity and reduce their vulnerability their socio-economic status and access to resources needs to be improved (Figueiredo and Perkins, 2013). South Africa is committed to promoting gender equality, this commitment alone has the potential to address gender differentiated impacts and vulnerability to climate change (Chikulo, 2014). Furthermore, social capital is one asset that enables women to negotiate with men access to other capitals such as land and water because one collective voice from women demands attention in respect to the importance of associated livelihood strategies to the entire community (Muthoni, 2012). Social networks should be strengthened as they increase adaptive capacity to the impacts of climate change especially in developing countries (Muthoni, 2012). Ndaki (2014) affirms this, strong social ties and networks exist in Africa and build adaptive capacity for example, self-help during disasters.

Women should be heard and engaged in leadership and decision making roles relating to climate mitigation/adaptation and resource management. Women’s voice will ensure equity, innovation and access to indigenous knowledge essential for community health (Molnar, 2010). Partnerships are needed between households, the private and public sectors to facilitate climate change adaptation (Shaw *et al.*, 2007). Women require outside support as this partnership could lead to more just and effective climate change adaptation (Edmunds *et al.*, 2013). Climate change offers opportunities for productive and sustainable land use management, such as reforestation, conservation agriculture, agro-forestry, improved rangeland management, improved soil management and improved water management (Tadesse, 2010). In closing according to Daze *et al.* (2009) opportunities for climate change adaptation can be facilitated by downscaling climate projections; training local government on adaptation; promoting climate resilient livelihood strategies; implementing disaster risk reduction plans; building community adaptive capacity and addressing underlying causes of vulnerability.

## **2.9 Conclusion**

This chapter critically examined literature on the SLF and the ecofeminist framework that conceptually underpin this study of women's FEW based climate change adaptation within a rural context. From the review, it is evident that climatic changes have been experienced and will be experienced in the future. Hence, the calls for climate change adaptation in all sectors. Women's vulnerability to climate change is discussed as it prompts adaptation. Women's climate change perception is also discussed. The thrust of this study is to understand women's climate change adaptation to changes in FEW resources. Furthermore, barriers and opportunities for climate change adaptation are discussed as they influence the implementation of adaptation strategies. The study area and methodology sections follow.

## **CHAPTER 3: STUDY AREA AND METHODOLOGY**

### **3.1 Introduction**

This chapter provides a description of the study area from a broader perspective, Ndwedwe local municipality, to a narrower view of the Cibane traditional area. The location, socio-economic, physical environment and climate change related issues are presented in the following sections. The description of Ndwedwe-Cibane is important in order to elucidate some aspects of the conceptual frameworks (Ximba, 2009). Concerning the methodology section, the research paradigm, methodological approach and research design are discussed. The discussion includes definitions and justification for all approaches and methods used. Qualitative methods (the dominant technique of data collection) included FGDs and key informant interviews. Trend analysis of meteorological data provided the quantitative component. The chapter further justifies the sampling procedure followed to select participants. In addition, the chapter captures the data collection process. It concludes with a description of the data analysis instruments and techniques and expounds on the methodology challenges and limitations.

### **3.2 Background to study area**

The word Ndwedwe, translated into English means ridge and refers to the location of Ndwedwe in the peaceful setting in the Valley of a Thousand Hills (Raper, 1989). Ndwedwe along with KwaDukuza, Mandeni and Maphumulo Local Municipalities fall under the iLembe District Municipality, on the KwaZulu-Natal north coast. About 83% of Ndwedwe Local Municipality's population is rural in nature while the remaining 17% is urban (Ximba, 2009). Nineteen municipal wards and 23 traditional areas constitute Ndwedwe, Cibane, the case study being one of them, falls under ward 16 (Ndwedwe Local Municipality 2014a; Ndwedwe Local Municipality, 2014b). The majority (68%) of traditional areas within the Ndwedwe Municipality are governed by traditional authorities excluding commercial farms (Ndwedwe Local Municipality, 2014b).



### 3.2.1 Site location

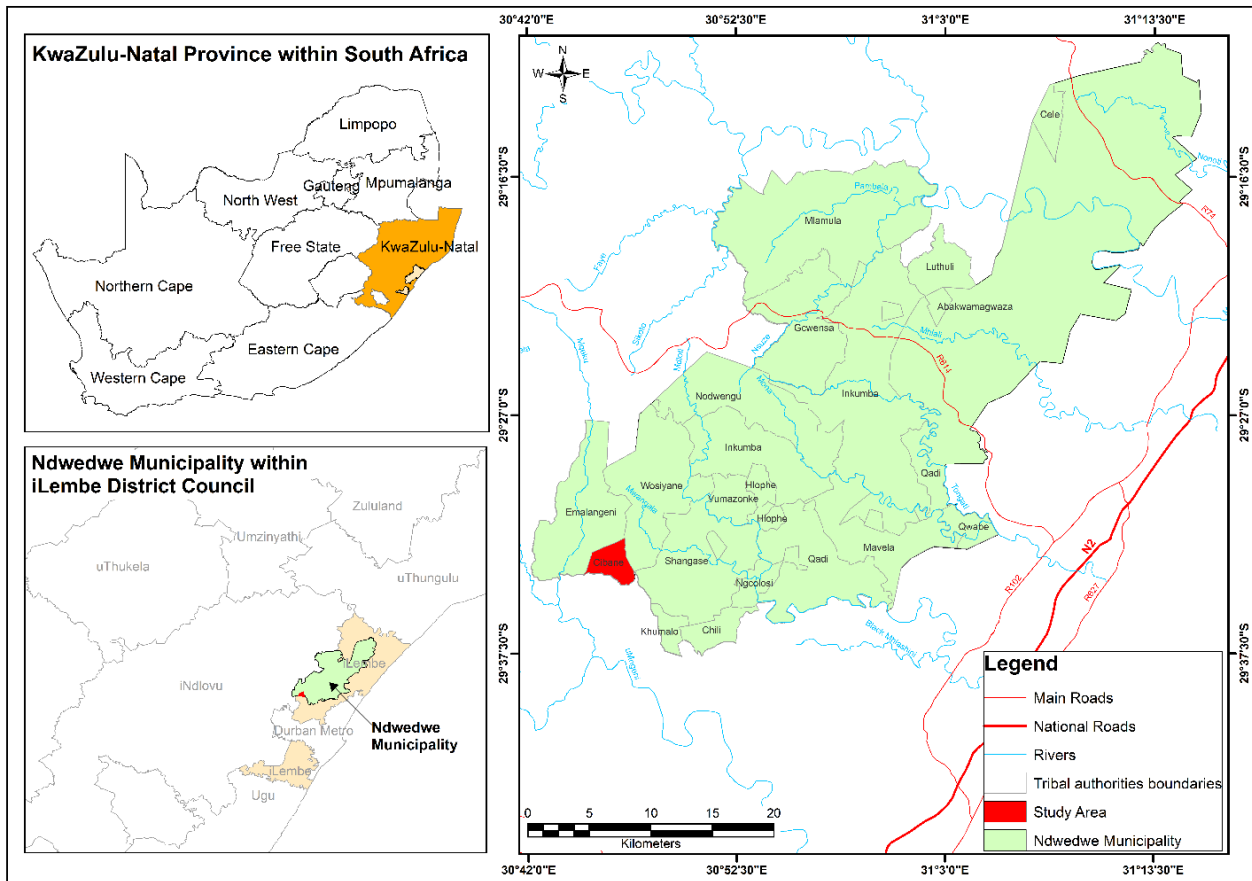


Figure 3.2.1.1: Location of the Cibane traditional area, within KwaZulu-Natal, South Africa (Source: author)

### 3.2.2 Socio-economic characteristics

Ndwedwe Local Municipality's population is approximately 140 820 (Stats S.A, 2012). There are about 7785 people in ward 16, less than six percent of Ndwedwe's population (Stats S.A, 2012). Roughly 68% of Ndwedwe's population are persons between 0-29 years old (Ndwedwe Local Municipality, 2014a). Cibane traditional area is a predominantly isiZulu speaking community with a strong hold of the Zulu culture and is dominated by the Cibane tribe. Ninety-nine percent of Ndwedwe's population is categorized as black (Ndwedwe Local Municipality, 2014b). Women are the dominant sex (52.8% and 55%) in Ndwedwe and in ward 16 respectively (Ndwedwe Local Municipality, 2014a; Stats SA, 2012). Males migrate to urban areas in search of employment opportunities leaving the women behind (Ndwedwe Local Municipality, 2014a). Consequently 60% of the homesteads under ward 16 are headed by women (Stats S.A, 2012).

The dependency ratio is estimated to be 56% (Ndwedwe Local Municipality, 2014a). According to Stats S.A (2012) the education level in Ndwedwe, particularly ward 16 is relatively low with only 13% of the population with a matric certificate and 26% of the population with no level of education. Ward 16 employment rate is 7.7% with an average monthly income of R1200 (Stats S.A, 2012). Socio-economic indicators of Ndwedwe are reflective of a community with low education levels, high unemployment and low income level. Ndwedwe remains underdeveloped, disadvantaged and poverty-stricken (Sotshongaye and Moller, 2000; Tuli, 2006) because of inequities established during the apartheid era and the slow rate of reform since 1994 (Tuli, 2006). Approximately 80% of the land within Ndwedwe's boundary is registered under the Ingonyama Trust Board including 16 traditional areas (Ndwedwe Local Municipality, 2014a). Allocation of land registered under the Ingonyama Trust Board is influenced by the local traditional council including the tribal chief, headmen and sub-headmen (Tuli, 2006). In addition, the Ingonyama Trust Board can lease land for agricultural or development purposes (KwaZulu-Natal Planning and Development Commission, 2009). The Cibane traditional area falls under the jurisdiction of Chief Cibane and communal administration of land and resource use is practiced as per norm (Nene, 2002).

### **3.2.3 Environmental characteristics**

According to Ximba (2009) Ndwedwe is characterized by steep, undulating hills with ridges, mountains and valleys separated by steep drainage lines. Mdloti, iNsuzi and Umvoti Rivers run through the Ndwedwe municipality (Ximba, 2009). Between September and March (spring and summer months), Ndwedwe experiences the wet seasons, whilst April to August are considered autumn and winter months, the dry seasons (Ximba, 2009). Ndwedwe's microclimate varies because of the orographic effect.

### **3.2.4 Livelihood strategies**

Ndwedwe is characterized by high levels of unemployment, poverty and survivalist activities (plate 3.2.3.1) (Isibani planning consultants, 2013). To sustain their livelihoods dwellers heavily rely on agricultural production and other microenterprises such as block making and sewing (Sotshongaye and Moller, 2000). Statistics reveal that the majority (21%) of employees are in the agricultural sector, followed by wholesale and retail (18%), government (17%), community (14%) and construction (10%) (Ndwedwe Local Municipality, 2014a). Secondary agricultural land, the dominant land use/cover in Ndwedwe is used for subsistence farming (Ndwedwe Local Municipality, 2014a). Land with the highest agricultural potential is privately owned and used for commercial agriculture (Ndwedwe Local Municipality, 2014a). Abundance of land, subtropical climate and close proximity to the Hazelmere dam render Ndwedwe suitable to the above mentioned livelihood strategies (Ndwedwe Local Municipality,

2014a). As a result of the diverse environmental and cultural features Ndwedwe's tourism potential is high but needs more attention.



Plate 3.2.3.1: Ndwedwe-Cibane (Source: unknown)

### 3.2.5 Infrastructure and service levels

There is a general backlog in basic services such as water, sanitation, electricity and housing in the municipality (Black Balance Project, 2014). Ndwedwe inhabitants live in remote areas, a distance from the few roads running across the municipality. There are only a few paved roads in the interior of Ndwedwe, most of the roads are gravel and as a consequent are frequently impassable (Monib, 2000). Sixty-six percent of households within the municipality do not have access to potable water (Ndwedwe Local Municipality, 2014a). In ward 16, only 17.3% of household's source water from service providers while 74% depends on the river for water supply (Stats S.A, 2012). Eighty percent of Ndwedwe's inhabitants have no access to electricity (Ndwedwe Local Municipality, 2014b). In ward 16 only 12.5% of households have access to electricity for cooking, heating or lighting (Stats S.A, 2012). According to Ndwedwe Local Municipality (2014a) wards 7, 8, 10, 11, 16, 18 and 19 require urgent electricity provision (Ndwedwe Local Municipality, 2014a). According to Black Balance Project (2014) service delivery is poor because of the relatively steep topography, low settlement density and high costs of service delivery.

### 3.3 Research paradigm

The research process has three major dimensions namely: ontology, epistemology and methodology (Abou-Assali, 2014). Apart from these dimensions, some researchers contend that there are two other dimensions: axiology and rhetoric (Creswell and Plano Clark, 2011; Tashakkori and Teddlie 2003, Tashakkori and Teddlie, 2010). However, in this study the researcher adopts the commonly used three dimensions. A research paradigm encompasses these three dimensions (Abou-Assali, 2014) and is defined by Guba and Lincoln (1994:105) as “a basic system or worldview that guides the investigator, not only in choices of method but also in ontologically and epistemologically fundamental ways”. Paradigms determine how a researcher views the phenomenon under study and informs the research questions, methodology and methods (Mack, 2010; Tuli, 2010). The adoption of a paradigm is crucial for any researcher who intends to conduct clear and detailed research (Mack, 2010).

There are four research paradigms, namely: positivism/post-positivism, constructivist, transformative, and pragmatism (Mertens, 2015). The latter was adopted in this study to understand women’s perceptions and experiences of climate change impacts. According to Creswell and Plano Clark (2007), pragmatism research focuses on consequences of action, is problem centered, pluralistic and is real world practice oriented. Chamberlain-Salaun *et al.* (2013) further add that the pragmatic paradigm is humanistic and emphasizes the role humans play in the construction of objective and meaningful reality.

A major tenet of pragmatism is that all available and necessary approaches are used to answer the research questions irrespective of whether they are quantitative or qualitative methods (Johnson and Onwuegbuzie, 2004). Pragmatism supports mixed methods, by rejecting the incompatibility of paradigms between qualitative and quantitative epistemologies, discrediting the paradigm wars (Denzin, 2012; Feilzer, 2010). Therefore, allowing the researcher to be free of constraints associated with either post positivism or constructivism paradigms and enabling the researcher to use any particular method or technique (Feilzer, 2010).

To elaborate on the three dimensions of paradigms (ontology, epistemology and methodology), Eriksson and Kovalainen (2008:13) define ontology as “the ideas about the existence of and relationship between people, society and the world in general”. Ontology is about the researchers’ knowledge (Abou-Assali, 2014), the set of beliefs and or ideas about the nature of reality (Chamberlain-Salaun, *et al.*, 2013). The central question in ontology is whether reality is objective or subjective (Morgan and Smircich, 1980). In this study, the researcher recognizes the importance of the physical and social world and thus takes a middle position between objectivism and subjectivism known as inter-subjectivity (Biesta, 2010) in accordance with pragmatic assumptions. The second dimension, epistemology is about how the researcher comes to know what they know (Abou-Assali, 2014). Creswell (1994) further adds that

epistemology looks into the relationship between the researcher and the researched. Likewise, in her ontological assumption, the researcher adopts a middle stance on the epistemology (in accordance with pragmatic assumptions) and views knowledge as a construction based on the reality of the world where human beings live and experience and whereby knowledge cannot be separated from the knower (Johnson and Onwuegbuzie, 2004). Epistemology determines the researchers' ontology and accordingly, it determines how the researcher approaches the research process (methodology) (Abou-Assali, 2014). Methodology warrants its own section and is discussed in the following section.

### **3.4 Research methodology**

Methodology refers to the theoretical framework underlying research and the philosophy underpinning the research design (Landman, 2006). The research methodology guides the research design and includes methods, sampling framework, data collection process, data analysis and presentation (Chamberlain-Salaun, *et al.*, 2013; Tuli, 2010). It is important to note that research paradigms and methodology are independent, however researchers can combine the two for complementary purposes in their studies (Thomas, 2010). For example in this study, mixed methodology is not a synonym for the pragmatic philosophical stance adopted but rather the mixed methodology is pragmatic. The key challenge is to use a methodology which, given the ontological and epistemological stance, provides a meaningful way of achieving the research objectives (Healey, n.d.). Previously climate change research was shaped by the natural sciences (Kaijser and Kronsell, 2014). Increasingly climate change is studied using multiple epistemologies and integrating social and natural sciences especially in studies examining climate change perception and adaptation (Birkenholtz, 2012). As such the methodology in this study was interdisciplinary and combined both social and natural sciences to understand the complex issue of rural women's climate change adaptation, it was hoped that it would reveal rigour and consistency.

#### **3.4.1. Mixed-methodology**

This study adopts a mixed methodology which is defined by Starr (2012) as research that combines both qualitative and quantitative methods. In this study, research questions were answered by the quantitative and qualitative approach individually or collectively. The study is sequential, exploratory, and qualitative dominant. Sequential because it involves two distinct phases, with the qualitative phase proceeding over the quantitative phase (see figure 3.4.1). Unlike a traditional sequential design, the results of the qualitative phase did not inform the quantitative phase data collection method and instruments. The choice of a sequential design was influenced by practical considerations. The study leans more towards the qualitative approach due to the weight placed on FGDs and key informant interviews. The findings from both phases were integrated during the interpretation phase, by comparison and connections.

Based on the work of Green *et al.* (1989) and Onwuegbuzie and Johnson (2006), mixed methods are employed in research to triangulate data sources and results, complement results from different methods, to develop or inform another method, to discover contradictions and new perspectives and to expand the breadth and range of enquiry by using different methods for different parts of the inquiry. The use of mixed methods allows the researcher to exploit the strengths while offsetting the weaknesses of both methods (Johnson and Onwuegbuzie, 2004; Starr, 2012). Furthermore, Tashakkori and Teddlie (2003) assert that mixed methods result in better interpretation quality. Mixed methods also increase the strength of research and results in depth and width of academic knowledge (Creswell, 2009). Proponents of mixed methods have expressed that social contexts are complex and pluralistic and as such demand the use of mixed methods, which are more fruitful (Siraj-Blatchford *et al.*, 2006). Bickman and Rog (1998) assert that multiple tools of data collection are needed if a topic is to be researched thoroughly and provide useful results.

The adoption of mixed methods is based on the belief that such an approach enables a researcher to pursue complex social phenomena such as climate change adaptation. The adoption of mixed methods was also encouraged by the gaps identified in literature, the limited climate change adaptation, mixed methods studies conducted in rural contexts. Hence, this study hoped to make theoretical and methodological contribution to existing climate change adaptation literature.

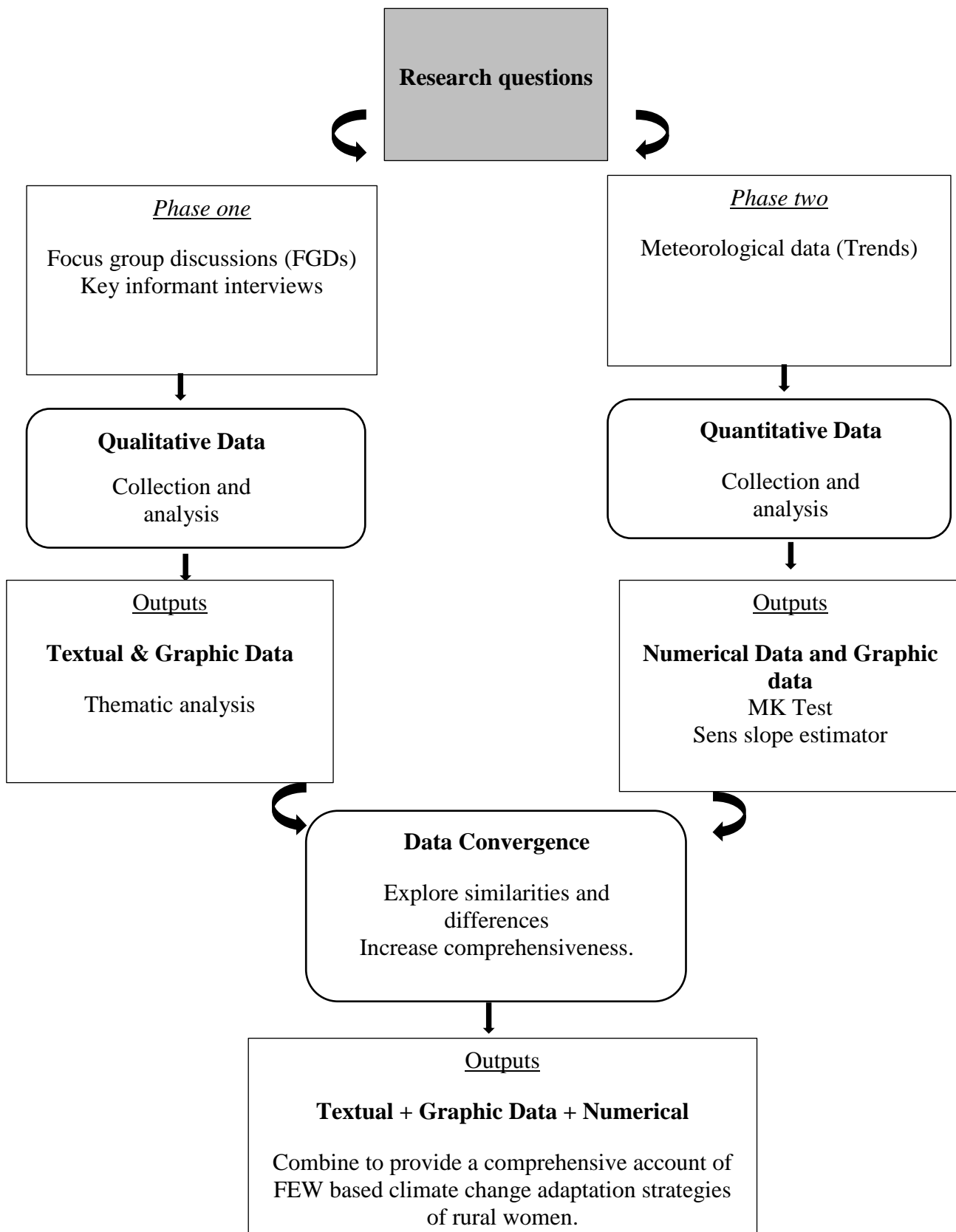


Figure 3.4.1: Summary of phase one and two of the methodology (Source: author)

### 3.5 Research design

The aim of the study in conjunction with the conceptual frameworks influenced the research design. According to Cohen *et al.* (2011), a research design is a plan of action that is based on research questions. It incorporates both the methodology and methods (Chamberlain-Salaun, *et al.*, 2013; Wahyuni, 2012). A single case study was the research design adopted in this study, and is discussed further below.

#### 3.5.1 Case study

A case study is a common research design among qualitative researchers (Burns, 2000) and is a way to collect in-depth information on a particular phenomenon (Creswell, 2003). The present study seeks to determine the impact of climate change on FEW resources and to discover adaptation strategies implemented by women in response to climate change impacts. The case study design was appropriate, firstly because the behavior of participants cannot be manipulated and secondly the researcher wanted to cover contextual conditions since they are relevant for climate change adaptation (Yin, 2003). Climate change cannot be studied without its context (for example, the rural livelihoods and environment).

Nieuwenhuis (2007), asserts that case studies strive for a holistic understanding of how participants relate; encourages participants to interact and encourages them to make their own meaning of the phenomenon under study; considers not only the views of the powerless and voiceless participants but also of other stakeholders and the interaction between them; it gives a voice to marginalized groups such as women and children; it develops comprehensive and rich understanding of participants and it makes use of several data sources and techniques of analysis since according to Gillham (2000) one source is unlikely to be sufficient. According to Feagin *et al.* (1991) the case study research design has been granted scientific status through the use of multiple methods of data collection. They further add that it serves as a “strategic supplement to the natural science model but is an essential feature of sociological inquiry in its own right” (Feagin *et al.*, 1991:28). Furthermore, Cohen *et al.* (2007) assert that strengths of the case study design include: the ability of a single researcher to conduct the study; results of the case are easily understood by the general audience because it reports on reality and it plays a critical role in advancing knowledge in a particular field. Cohen *et al.* (2011) further add that case study designs can answer ‘how’ and ‘why’ questions and allows research to be based on a specific geographical area.

Weaknesses in the case study research design include: inability to generalize the conclusion because it based on a single case (Dyer, 1995; Leedy and Ormrod, 2005; Nieuwenhuis, 2007). However, Perrings *et al.* (2011) assert that information from case studies can reveal relationships that can be used to modify existing models and frameworks or to generate new models and frameworks. Tellis (1997) adds that case study findings are not meant to be representative but rather to see what can be learnt from a single case



thereby enhancing knowledge of a particular domain. As is the case in this study, the researcher seeks to improve knowledge on women's adaptation to climate change impacts in rural areas through the use of PRA methods and techniques. Lee *et al.* (2010) further note that generalization can be made to other cases if these are formulated as hypotheses. Case studies may also be researcher bias - overstating or understating the case (Nieuwenhuis, 2007). Despite the mentioned weaknesses of the case study design the researcher contends that the case study approach is relevant for this particular study. Merriam (1998) supports the use of case studies as she revealed that the strengths outweigh the weaknesses of the approach.

### **3.6 Sampling framework**

#### **3.6.1 Study area**

The researcher selected Ndwedwe particularly the traditional area known as Cibane under the jurisdiction of the Cibane traditional council as the single case study. Ndwedwe-Cibane was chosen through purposive sampling based on the premise that it a rural area, which is under-developed with inhabitants heavily dependent on natural resources for their livelihoods, consequently making them highly vulnerable to climate change.

#### **3.6.2 Participants**

The sampling framework is a critical factor in the success of any study (Leedy, 1997). Latham (2007) defines sampling as a process to select a portion of the population for study. The purpose of studying a sample is to make inferences about the population (Kitchin and Tate, 2000; Rice, 2010). This study is largely qualitative and for that reason non-probability sampling was used, which tends to be the norm in qualitative studies (Berg, 2007). Likewise, Rukema (2010) notes that participants in qualitative research are not chosen to meet statistical requirements but are rather chosen because they have knowledge pertaining to the research topic.

Participants were selected using both purposive and snowball sampling. Snowball sampling is more suitable and effective when mixed with purposive sampling (Mthethwa, 2012). The adoption of purposive sampling allowed the researcher to target a group of women. Whilst snowball sampling enabled participants to identify more participants because they knew who had the necessary experience or characteristics to be included in the study (Latham, 2007). An inclusion criteria was developed and applied when selecting participants. Participants were eligible if they were female residing in the area for 10-20 years, single and married, above the age of 25 and dependent on natural resources for their livelihoods, available during the day and willing to participate in the study.

According to Bradshaw and Startford (2005) there are no rules to be followed when deciding on a sample size especially for qualitative research. The sample size depends on the research questions, the level of trustworthiness you want to achieve, timeframe and budget (Kjelstrup, 2011). The sample size was 20 to 21 women. The decision to choose a sample size of 20 to 21 was based on the costs, timeframe and nature of inquiry.

### **3.6.3 Key informants**

A key informant refers to an individual who is in a position to participate in the research because they possess a great depth of knowledge about a specific field (Cavestro, 2003). Key informants were selected based on the role they play in the community. The Chief was selected using purposive sampling whilst snowball sampling allowed for the identification of the DAEA representative (extension officer). The extension officer did not reside in the study area however she was directly associated with the community's interests as deployed by DAEA. The researcher intended to interview personnel involved in water and firewood resources, however according to the leader of traditional council there are no individuals/groups/institutions or organizations in the community concerned with these aspects of their livelihoods.

## **3.7 Research methods**

### **3.7.1 Qualitative methods**

Van Maanen (1979:520) as cited in Voldnes *et al.* (2014:143) defines qualitative research as “an array of interpretive techniques which seek to describe, decode, translate and otherwise come to terms with the meaning, not the frequency, of certain more or less naturally occurring phenomena in the social world”. Niewenhuis (2007) highlights that qualitative research places emphasis on quality and depth rather than the breath of the information gathered. He further adds that qualitative approaches allow for women's perspectives and experiences to come through the research, which is what this research intended. In selecting qualitative methods, the researcher aimed to gain a holistic and comprehensive picture of women's adaptation to climate change impacts, precisely their strategies, constraints and opportunities. Qualitative methods are not without limitations they can be time consuming and labour intensive (Ndlela, 2007). Miles and Huberman (1994) further add that researcher bias is increased in qualitative research.

A combination of methods is encouraged in qualitative studies because each method reveals different facets of the phenomenon under study, generates multiple perspectives and reduces vulnerability of the study, which may be caused by the use of a single method (Mosimane, 2012). Mthethwa (2012) highlights that complementarity justifies the use of multiple methods, as this leads to elaboration, illustration and clarification of results. Furthermore, the researcher holds the view that a consistent picture of reality will be captured by the use of different methods. If that is not the case the researcher will be afforded the opportunity to explain differences in social reality from multiple perspectives. In this study qualitative data was collected using several PRA methods. Ethical clearance (appendix 1) was approved by the University of KwaZulu-Natal research ethics committee for all qualitative methods utilized in this study and informed consent was received from all participants. Below all methods used are discussed briefly but first PRA is discussed.

### **3.7.1.1. PRA**

The World Bank (1996:183) defines PRAs as “a family of participatory approaches and methods which emphasize local knowledge and enable local people to do their own appraisal, analysis and planning”, using group exercises to gather, share and analyze information. PRA methods/techniques thus lend themselves to building awareness and capacities for climate change adaptation (Van Aalst *et al.*, 2008). Binns *et al.* (1997:8) indicates that “in South Africa there is an especially urgent need for geographers to engage in field-based PRA research, particularly in marginal and impoverished black areas”. He further adds that, “such research must be undertaken with a view of identifying appropriate development options and strategies in partnership with communities”. In agreement with Binns *et al.* (1997), Hill and Nel (2004) voiced that the use of PRA as a participatory research method is important and suitable for marginalized and oppressed communities.

There are three types of PRAs, namely: topical, exploratory, and problem solving (Adebo, 2000). Problem solving PRA is applicable to this study, it utilizes techniques to diagnose problems (accelerated climate change and its associated impacts on women’s livelihoods, in this study) and suggest solutions based on participants’ participation (Adebo, 2000). PRA tools and techniques “shift the normal balance from closed to open, from individual to group, from verbal to visual, and from measuring to comparing” (Chambers, 1997:104 as cited in Percy 1999:402). In support of Chambers (1997), Cornwall and Pratt (2011) note that PRA differs from other research methodologies because of its distinctive use of visualization methods: such as maps, matrices, rankings, calendars and scorings, done by groups of people complemented by discussion. Visualization techniques encourage participation and interaction among the researcher and participants (Doyle and Krasny, 2003). Additionally, visual methods enable researchers to equalize relations between themselves and often the illiterate but ‘visually- literate’ participants (Doyle and Krasny, 2003; Percy, 1999). Percy (1999) further notes that the use of

visualization tools allows previously invisible members of the community to be heard in this case women. PRA methods empowered women enabling them to be equal partners in the data collection process. In addition, PRA served as an analysis tool, since the researcher could analyze participants' responses on site through activities and discussions (Ling, 2011). PRAs are also cost effective, easily understood by participants, instill ownership by participants and rapidly generate information (Kalibo and Medley, 2007).

Weaknesses of participatory methods (including PRA) are that they can be time consuming (Richard, 1995), they may raise participants' expectations (Turyatunga, 2004), and their inability to lead to empowerment above merely exploring and extracting information (Cornwall and Pratt, 2011). The researcher adopted PRA methods with both intent to extract information and empower women given the magnitude of women marginalization and disempowerment in rural areas (Motteux *et al.*, 1999) and their vulnerability to climate change. The researcher hoped that the use of PRA techniques would also de-emphasize hierarchies in climate change adaptation and help women realize the importance of their agency at the community level as a start. Furthermore, PRA was used to seek a clear picture of women's ideas, knowledge of climate change and associated issues with a view to enable women to make their own analysis of barriers to climate change adaptation and the formulation of actions to address the constraints to adaptation. It was envisaged that women would then be able to design their own interventions to counteract climate change impacts.

#### **3.7.1.1.1 Focus group discussion (Appendix 2: Focus group discussion schedule)**

PRA methods employed in this study included focus groups and key informant interviews (Cavestro, 2003). A FGD is defined as “a planned, facilitated discussion among a small group of stakeholders designed to obtain perceptions in a defined area of interest in a permissive, non-threatening environment” (Campbell, 2008:3). FGDs result in a wide range of responses, bringing about original ideas compared to individual interviews, participants may assist each other in remembering certain details applicable to the study and are cost effective since several people are interviewed at once (Kitzinger, 1994; Phaswana-Mafuya and Shukla, 2005). Additionally FGD benefits include, that it “captures responses in real space and time in the context of face-to-face interactions and it strategically ‘focuses’ interview prompts based on themes that are generated in these face to face interactions and that are considered particularly important to the researchers” (Kamberelis and Dimitriadis, 2005:899 as cited by Ahmed and Nadasen, 2013:11).

FGDs have several weaknesses and limitations. Group discussions are not confidential and therefore, one of the participants may share what has been discussed outside the group (Murugen, 2008).

Additionally, group discussions may encourage ‘group think’ which reduces the dependability of the data (Jackson *et al.*, 2007; Nyiraruhimbi, 2012), and prevents the voicing of individual perceptions and opinions that deviate from the groups accepted focus (Nyiraruhimbi, 2012). Conversely, to the ‘group think’ phenomenon, an individual or cluster of individuals may greatly influence the group discussion (Starr, 2012). Lastly, group discussion findings cannot be generalized to the population at large (Shisanya, 2008). Despite the aforementioned weaknesses, three FGDs were appropriate for this study and as such were conducted orally (over a period of three days) with the use of PRA techniques (see table 3.7.1.1.1). Some of the techniques used were adapted from the *climate vulnerability and capacity analysis handbook (2009)* by Daze *et al.* (2009) and the *Community-based Risk Screening Tool-CRiSTAL User’s Manual* by the IISD (2012).

Table 3.7.1.1.1: PRA techniques used to collect data in Ndwedwe-Cibane, KwaZulu-Natal

<b>Method</b>	<b>Description</b>	<b>Application of method</b>
Listing and/or Ranking	- Estimates and quantifies either using judgments or local materials/measures (Balfour, 2004; Mukherjee, 1995).	- To identify critical natural livelihood resources - To identify key livelihood strategies - To reveal resources essential for climate change adaptation - To identify adaptation strategies currently used to address the climate change impacts - To identify key barriers to climate change adaptation
Matrix scoring	- This exercise is used to identify, rank and then score issues in order of importance (Uddin and Anjuman, 2013).	-To understand women’s perception of past climate change
Vulnerability matrix	- Graphical representation of climate hazards and impact on resources (IISD, 2012).	- To elucidate women’s vulnerability to climate change - To determine the significance of climate change impacts on agriculture, water and firewood resources.
Daily activity profile	- This technique is used to explore the amount of time women dedicate to specific tasks on a daily basis (Maalim, 2006).	- To identify the amount of time women allocate to agriculture, water and firewood collection -To identify women’s routine activities and workload
Trend diagramming	- Trend diagram refers to the representation of changes in community resources or village life	- To explore changes in the availability of livelihood resources

	<p>over time (Wilde and Vainio-Mattila, 1995).</p> <ul style="list-style-type: none"> <li>- This technique enables community members to share their perceived past experiences and changes in the environment and behavior and to understand causal links (International Federation of Red Cross and Red Crescent Societies-IFRC, 2007).</li> <li>- This technique enables the researcher to gain an understanding of past conditions, to understand the present situation in the community and how conditions may change in the future by determining a trend (IFRC, 2007).</li> </ul>	<p>-To identify climate change impacts</p>
Venn diagramming	<ul style="list-style-type: none"> <li>- Venn diagram is a visual representation used to collect social data to show the relationship between a community and various individuals/groups/institutions and organizations (IFRC, 2007; Mukherjee, 1995).</li> <li>- Venn diagrams not only show the relationship but also indicate the institution status in the community and the interactions between the inhabitants and the identified institutions (Maalim, 2006).</li> <li>- This diagram is then used to identify support which is or maybe available to the community to build local capacity (Adebo, 2000; IFRC, 2007).</li> </ul>	<ul style="list-style-type: none"> <li>-To identify individuals, groups, institutions and organizations supporting women’s climate change adaptation efforts, these maybe positive or negative.</li> <li>- To identify individuals, groups, institutions and organizations that could support women’s climate change adaptation efforts.</li> </ul>
Observation	<ul style="list-style-type: none"> <li>- Observation is a method of observing people, actions, objects and relationships (IFRC, 2007).</li> </ul>	<ul style="list-style-type: none"> <li>- To document physical and social aspects of the community.</li> <li>- Observations involved establishing geographical details, community resources, distance from homes to natural resources and agricultural fields, livelihoods, climate change and variability impacts on livelihoods and adaptation to climate change and variability.</li> <li>- To observe and confirm information gathered during other PRA exercises</li> </ul>

FGDs were semi-structured, informal, conversational and flexible to encourage participation. Semi-structured questions were appropriate because they “are said to allow people to answer more on their

own terms than standardized interview permits, but still provide a greater structure for comparability over that of the focused interview” (May, 2001:17). Furthermore, they allow the researcher to probe deeper (Kajornboon, 2005) and modify questions as new issues arise during the conversation.

Single and married women were separated into two groups during the FGDs which took place at the community court, a natural setting for them. This venue allowed women to be comfortable as they were familiar with the surroundings (Chesebro and Borisoff, 2007). Additionally, Jiyane *et al.* (2012), note that a natural setting for data collection enables the data collection process to take place naturally without a predetermined course. Selection of the community court was also influenced by logistic reasons and proximity to participants’ homes. To improve the response rate women received a stipend of R50.00 for each day, when participating in this research, which would cover the necessary transport costs and refreshments were served. The language of communication during the FGDs was Isizulu, which is the local language of communication in Ndwedwe-Cibane.

Before the commencement of any of the FGDs, the researcher explained the daily objective and the PRA techniques to be used (see table 3.7.1.1.1). The researcher emphasized that the study was for academic purposes and not any form of development would come from it unless participants decide to take up development on their own. FGDs were two and a half hour to three hours long and as such were described as extended focus group discussions. FGDs commenced at ten o’clock in the morning. This seemed like the perfect time since it minimized the disruption of women’s daily routines during daylight hours (Rachel, 1997). Twenty women participated in the first FGD, while 21 participated in the second and third FGD. Of the 21 participants eight were single and the 13 were married women. Some participants would arrive late and thus affect scoring and ranking exercises.

Day one of the FGDs assessed women’s knowledge of climate change and women’s vulnerability to climate change. Day two examined strategies adopted by women to respond climate change impacts and identified barriers to adaptation. The aim of day three was to allow women to identify opportunities for climate change adaptation to reduce their vulnerability. These FGDs were then followed by key informant interviews.

#### **3.7.1.1.2 Key informant interviews (Appendix 3 and 4)**

Key informant interviews served as ‘ground truthing’, where the information on climate change adaptation gathered from local women was compared to information from key informants living in the area or working in the area. The same interview schedule was used for each informant with slight variations. The interview conducted with the Chief aimed to obtain information regarding the role of the

traditional council in climate change adaptation, measures the council has proposed or adopted to minimize the negative impacts of climate change and enhance the positive aspects, and gender/marital status differences in adaptive capacity amongst others. The interview conducted with the extension officer focused on the department's initiatives to counteract agricultural climate change impacts, challenges faced in climate change adaptation and future plans for climate change adaptation amongst others.

The interviews with the Chief and extension officer were semi-structured and face-to-face. Face to face interviews allow for direct observation of the interviewee while responding to questions (Voldnes *et al.*, 2014). Furthermore, communication is synchronous and as such the interviewees' response is spontaneous without extended reflection (Opdenakker, 2006). Knox and Burkard (2009) confirm that face-to-face interviews allow the researcher to observe verbal and nonverbal data.

Key informant interviews were conducted at times and venues convenient for the interviewees (see table 3.7.1.1.2). On average interviews lasted 30 to 45 minutes. Key informant interviews were conducted in English or Isizulu depending on the preference of the informant. During interviews, key informants were asked to provide relevant documentation to triangulate findings in order to answer the research questions (Wahyuni, 2012).

Table 3.7.1.1.2: Schedule of interviews (Source: author)

<b>Interviews</b>	<b>Respondents</b>	<b>Related fields of expertise</b>	<b>Instrument</b>	<b>Interview date</b>
Leader of traditional council	Chief	Community representative	Face to face interview (Community court)	9 June 2017
Local Department of Agriculture and Environmental Affairs	Extension officer	Department of Agriculture and Environmental Affairs representative	Face to face interview (DAEA Ndwedwe offices)	6 June 2017

### **3.7.1.2. Field work and data collection**

The fieldwork was conducted in March and June 2017. The researcher spent five days in the study area, three of which were spent conducting the appraisal. This was in line with Brown (2006) who reveals that on average PRA involves a three to ten-day visit to the area of study to conduct the appraisal. For the



duration of the data collection process the researcher resided in a family home situated in the area. Hill *et al* (2001) and Ling (2011) assert that the researcher must be ‘together’ with the local community for example by living in the study area for a certain period of time or by helping villages with their daily chores. Furthermore, Lincoln and Guba (1985) assert that living in the study area builds trust and rapport with the participants, enhancing the credibility of findings.

### 3.7.1.3 Data analysis

Thematic analysis was used to identify, analyze and report themes in verbal and visual responses from participants (Braun and Clarke, 2006). A guide to thematic analysis provided by Braun and Clarke (2006) was utilized by the researcher (see table 3.7.1.3). All analyzed data is presented in the form of tables, diagrams and written statements.

Table 3.7.1.3: Phases of thematic analysis (Source: Braun and Clarke, 2006:36)

Phase	Description of the process
1. Familiarizing yourself with your data:	Transcribing data (if necessary), reading and rereading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes:	Checking the themes’ work in relation to the coded extracts (level 1) and the entire data set (level 2), generating a thematic ‘map’ of the analysis.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating the analysis back to the research question and literature, producing a scholarly report of the analysis.

### 3.7.2 Quantitative methods

Creswell (2003:18), defines the quantitative approach as “one in which the investigator primarily uses post positivist claims for developing knowledge (for example, cause and effect thinking, reduction to specific variables and hypotheses and questions, use of measurement and observation, and the test of theories)”. Common approaches to quantitative research include: surveys, correlational research, exploratory research, descriptive research, experimental research and trend analysis (Sukamolson, 2010). Quantitative research findings may be predictive, confirming or explanatory (Williams, 2007). This study is largely qualitative in approach with quantitative methods used solely to analyze climate trends. Advantages of using quantitative methods include: objectivity, generalizability of results and repeatability of the process (González López and Ruiz Hernández, 2011). Quantitative data collection is also relatively quick and less time consuming when using statistical software for analysis and the researcher is independent of the results (Johnson and Onwuegbuzie, 2004). Limitations of quantitative methods include inability to explore a phenomenon in-depth (Sukamolson, 2010), the lack of rigour and the disregard of socio-cultural contexts (Kura and Sulaiman, 2012).

The first research question required an investigation of climate trends. Historical meteorological data was used to determine past temperature and rainfall trends in Ndwedwe-Cibane. Women’s perceptions and historical meteorological data were compared for similarities and/or discrepancies. Downscaled GCMs were analyzed to project future temperature and rainfall change. This is essential to develop appropriate adaptation strategies for the future and to see if past and current adaptation strategies were or are appropriate considering the trends from data. This approach comes highly recommended by Lumsden *et al.* (2009) who assert that meteorological variables should be examined in support of climate change adaptation efforts in Southern Africa.

#### 3.7.2.1 Temperature and rainfall trend analysis

Initially rainfall data was gathered from the Ndwedwe meteorological station (due to proximity to the study area) while temperature data was from Mount Edgecombe, the closest station to Ndwedwe that provides temperature data. There are no temperature recording stations in Ndwedwe. However, after careful analysis of the data, the researcher decided to use rainfall data from the Mount Edgecombe station because the data from Ndwedwe station had too many missing values. Both stations belong to the South African Weather Service - SAWS organization (see table 3.7.2.1 and figure 3.7.2.1 for further details). Monthly minimum and maximum temperatures (°C) and monthly rainfall data (mm) from 1965 to 2015 were used in this study. A period of 50 years for analysis was chosen because “climate is statistical information and is usually based on the weather in one area averaged for at least 30 years” (Ramamasyet *et al.*, 2007 as cited by Phuong, 2011:3).

Table 3.7.2.1: Details of the meteorological station from which temperature and rainfall data was collected (Source: South African Weather Service, 2016 via email)

Station Name	Latitude (S)	Longitude (E)	Approx. distance from Cibane (km)	Data years	
				Rainfall	Temp
Ndwedwe	29°37'0"	30°56'0"	15	1965-2015	x
Mount Edgecombe	29°42'24.0"	31°02'46.0"	29.8	1965-2015	1965-2015

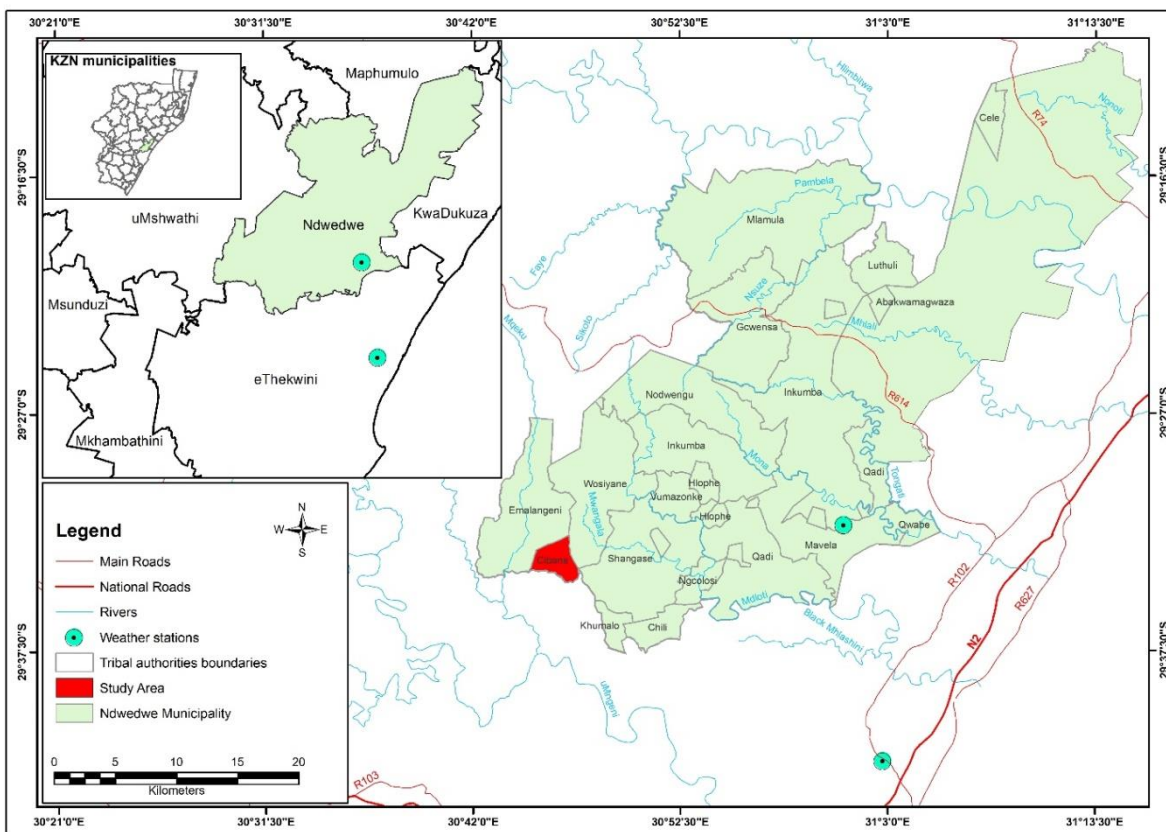


Figure 3.7.2.1: Location of the meteorological stations in relation to the study area

### 3.7.2.1.1 Mann-Kendall trend test

The Mann Kendall - MK test can be used to analyze past and future trends of climate variables including temperature and rainfall (Mondal *et al.*, 2012). It is widely used for trend detection in climatological data (Mavromatis and Stathis, 2011). The World Meteorological Organization - WMO (2000) as cited by

Lespinas *et al.* (2010) has dubbed the MK test as the official tool for detection of trends in the context of climate variability and change.

XLSTAT 2013 plug-in of Microsoft excel with 5% significance was downloaded from <https://www.xlstat.com/en/download> and used to perform the non-parametric MK test to analyze temperature and rainfall data in order to determine the direction of the trend and the significance of the trend. The MK test was chosen on the basis that it robust, simple, can cope with missing data and the data does not need to be normally distributed (Mapurisa and Chikodzi, 2014). To compare participants' climate change perception with the meteorological data, time series graphs were plotted, trend lines inserted then tested for significance using MK trend test.

The MK test statistic  $S$  is calculated using the formula

$$S = \sum_{k=1}^{n-1} \sum_{j=k+1}^n \text{sgn}(x_j - x_k), \quad (1)$$

where  $x_j$  and  $x_k$  are the annual values in years  $j$  and  $k$ ,  $j > k$ , respectively, and

$$\text{sgn}(x_j - x_k) = \begin{cases} 1 & \text{if } x_j - x_k > 0 \\ 0 & \text{if } x_j - x_k = 0 \\ -1 & \text{if } x_j - x_k < 0 \end{cases} . \quad (2)$$

When  $S$  value is high and positive it implies that the trend is increasing, while a very low negative value indicates a decreasing trend. However, to statistically quantify the significance of the trend it is necessary to calculate the probability associated with  $S$  and the sample size  $n$ . The variance of  $S$  is given as

$$\text{VAR}(S) = \frac{1}{18} \left[ n(n-1)(2n+5) - \sum_{p=1}^q t_p(t_p-1)(2t_p+5) \right] \quad (3)$$

Where  $q$  is the number of tied groups and  $t_p$  is the number of data values in the  $p$ th group. The values of  $S$  and  $\text{VAR}(S)$  are used to calculate the test statistic  $Z$  as given below

$$Z = \begin{cases} \frac{S-1}{\sqrt{VAR(S)}} & \text{if } S > 0 \\ 0 & \text{if } S = 0 \\ \frac{S+1}{\sqrt{VAR(S)}} & \text{if } S < 0 \end{cases} \quad (4)$$

The Z value is tested at 95% level of significance ( $Z_{0.025}=1.96$ ). If the Z value is negative and the absolute value is greater than the level of significance, the trend is decreasing. On the other hand if the Z value is positive and greater than the level of significance, the trend is increasing. There is no trend if the Z value is less than the level of significance (Olofintoye and Sule, 2010).

### 3.7.2.1.2 Sen's Slope Estimator

Sens slope estimator was used to measure the slope of the trend. Sens slope estimator is a non-parametric procedure developed by Sen (1968) as cited in Drápela and Drápelová (2011). It is the true slope (change per unit time) of a linear trend (Drápela and Drápelová, 2011; Olofintoye and Sule, 2010). Advantages of this procedure include: the data need not conform to any distribution, missing values are allowed and it is not affected by single data errors or outliers (Olofintoye and Sule, 2010). The linear model  $f(t)$  can be described as

$$f(t) = Qt + B \quad (5)$$

where  $Q$  is the slope,  $B$  is a constant and  $t$  is time.

To derive the slope estimate  $Q$  in equation the slopes of all data value pairs are calculated using the equation

$$Q_i = \frac{x_j - x_k}{j - k}, \quad (6)$$

Where:  $Q$  = slope between data points  $X_j$  and  $X_k$

$X_j$  = data measurement at time  $j$

$X_k$  = data measurement at time  $k$

$j =$  time after time  $k$ ,  $X_j$  and  $X_k$  constitute the pairs of observations identified by place in the series. The median of these estimates is Sen's estimator of slope, where  $j > k$ .

Additionally, to compare results obtained from the MK test and Sen's slope estimator, linear trend lines were plotted for each state using Microsoft Excel 2011.

### 3.7.2.2 Temperature and rainfall change projections

GCMs are used to project future climate change (Aksornsingchai and Srinilta, 2011). However GCM spatial resolution is low (Aksornsingchai and Srinilta, 2011). Since it represents an area of about 300km and therefore has limited value in local studies (Ngcobo, 2013; Tadross *et al.*, 2008). The climate of a particular area is influenced by local topographic features which are not considered in global projections due to the low resolution (Barichievy, 2009; Sarhadi *et al.*, 2016), hence the importance of downscaling GCMs to improve spatial detail. Downscaled GCMs assume there is a constant relationship between the large scale (predictor) and local climate (predictands) (Aksornsingchai and Srinilta, 2011). GCMs are downscaled to facilitate adaptation strategies (Marengo *et al.*, 2009). It is important to note that projections regardless of scale should always be treated with caution, they show possible scenarios for the future which are not definite (Daron, 2014).

Statistical downscaling of Coupled Model Inter-comparison Project Phase 5- CMIP5 projections (across 10 different GCMs) to station locations in South Africa have been undertaken by CSAG for different periods. In this study the 2015 to 2035 (relative to 1980-2000) period was selected, an arbitrary period of twenty years to account for inter-annual variability while projecting for the Representative Concentration Pathway - RCP 4.5. These projections are available on the CSAG Climate Information Platform - CIP website (<http://cip.csag.uct.ac.za/webclient2/datasets/africa-merged-cmip5/>) and are presented under section 4.3 in this study.

Statistical downscaled CMIP3 projections are also available but were not used because firstly, they only present total monthly rainfall anomalies under A2 and B1 SRES scenarios while the researcher is interested in rainfall and temperature changes. CMIP5 projections included total monthly rainfall; average minimum temperature and average maximum temperature which are important variables in this study. Secondly, according to Kumar *et al.* (2014) CMIP5 models are more advanced than CMIP3. CMIP5 models typically have finer resolution processes, and are well-integrated into earth system components (Kumar *et al.*, 2014). Moreover, some of the CMIP5 models include carbon cycle feedback, atmospheric chemistry, aerosol, biogeochemistry, and dynamic vegetation components (Kumar *et al.*, 2014). Thirdly, Sun *et al.* (2015a) add that CMIP5 projections encompass a larger range of possible future greenhouse gas concentrations, which translates into more climate outcomes. Kusunoki and

Arakawa (2015), Sun *et al.* (2015b) and several other authors (Kug *et al.* 2012, Liu *et al.* 2012, and Monerie *et al.* 2012) as cited in Kumar *et al.* (2014) have observed CMIP5 simulation improvements in their studies.

The focus of this study is exclusively on RCP which is an improvement from the SRES approach (Terink *et al.*, 2013). The CIP projections are available under RCP 4.5 and RCP 8.5. RCP 4.5 is a stabilization scenario, its assumptions include reduction of greenhouse gas emissions due to the introduction of climate policies, for example setting prices for greenhouse gas emissions (Thomson *et al.*, 2011). Under this scenario the future is consistent with increasing reforestation programmes, decreasing use of crop and grasslands due to increased productivity and dietary changes (Bjørnæs, 2013). Contrary to RCP 4.5, RCP 8.5 is a scenario where there are no policy changes and greenhouse gases continue unabated in the absence of mitigation (Bjørnæs, 2013). Additionally assumptions include increasing human population, slow income growth, lowest rate of technology development and high-energy intensity developments (Bjørnæs, 2013; Riahi *et al.*, 2011). RCP 4.5 was adopted in this study since the researcher understands that it is the most applicable in the South African context because there are climate policies and reforestation projects, for example the Bufflesdraai and eMdloti reforestation projects. Within the CIP the closest station to Ndwedwe-Cibane is the old Durban international airport station (29°58'12.0"S 30°57'00.0"E) which is approximately 59.8 km from the study area.

### **3.8 Limitations and challenges**

Limitations encountered whilst conducting the study included the sampling method specifically-purposive sampling which prevents the generalization of this study to other settings (Tesfai and de Graaff, 2000). As mentioned earlier on, use of the case study design also limits generalization of the findings since cultures and values differ in each community. Inability to generalize findings was not a problem since the aim of the study was not to generalize the findings but rather to inform future research. Women may misrepresent information about themselves, by underreporting embarrassing behaviour and over-reporting what they think the researcher wants to hear. To deal with this the researcher assured participants confidentiality and explained the value of truthful answers for the success of the study (Starr, 2012).

The study was carried out by an individual instead of a team of experts, which may have led to researcher bias in the data collection process (Jorgensen, 2012). Researcher bias may influence the quality of this study as a whole. PRA methods have their own inherent limitations, for example, they may raise participants' expectations for positive change (Rietbergen-McCracken and Narayan-Parker, 1998). However, to deal with this the researcher explained clearly to the participants that the research was for academic purposes and that there would be no social change unless they took it upon themselves

to change their lives. Translation of all transcripts from isiZulu to English may have led to distortions, the researcher read the translated text twice to minimize the number distortions if there were any. The researcher noted that the study was not exhaustive due to a number of constraints, however emerging issues were discussed. Due to the number of limitations in this study readers should approach the findings with caution.

Since this study was gendered, it was restricted to exploring the perceptions of rural women only. Notwithstanding the findings from women perspectives, the absence of males' perspective with the exception of the Chiefs' represents an important limitation in terms of gaining insights into why and how gender intersects with FEW resources based climate change adaptation in a rural context. However previous research on climate change has generally focused on men perspectives therefore in a way this study is balancing the studies where women were considered invisible.

There were gaps in the meteorological data (especially between 1992 and 1993) and the researcher had no control over the quality of the meteorological data. Regardless of the limitations the meteorological data was considered sufficient for the purpose of this study. Moreover, the data is from the Mount Edgecombe weather station, there may be differences in the environmental conditions between Mount Edgecombe and Ndwedwe-Cibane that may affect the weather and subsequently the climate. Thus the data may not be a true representation of Ndwedwe-Cibane. Likewise, downscaled projections may not be a true representation of Ndwedwe-Cibane since they are based on data collected from the old Durban International Airport and because of inherent GCM limitations.

### **3.9 Conclusion**

Chapter three through the study area description reveals that the majority of the population is poverty stricken and heavily reliant on natural resources for survival. Climate change impacts could change women's livelihood activities, thereby exacerbating their poverty levels. This chapter has also outlined the various procedures for collecting, analyzing and reporting results. A mixed-method approach was adopted to collect data. The philosophical underpinnings were addressed at the beginning of the chapter. Furthermore, the sampling framework was discussed. This chapter also highlights the techniques and software used to analyze the data. Primary data in conjunction with secondary data was used to achieve the objectives. The following chapters present and discuss the results based on the findings obtained through the use of FGDs, key informant interviews, MK test, GCMs and secondary sources of data.



## **CHAPTER 4: PAST AND FUTURE CLIMATE TRENDS AGAINST WOMEN'S CLIMATE CHANGE PERCEPTION**

### **4.1 Introduction**

The first research question related to past climate trends in Ndwedwe-Cibane, how they are perceived and explained by women, and what the likely future climate trends are. This chapter attempts to answer this question in three sections. The first section uncovers the trends in meteorological data and projects future changes in climate variables. The second section reveals women's perception of past climate change, and the third section examines causes of climate change and sources of climate change information.

### **4.2 Trends in meteorological data**

Trend analysis for Ndwedwe-Cibane (using Mount Edgecombe meteorological stations), has been done in this study with 50 years of temperature and rainfall data from 1965 to 2015. The analysis was based on temperature and rainfall data because both these variables are the main indicators of climate change in Africa's arid and semi-arid regions (Bawakyillenuo *et al.*, 2016). The MK test, Sen's slope estimate and linear regression lines were used to determine the trends. The purpose of determining trends is to get a better understanding of the association between climate variability, change and women's perception. Under climate change conditions Warburton (2005), hypothesized that air temperature would increase while the annual rainfall amount would decline.

#### **4.2.1 Trends in annual mean minimum and maximum temperatures**

The long-term trends in annual mean minimum and maximum temperatures are presented in figures 4.2.1.1 and 4.2.1.2 respectively. Annual mean minimum temperatures varied within the range of 11.47°C (1993) to 17.58°C (2010), averaging 15.79°C, over the 50 year period. While annual mean maximum temperatures, ranged between 18.93°C (1993) and 26.35°C (1999), averaging 24.60°C, over the 50 year period. For annual mean minimum temperatures at Ndwedwe, the MK Statistic  $S = 383$  and Sen's slope estimate  $Q = 0.02$ , both revealing an increasing trend. Furthermore,  $p=0.002$ ,  $p<0.05$  indicating a statistically significant increasing trend (Table 4.2.1.1). Similarly for annual mean maximum temperatures the MK Statistic  $S = 578$  and Sen's slope estimate  $Q = 0.03$  both indicating a positive trend. In addition,  $p=0.0001$ ,  $p<0.05$  demonstrating a statistically significant increasing trend.

On fitting the linear trend lines, it was observed that the trends are increasing for both annual mean minimum and maximum temperatures although slopes are small in magnitude. Annual mean minimum temperatures have increased by 0.01°C per year while annual mean maximum temperatures increased by 0.03°C per year (figure 4.2.1.1 and 4.2.1.2). It was observed that annual mean maximum temperatures increased faster than annual mean minimum temperatures. Both annual mean minimum and maximum temperatures had a low coefficient of determination ( $R^2$ ), 0.03 and 0.10 respectively, indicating inter-annual variability in temperature changes. The MK test, Sen's slope estimator test and linear trend lines show similar results, an increasing trend. The temperature increasing trends are consistent with IPCC (2007) predictions for southern Africa.

Table 4.2.1.1: Summary of the Mann-Kendall trend test and Sen's slope estimator results

Station	Climate Variables	Mean	Mann-Kendall stat (S)	Var (S)	p-value (Two-tailed)	Sen's slope estimate
Mount Edgecombe	Minimum Temperature (°C)	15.79	383.00	15156.33	0.002 **	0.02
Mount Edgecombe	Maximum Temperature (°C)	24.60	578.00	15155.33	<0.0001**	0.03
Mount Edgecombe	Rainfall (mm)	925.42	-117.00	15158.33	0.342 *	-2.53

\* Non-significant

\*\* Significant

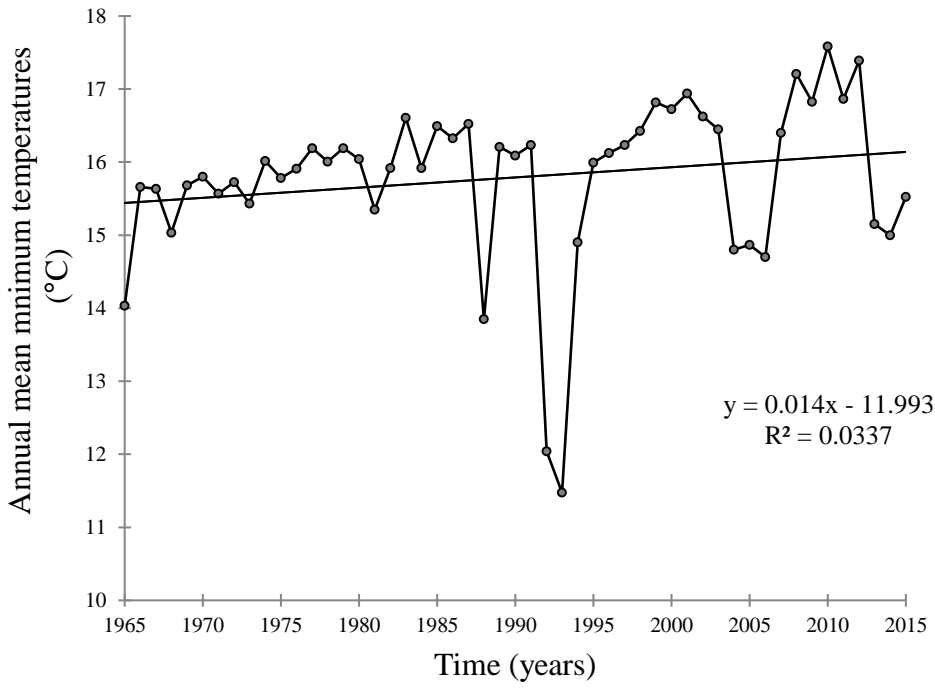


Figure 4.2.1.1: Annual mean minimum temperature time series for the 1965-2015 period

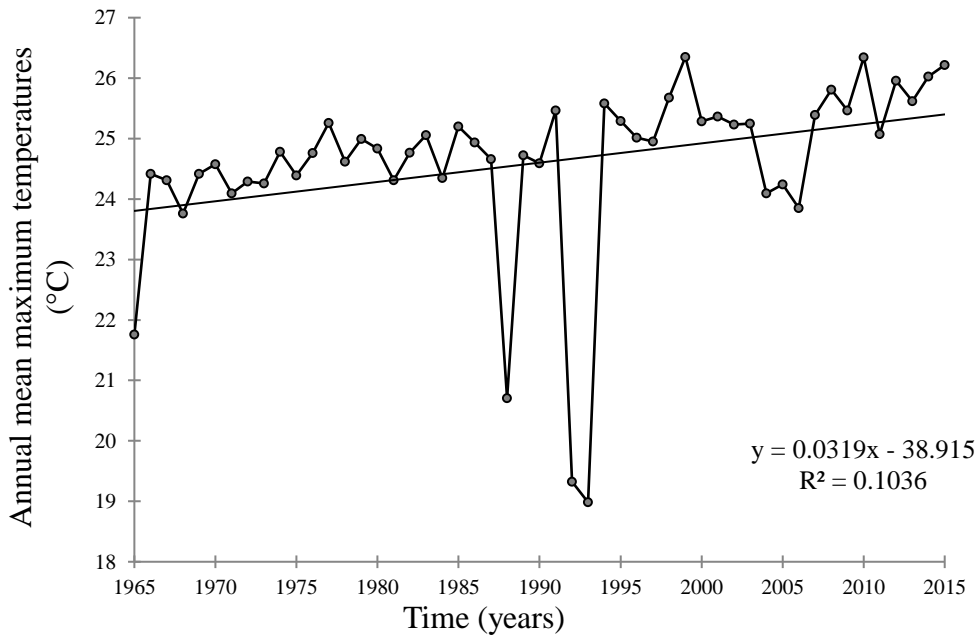


Figure 4.2.1.2: Annual mean maximum temperature time series for the 1965-2015 period

#### 4.2.2 Trends in annual rainfall amount

The time series trend for annual rainfall is presented in figure 4.2.2.1 below. Annual rainfall amount ranged from a minimum of 312.3 mm recorded in 1992 to a maximum of 1571.4 mm recorded in 1988, averaging 925.42 mm between 1965 and 2015. The MK Statistic  $S = -117$  and Sen's slope estimate  $Q = -$

2.54, both indicating a decreasing trend. In addition,  $p=0.34$ ,  $p>0.05$  indicating that the decreasing trend is not statistically significant (Table 4.2.1.1). The annual rainfall amount has been reduced by 126.5 mm during the 50-year data record, which represents 13.67 % of the long-term mean rainfall amount.

On fitting the linear trend line, a decreasing trend was also observed. The slope of the trend line indicates a small rate of change of -2.88 mm per year (Figure 4.2.2.1). The analysis reveals inter-annual variability in rainfall amount represented by simple gradual and abrupt changes and a low coefficient of determination ( $R^2$ ) of 0.02. This is supported by Flatø *et al.* (2017), who assert that studies conducted in South Africa have revealed increased rainfall fluctuations since 1960. The MK test, Sen's slope estimate test and the linear trend line results are consistent with one another in the detection of the trend even though it was not significant. An insignificant decreasing rainfall trend in South Africa has been reported previously by Gyamfi *et al.* (2016). Furthermore, evidence of significant long term trends in annual rainfall amount in South Africa are rarely reported (Gyamfi *et al.*, 2016). Analysis of meteorological data supports the growing evidence that temperature is continuously increasing while rain becomes unpredictable (Amadou *et al.* 2015).

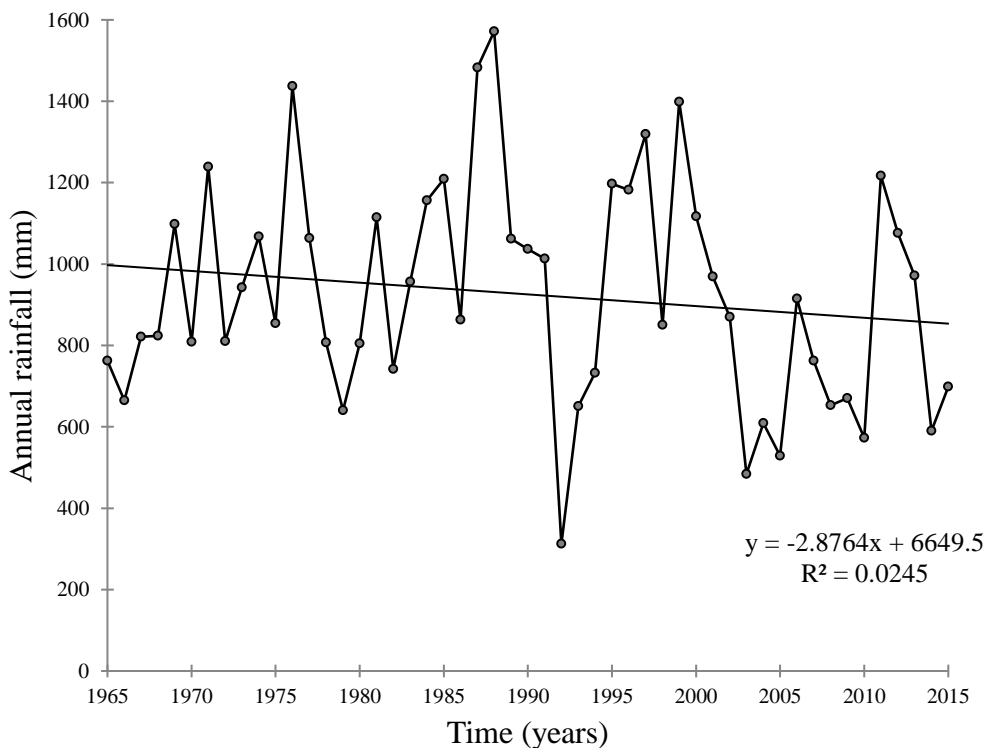


Figure 4.2.2.1: Annual rainfall time series for the 1965-2015 period

### 4.3 Future climate projections (temperature and rainfall amount)

The 10 ‘spaghetti’ style lines (grey in colour) in figure 4.3.1 to 4.3.3 represent simulations of future climate. Model projections anomalies are represented in blue and red bars. The anomalies represent changes from the average monthly rainfall in the historical period (1979 to 2000) to the selected future period (2015 to 2035). Figure 4.3.1 and 4.3.2 show systematic warming for both mean minimum and maximum temperatures throughout the year across all models. The highest increase for both mean minimum and maximum temperatures is for the month of October with one model showing roughly 1.6°C increase (mean minimum temperature) and approximately 1.5°C (mean maximum temperature) for the other. The lowest increase for both mean minimum and maximum temperatures is for the month of June with a model showing an increase of 0.1°C for mean minimum temperatures and an increase of 0.2°C for mean maximum temperatures which is slightly more than the increase for mean minimum temperatures (figure 4.3.2). The study results are consistent with CSAG projections for South Africa under the RCP 4.5 that indicate that minimum and maximum temperatures will increase for all seasons by 1 to 2°C, inland and by less than 1°C, in the coastal areas by 2015–2035 (DEA, 2013).

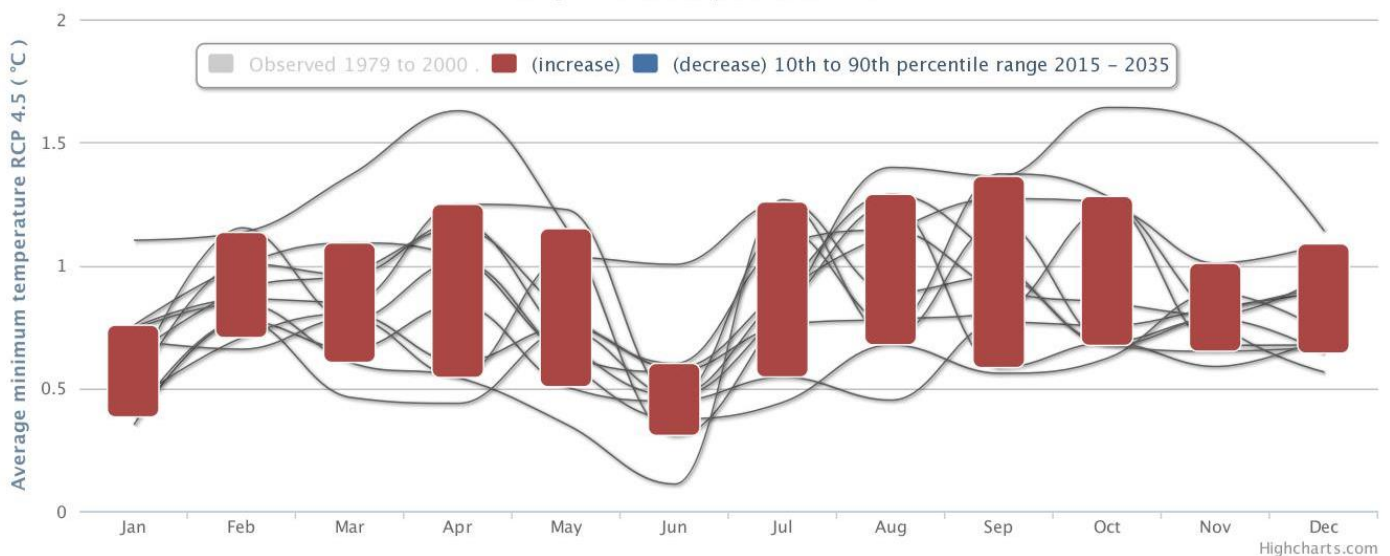


Figure 4.3.1: The range of mean minimum temperature projections for January-December (2015-2035) under RCP4.5 pathway (Source: <http://cip.csag.uct.ac.za/webclient2/datasets/africa-merged-cmip5/>)

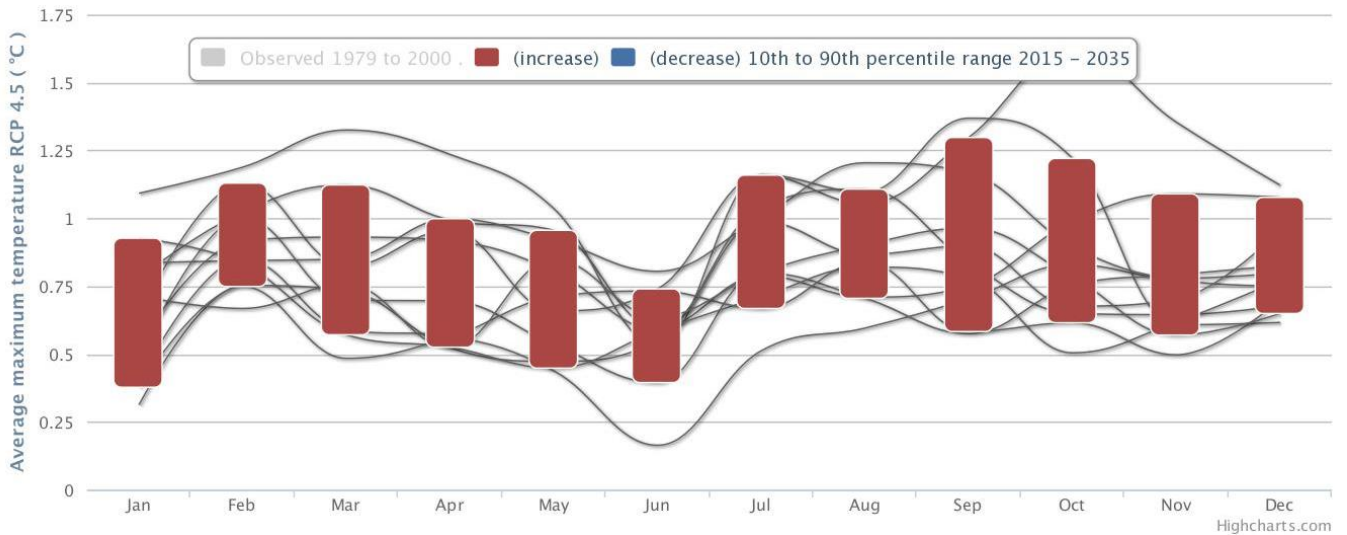


Figure 4.3.2: The range of mean maximum temperature projections for January-December (2015-2035) under RCP4.5 pathway (Source: <http://cip.csag.uct.ac.za/webclient2/datasets/africa-merged-cmip5/>)

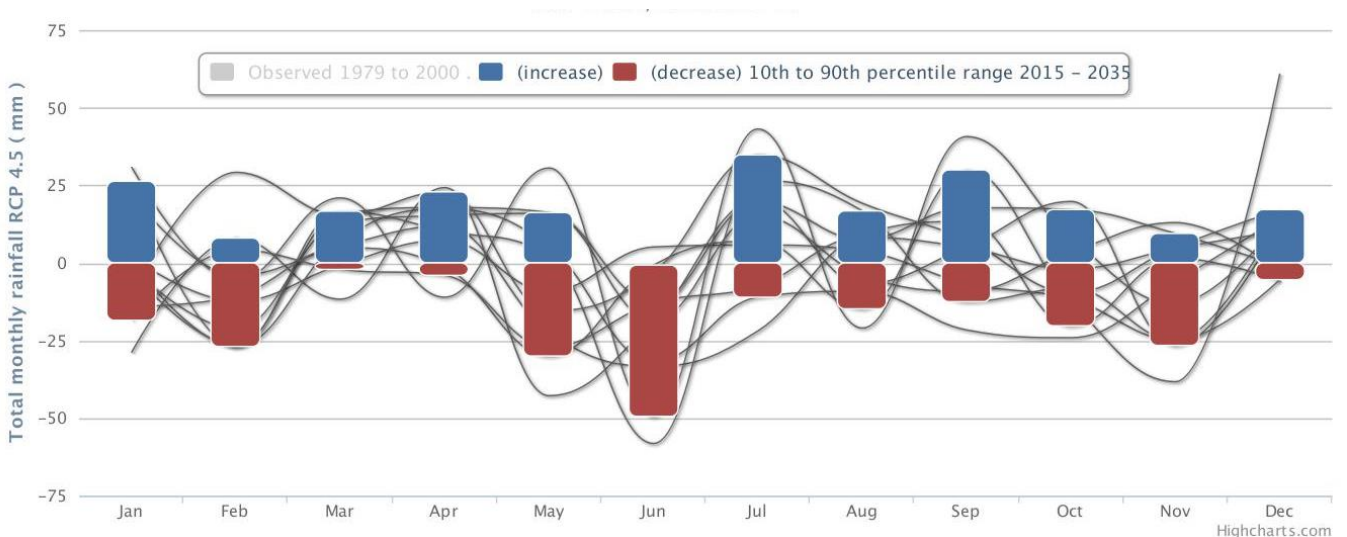


Figure 4.3.3: The range of total monthly rainfall projections for January-December (2015-2035) under RCP 4.5 pathway (Source: <http://cip.csag.uct.ac.za/webclient2/datasets/africa-merged-cmip5/>)

All climate models detect shifts in historical rainfall patterns (figure 4.3.3). However, they do not agree on the direction of change hence it is not clear whether annual rainfall will increase or decrease. A number of projections suggest South Africa will be dryer by 2050 (Flatø *et al.*, 2017; Kruger and Shongwe, 2004). For the month of June most models show a reduction in rainfall, with one model showing the highest decrease of 55mm (figure 4.3.3). Again most models show an increase in rainfall for the month of April, with one model showing an increase of approximately 23mm. For the month of August it appears there will be no change in rainfall amount. For the month of July most models show an increase in rainfall. This was expected as rain increases just before the August planting season. For the month of November models indicate decreasing rainfall yet during that month peak summer rainfall is

expected, instead summer rainfall appears to have moved to January. Projected changes in rainfall vary across the country (Karmalkar *et al.*, 2015). In general there appears to be systematic wetting in the region (old Durban International Airport). The observed wetting is consistent with projected global increase in rainfall and contrary to the projected drying expected in South Africa. A long term climate trend is difficult to discern from the figures provided, but generally it projected to get warmer in all seasons and wetter in winter. The projected warming trend will affect agriculture, water and firewood supplies. Such information is important for women irrespective of marital status.

#### 4.4 Women’s perceptions of climate change (based on temperature and rainfall)

According to Deressa (2010) climate change adaptation is a two stage process. The first stage is climate change perception and the second is adaptation which is dependent on whether a person perceived climatic changes or not. Perceptions are considered to be among the factors that influence successful adaptation strategies (Teschahunegn *et al.*, 2016). This study assessed women’s perception of climate change and associated impacts (chapter five). During a FGD perceptions were sought by means of matrix scoring their experiences of long-term changes in temperature and rainfall. Both variables (temperature and rainfall) could be perceived as increased, decreased, seasonal changes observed or no changes. Women’s perceptions were assessed using a marital lens. The researcher postulated that, marital status would influence climate change perception among women. Table 4.4.1.1 below depicts women’s experience of climatic changes in the past 30 to 50 years.

##### 4.4.1 Past climate change perception

Table 4.4.1.1: Matrix scoring for past climate change perception among women in Ndwedwe-Cibane (n=6 single and n=11 married women)

Perception of past climate	Score			
	Single		Married	
	Temperature	Rainfall	Temperature	Rainfall
Increase	11111	1	11111111111	11111
Decrease	1	11111		11111
Seasonal changes				
No change				

All participants perceived changes in climate variables in the first FGD (table 4.4.1.1). Disaggregation of perceptions by marital status revealed that the majority of single women observed a long-term increase in temperature and a decrease in rainfall amount. Of the married women, the majority also perceived an increasing temperature trend and contrary to single women an increasing rainfall trend. To confirm claims of decreased rainfall a single women shared that, “*rain has decreased and may not be around in the coming years*”. In support of increased rainfall a married women reiterated that “*there is rain however it timing has changed and arrives unexpectedly and is heavy rainfall. In the past rain used to come in August and now it does not*”. Another married women noted that, “*It is March, we are approaching winter yet we get water from the river*”, she further added that, “*at the moment water is not scarce because it rains and we have jojo tanks outside that store rain water*”. Conversely, in support of decreased rainfall a married woman shared that “*There is no rain, small compared to when we were growing up*”. Evidence of decreased rainfall according to the woman was the low water level in the river.

Women identified August as the period for onset of rainfall in the study area. In addition they shared that there is a change in timing of rains and expanded that they were approaching winter yet it was still raining, the river water level was fair and jojo tanks were full and that this was not normal. Therefore, rainfall was less predictable and deviates from the previously known pattern. Women’s perception of temperature change did not seem to vary with marital status. This is probably because they play the same if not similar roles and responsibilities within their homesteads and community and this in turn affects their perception. However, rainfall perception varied. Based on the Lorenzoni and Langford (2001) set of typologies on climate change perception, the majority of women are in the study area are ‘engaged’.

Women’s long-term perceptions of temperature and rainfall change in Ndwedwe-Cibane were compared to local meteorological data. Previous studies have recognized consistency between local’s perceptions and meteorological data (Savo *et al.*, 2016). Single and married women demonstrated high perception when past temperature (figure 4.2.1.1 and 4.2.1.2) data were compared to their perception since both indicated increasing temperature trends. Women’s temperature perception is comparable with the worldview on climate change. Therefore women in Ndwedwe-Cibane are aware of climate change. The Chief conformed to women’s perception and relayed that “*too much sun, rain we do not know it anymore. Drought has been a problem*”.

Contrary to high temperature perception, single and married women demonstrated low perception when past rainfall data were compared to their perception. Single and married women’s rainfall perceptions are not only divergent from each other as established but also from rainfall data. Women either indicated that rainfall has decreased (mainly single women) or increased (mainly married women) while data



reveals no significant rainfall trend but showed high inter-annual variability (figure 4.2.2.1). With reference to perceived decreasing rainfall, the difference between women's perceptions and rainfall data may be due to a stronger influence of recent droughts (reduced rainfall amount) for example the 2015 and 2016 droughts rather than long term patterns. This has been a major factor in previous studies by Van *et al.* (2015) and Zampaligré *et al.* (2014). Thomas *et al.* (2007), assert that perceptions are in part based on past observation, however it has been noted that people place greater emphasis on recent climate events to inform their perceptions as opposed to long-term climate changes. In addition, increased evapotranspiration and demand on available water as a result of increasing temperature may also explain women's perceived decreasing rainfall (Hitayezu, 2015). Inaccurate perception of increasing rainfall by mostly married women may be explained by the availability of water even if though it has not rained (Niles and Mueller, 2016). Van *et al.* (2015) found that in Vietnam, perceived increasing rainfall is attributed to high reliance on irrigation, which lowers farmers' risk perception associated with reduction in rainfall amount.

To elaborate, Savo *et al.* (2016) have suggested that a number of factors contribute to the discrepancy between local's perception of rainfall and meteorological data. Firstly, it is the potential mismatch in time scale of comparison. While meteorological data could be for a period of 50 years, people's perceptions which should also represent 50 years may in fact represent a shorter or longer time frame. Secondly, it is the potential mismatch in the spatial scale and resolution of the rainfall data. People's perceptions are based on local observations while rainfall data maybe based on broader patterns of change. Thirdly, changes in other factors other than rainfall could contribute to the perceived decreasing rainfall. For example changes in rainfall timing through late onset rather than on the amount of annual rainfall can affect crops in ways similar to decreasing rainfall (Amadou *et al.* 2015; Savo *et al.*, 2016). Assoumana *et al.* (2016) observed discrepancies between perceptions and meteorological data and attributed them to limited human capacity to record climate trends over long time periods and the influence of the media. According to Deressa *et al.* (2009), climate change perception may not be based on actual climate conditions but may be determined by environmental and socio-economic factors such as age, caste, social capital and agro-ecological setting among other factors. Discrepancies between women's perceptions and meteorological data have implications for readiness to adapt to climate change impacts (Mulenga and Wineman, 2014).

In the second FGD the woman who had perceived long-term temperature decrease, changed her view and shared that temperature had in fact increased. Additionally, the nuanced views on rainfall seen in the matrix scoring were not repeated. Women who had indicated that they had observed increasing rainfall over the past decades were quiet and were reluctant to express this view. Suddenly, everyone was in agreement that rainfall had decreased. Could this be the effect of group think? Mertz *et al.* (2009)

observed that in a group it is not easy to challenge established local and international narratives of decreasing rainfall. The results are also comparable with Ogalleh *et al.* (2012) study in East Africa, Laikipia County whereby farmers perceived increasing air temperature, declining rainfall amount and unpredictable rainfall pattern.

#### **4.4.2 Will the current climate trends persist?**

When asked if the observed trend would persist, the majority of single women indicated that the perceived trend would remain the same. Temperature would increase and rainfall would decrease. In the FGD a woman shared that *“rain falls hurriedly at the moment but will decrease in the future”*. Another woman said *“rain would decrease but the problem is inkanyamba that brings rain, the snake comes with rain, houses fall, it is outside of the water, water has dried up, so we should expect heavy rainfall until the snake finds a place since water bodies are dry”*. Of the married women a great majority noted an increasing trend in temperature, while the minority felt there would be no change in temperature in the future. With regards to rainfall changes women provided inconsistent accounts. An equal number of women indicated that rainfall would increase and decrease in the future. A woman who was of the view that rain would decrease shared that *“rain will decrease in the future because in the river we can now see big boulders which were submerged”*.

Overall both single and married women anticipate that the current trend would persist. Most of the women agree that temperature will increase and there are differences in views based on marital status with regards to predicted changes in rainfall. When asked about future climate changes, the Chief was hesitant to answer this question and found it challenging. At first he asserted, *“awukwazi ukuqamba ingane ingakazalwa”* (you cannot name a child before s/he is born). On second thought he shared *“five years ago there was a storm all the houses you see were rebuilt. We had drought but when the rain comes back we do not enjoy it. There was a time where people’s houses were fetched from the road. There was a dark cloud during the day, clouds with rain caused a storm people lost their lives. There are houses without parents because of the incident because the rain comes once hurriedly after a long drought”*. The Chief’s answer highlights climate variability and the unpredictability of the weather.

#### **4.5 Explanations for climate change**

In addition to experienced climate changes, one of the most important determinants of climate change adaptation is the perceived cause of climate change (Ato Armah *et al.*, 2017). The identification of climate change causes enables the researcher to understand women’s level of awareness which is very important since appropriate adaptation needs to be built based on that level (Lata and Nunn, 2012). Single and married women shared the same explanations during the FGD, they are listed below with

supporting quotes. However, some women did express uncertainty about how these climatic changes have come about.

Like many traditional societies in Africa, single and married women attribute climate changes to God as a form of punishment for disobedience of Gods' rules (Debela *et al.*, 2015).

- *“I am a bit confused but God is responsible for climate change”.*
- *“We plant crops when someone has died in the village, we are not supposed to do that until ukuwasha amageja (a ceremony termed ‘washing the hoe’) has been done. God doesn’t support this action of planting while someone is dead”.*
- *“Our sins we have sinned too much that is why it is hot”.*

In addition to God, *inkanyamba* (giant water snake) is also the cause of climate change according to women.

- *“Ikanyamba is responsible”.*

Women also cited the lack of observance of traditional practices as the cause of climate change.

- *“When there has been wind, we are supposed to mourn and not go to the fields but now we go and this leads to the observed climatic changes”.*
- *“We do not follow traditional practices like growing crops for iNkosazane (water goddess) and planting crops at the right time. In the past we used to start growing crops in July. Before planting we would go to a remote area with different seeds and plant them to attract the rain and sing. On the day we come back it would start raining. We are not supposed to plant crops until we have went to the wild and planted these crops”.*

Researchers reveal that people either explain climate change using a scientific or religious approach (Tesfahunegn *et al.*, 2016). The latter approach is applicable in this study. Attribution of climate change to God as a form of punishment for sins is echoed in several studies (for example in, Alemayehu and Bewket, 2017; Ato Armah *et al.* 2017; Debela *et al.*, 2015; Innocent *et al.* 2016; and Tesfahunegn *et al.*, 2016). Spiritual ceremonies (including praying to the water goddess) which are meant to induce rain are normal in southern Africa (Jiri, 2016). For example in Zimbabwe the ceremony is also practiced but called Mukwerera/Lwindi (Mubaya and Mafongoya, 2017). However practice of such ceremonies has declined with modernization and neglect of traditional practices. The Chiefs' account is consistent with women: *“women go to the mountain and ask for rain, praying to the water goddess. Since this practice*

is no longer followed the water Goddess will not bless them with rain”. What is unique in this study is the attribution of climate change to inkanyamba.

None of the women cited greenhouse gas emissions as the cause of climate change, yet emissions are generally regarded as the main cause of climate change globally (Codjoe *et al.*, 2014). Despite being aware of changes in climate variables, misunderstanding the causes of climate change among women is concerning and reveals their limited knowledge on climate change. This study affirms research conducted elsewhere that shows that rural women know little about climate change (Tunde, 2012). Perceived causes of climate change may inhibit adoption of adaptation strategies and uptake of actions to deal with impacts (Ato Armah *et al.*, 2017; Ohwo, 2015), thus increasing their vulnerability.

#### 4.6 Sources of climate change information

In this study it is assumed that regular access to climate information regardless of source improves climate change perception (Tesfahunegn *et al.*, 2016). In addition, access to climate related information positively contributes to adaptive capacity (Mulwa *et al.*, 2017; Ndaki, 2014).

Table 4.6.1: Information available on climate change (source, frequency and dissemination) (n=6 single and n=11 married women)

Source	Single		Married	
	Frequency	Dissemination	Frequency	Dissemination
Scientific publication	-	-	-	-
Community meetings	-	-	-	-
The internet	-	-	-	-
Print media	-	-	-	-
Extension officers	-	-	-	-
Radio	111111	Daily	11111111	Daily
Television (TV)		Daily	111	Daily

The FGD results showed that the majority of both single and married women access climate related information via radio broadcasts (table 4.6.1). This finding collaborated with Kutir *et al.* (2015) and Nabikolo *et al.* (2012) findings which revealed the radio as the main source of climate information. Additionally, some of the married women have access to television - TV sets. Most women preferred to receive information via radio broadcasts because they only have access to the radio and because they can be busy with other activities whilst listening to the radio unlike TV broadcasts where you have to sit and

watch and forgo other activities. In addition, there is limited ownership of TV sets. Furthermore, Ndwedwe-Cibane is not connected to the national electricity grid and thus lacks access to electricity. This might explain the low level of TV use. Only homesteads that have paid for private installations have access to electricity.

In Gambia research participants preferred radio as the main information source because it was the most accessible source of information, they completely had trust and confidence on the information because it was shared by experts and the language of communication was local and thus more farmers could understand (Kutir *et al.*, 2015). On the contrary, women in Bangladesh preferred TV sets as information sources because they had the impression that their understanding would improve due to visual and auditory presentation (Jost *et al.*, 2015). In the same study women in Uganda had preference for megaphones and gatherings as information sources because of limited access to radios (Jost *et al.*, 2015).

With reference to radio broadcasts a woman shared that *“the radio advised us to burn less because when we do, the smoke goes up and damages the atmosphere”*. Another woman said that *“the radio advised us not to cut trees, but rather to plant them because they bring water/rain”*. Upon further probing some of the single women revealed that they receive weather notifications on their cellphones. Similar results were found in Uganda by Jost *et al.* (2015), where farmers received weather notifications as a short text message - SMS. Anuga and Gordon (2016) reveal that general cellphone use is increasing in rural areas within Africa however access to weather information via the cellphone is limited and less noted. In addition, some single and married women shared that they can feel it in their bodies if conditions will be cold: they either get tired easily; have constricted and painful chest or a throbbing pain where they had a caesarean section. Jiri's (2016) study in Zimbabwe found similar results where participants shared that a painful operation is an indication of forthcoming cold weather and humid conditions.

Other sources of information such as print (newspaper, scientific publications), digital media (internet) and extension officers were non-applicable. Lack of reliance on print media as a source of information has previously been attributed to high illiteracy among women and/or lack of affordability to purchase copies due to 'high costs' (Mzimela, 2015). With regards to digital media, high cost of laptops and internet connection and the lack of technical know-how may be a barrier to their use (Mzimela, 2015). Women shared that they used to interact with the extension officer during her field visits but she no longer visits. For further verification of women's claim of abandonment, the officer was interviewed. She revealed that she no longer visits because there are no agricultural activities to attend to. She relayed *“What will I say to them since the situation is like this firstly, secondly they only need monitoring, they do not need an extension officer, they have been working for a long time unless they want to order seeds they know where to find me. I also assist with homestead gardens but I cannot find out which homestead*

*has a garden or not, eyomile iyaziyela emfuleni (if you seek assistance, find me). Usually the Chief's secretary contacts me when they need potatoes and I take it to them. They pay for most agricultural inputs but sometimes they get them for free*". From the officers' comment it is evident that she views her role as limited to monitoring crop production (these discussions will be taken up in section 7.2). Therefore, it seems like her job is seasonal if it is only limited to when crops are planted. Moreover there is a lack of integration between cropping, water use/conservation, climate change adaptation, building community resilience and poverty reduction. The data does not provide any evidence of significant differences in climate change information source for women based on marital status.

While most women perceived changes in climate conditions, none of them indicated any knowledge of climate change provided to the community other than by the SAWS on radio and TV broadcasts. When women were asked if there was any partnership between them and the SAWS or any climate change research organization, they revealed that there was no partnership. Trust in the information provided by SAWS is sometimes weak among the women. For example a woman reported that *"at times my knowledge coincides with SAWS predictions, and at times it does not"*. *"At times SAWS says it will rain and it does rain but at times they say it will not rain and it rains"*. Women still have reserved trust in traditional indicators of weather and climate. Climate change information, in the form of early warning systems is not available to the women in any form yet they are essential to improve preparedness and adaptive capacity.

DAEA extension officer was asked to share her source of climate change information: *"I depend on the media (radio and TV) for climate changes and share that with people and SMS, however they report what going to happen in a few days to come. Head office sends the SMS but they send them once in a while"*. The officer reiterated that by once in a while she refers to a long period of time. For example: *"I have been working for 20 years, there has been only one climate change workshop, five years ago"*. There seems to be lack of vertical (top-down/bottom-up) and horizontal (extension to farmers) integration of knowledge dissemination. A question that remains unanswered is just how seriously is the DAEA taking climate change impacts on peoples livelihoods?

When asked if the local traditional council has access to climate change and adaptation information, the Chiefs' response was as follows: *"yes, the council has knowledge. As the council if I remember correctly we were taught what we should do or not do based on the weather. We were taught by the DAEA. Only the traditional council was taught this once it never happened again but it was the previous traditional council, I was a member of. The new members do not have any knowledge. Members of the traditional council change every five years"*. Later on during the interview the Chief shared, *"If I am going to be honest, government/departments things are a problem. In fact rather than teaching us they were asking*

*for permission that one day they would come and we should get the villagers together. They still have not come, I do not think they are still coming. We do have that problem. People ask us to get the community together and they say they will come but never come”.*

There is in general no urgency to engage with the community on climate change risks in the Cibane traditional area. The traditional council responsibility includes supporting government but for this to happen they must form cooperative relations and partnerships with government (George and Binza, 2011). This is not happening because government departments have failed to build trust with the traditional council, as the Chief relayed that occurrences of not showing up are common. This study supports Mhlanga (2012) study which revealed that 99% of traditional leaders felt there was no proper communication and involvement between them and local government. Poor engagement by government departments and inability to keep promises deteriorates relations between the traditional council and government departments; creates an unstable operating environment; and reduces government visibility and reputation (B-Analytics, n.d.). Constant communication between stakeholders is important as it paves way to address an issue when it arises (B-Analytics, n.d.). The local government should develop a harmonious relationship with the traditional council to fast track service delivery (Mhlanga, 2012) and climate change adaptation. Loss of trust of the local government by traditional council leads to a somewhat unproductive relationship.

The role of government in terms of climate change adaptation and building resilience seems limited in the community yet the researcher through her position as a sustainability intern has been a part of a programme known as the Local Government Climate Change Support programme phase 3- LGCCSP 3 which aims to develop governments capacity to respond to climate change impacts in all sectors. This will facilitate the development of climate change adaptation strategies at all levels of government starting at the provincial level this year. Thereafter the local government is expected to engage with the community in the future to discuss and implement adaptation strategies.



Plate 4.6.1: Day one of FGDs (Source: author)

#### **4.7 Conclusion**

This chapter analyzed trends in annual mean minimum and maximum temperatures and annual rainfall amount in Ndwedwe-Cibane over a 50-year time period (1965-2015). The observed trends revealed climatic changes. The increasing annual mean minimum and maximum temperatures and decreasing non-significant trend in annual rainfall provide sufficient evidence of global warming. There was conformity in the results obtained from the MK test, Sen's slope estimator and the linear trend lines for both climate variables. Projections under RCP4.5 scenario reveal a possible warming and wetting trend over Durban for the next two decades with shifts in seasonal rainfall. However, the wetting signal across the model ensemble remains weak. These changes highlight the importance of mitigation and adaptation strategies. In addition the chapter aimed to establish association between women's marital status and climate change perception. Furthermore, the relationship between women's perception and meteorological data was established.

The majority of women regardless of marital status perceived changes in temperature and rainfall. Thus, women are aware of climate change. The changes perceived by the majority of women were similar with respective to temperature data and different when compared to rainfall data although they share the same climate. The researcher concludes, marital status plays a role in rainfall perception. By comparing women's perceptions and meteorological data, the researcher has been able to identify discrepancies and areas of agreement. Women's



perceptions were consistent with Chiefs' opinion. When asked if the observed trend would persist, the majority of single women indicated that the perceived trend would remain the same. Of the married women a great majority noted an increasing trend in temperature while the minority expected no changes. With regards to rainfall changes women provided inconsistent accounts, some indicated that rainfall would increase while others believed it would decrease in the future.

Women shared diverse interpretations to make sense of climate change, they were either spiritual or based on traditional customs as previously reported in literature. New was the attribution of climate changes to inkanyamba. Women's knowledge of climate change has been largely derived through mass media (radio and TV). What was initially thought to be unique in this study is the ability of some women to forecast climatic conditions through the way they feel, as it turns out such views have been shared in Zimbabwe. Women's perceptions point to the need to disseminate climate change information in culturally appropriate way to enhance adaptive capacity. The following chapter details vulnerability and climate change impacts.

## **CHAPTER 5: WOMEN'S VULNERABILITY AND CLIMATE CHANGE IMPACTS ON FEW RESOURCES**

### **5.1 Introduction**

This chapter explores the components of the SLF within Ndwedwe-Cibane starting with livelihood resources which were identified through resource and hazard mapping. Livelihood strategies were also identified and listed. FEW resources vulnerabilities to climate change impacts were assessed and are represented by resource and hazard maps and the vulnerability matrix. Transforming structures and processes were also identified and are represented in the form of venn diagrams. In addition, during the FGD women gave insight into agricultural production (crops and livestock), firewood and water supply. The impacts of climate change on FEW resources are also discussed aided by trend diagrams.

### **5.2 Vulnerability of women's FEW resources**

#### **5.2.1 Resource and hazard mapping and resource listing**

This section presents the outcomes of the resource and hazard mapping and resource listing exercise. Resource and hazard maps were drawn by both single (plate 5.2.1.2) and married women (plate 5.2.1.3) during the FGD, and are important because on the one hand resources essential for livelihoods were identified and their location established and on the other hand vulnerability to climatic changes was established. Resource and hazard mapping was also useful for completing the vulnerability matrix (Cross *et al.*, 2006). Resources under the five capital categories which influence livelihood strategies adopted by women were identified through the use of the SLF (table 5.2.1.1).

Resource and hazard mapping and resource listing identified the river water, land including the mountain, forests and livestock as the main natural resources essential for livelihoods as seen in column one (table 5.2.1.1). A perennial river known as *Ichameni* flows through the mountain. All water is collected from this river but at different locations, for example at the top and/or bottom of the mountain. The mountain is also known as *Ichameni* mountain, it encompasses a forest, which provides firewood and pasture for livestock (Plate 5.2.1.1). When the researcher observed a fence around the mountain she enquired and was told that

livestock are herded there to graze and that gates are locked to restrict livestock mobility in order to prevent them from damaging crops because during the day children are at school and there is no one to herd them. There are also two major gardens, one close to the court, and the other close to the clinic. In addition most homesteads have small gardens close by for control purposes.

Women identified five physical resources as seen in the second column (table 5.2.1.1). These resources were homesteads, roads, educational, sporting, spiritual, administrative, social and health establishments (plate 5.2.1.2 and 5.2.1.3). From the maps it evident that homesteads are scattered but generally clustered next to the school, clinic and *Ichameni* mountain. Below the establishments are listed:

- Educational: Emakhasini Primary School, identifiable on the maps. Goza high school was not drawn by participants but is in the study area probably because it was built recently.
- Sporting: A football field with toilets
- Spiritual: Two church establishments
- Administrative: Tribal court
- Social amenities: A community hall, and two tuck shops
- Health: One clinic served the traditional area

Table 5.2.1.1: Women’s (both single and married) livelihood capitals

Natural resources	Physical resources	Human resources	Financial resources	Social resources
Water	Houses	Education	Savings group	Co-operatives
Land	Clinic	Sewing skills	Employment	ABET group
Forests	School	Cooking skills	Sewing	Women’s' baking groups
Livestock	Roads	Farming skills	Zulu beadwork	Women's sewing groups
	Livestock	Bead making sills	Social grants	
	Football field	Weaving (mats)	Petty trading	
	Church	Caring for the family		
	Court	Child rearing		
	Hall	Trading skills		

Women identified several human resources as listed in column three (table 5.2.1.1). As mentioned before human resources are essential to exploit the other four capital categories

(DFID, 1999). Financial resources were also identified as seen in column four. It was established that women's financial status is dependent on several income avenues including social grants. Literature reveals that rural households rely on social grants as a source of income, yet social grants are unsustainable but do provide invaluable relief during 'shocks and stresses' (Pereira *et al.*, 2014). Surprisingly married women did not mention remittances from husbands as an income source yet several studies have highlighted the importance of remittances in South African households (see Biyase 2012). Upon probing a married woman shared that she gets remittances from her husband but not regularly and that the value at times is negligible compared to household expenditures. In support of women's sentiments, Le Goff and Salomone (2015) revealed that male migrants remit less frequently and remit a lower amount in comparison to female migrants. In Angola wives are remitted by their husbands however the male heads (for example, husband brother) decide how the money should be used, as a consequence some women have reported no change in their financial position (Lopez-Ekra *et al.*, 2011). Literature also reveals that men usually remit for investment purposes and not direct consumption this may also be the reason why women did not mention remittances as a source of income (Lubambu, 2014). What becomes apparent is that remittances are not the only or prime source of income for married women.

Social resources are demonstrated in four ways. Firstly, women were mobilized by the extension officer to form co-operatives. Secondly, women formed Adult Basic Education and Training - ABET groups. Thirdly, women organized themselves into baking and fourthly sewing groups. It appeared that there was a breakdown of social capital since farming co-operatives were no longer functional and ABET classes had ceased. Breakdown of social capital in eastern Botswana has contributed to reduced household resilience when exposed to shocks (Motsholapheko *et al.*, 2011). This highlights the importance of social capital as a resource to deal with climate change and associated impacts.



Plate 5.2.1.1: *Ichameni* mountain and forest (Source: author)

All resources identified are used as either inputs or services by women. According to Nelson *et al.* (2010:20) “balance between the five capitals is also important, because minimum levels of one capital may be necessary to effectively make use of another”. Concerning climate hazards both single and married women identified strong winds as the cause of major damage in the area. Strong wind exposure is a problem mainly in the area surrounding the hall and school. All other climate variables affect all areas the same way. Single women’s resource and hazard map corroborated with married women’s map. Therefore, there is no difference in situated knowledge between both groups of women probably because of gendered roles and responsibilities that do not change regardless of marital status as long as you are a woman.



Plate 5.2.1.2: Resource and hazard map by single women (Source: author)



Plate 5.2.1.3: Resource and hazard map by married women (Source: author)

### 5.2.2. Women's ownership, control and access to natural resources

Women's ownership, control and access to natural resources is particularly important in this study since the focus is on agriculture, water and energy supplies. Livestock is the only resource women can own (figure 5.2.2.1). Single women reported owning chickens, goats, and sheep while married women in addition to chickens, goats and sheep owned cattle. In general ownership of cattle is seen as an indicator of wealth and high social status in traditional societies (Nyakurimwa, 2011). Concerning forests there are no arrangements that exclude access of either single or married women to forest resources. If a forest is by the *Ichameni* mountain women have access and control over its resources as village members however if it falls under a particular family's authority, limited access may be granted after receiving permission from the family but there is no control over it. Women considered forests vital for mainly water, firewood supply and building materials. With reference to water women have access and control over water resources but no ownership.

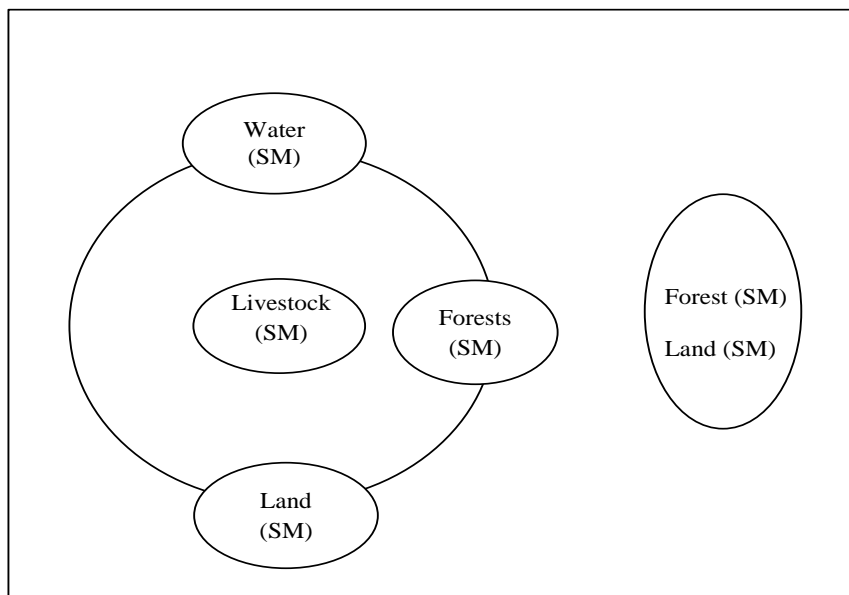


Figure 5.2.2.1: Women's ownership, control and access to natural resources (Source: author)

*Note:* Women have ownership over resources in the circle. On the borderline, women can access and control these resources, and outside the circle women have no control, but access to these resources.

*Note:* SM= Single and married women



With regards to land its value to women stems from its ability to be exploited to meet subsistence needs, and for accessing other resources and services (De Schutter, 2013). Hence, the importance of addressing issues of ownership, control and access to land when studying women and agricultural production (De Schutter, 2013). Women have access to land and control over that land if it is allocated to them by their husbands or directly by the traditional council/authority (inclusive of the Chief and headmen). In line with Cross and Friedman (1997) but contrary to Wanyeki (2003) as cited by Jacobs (2014) women in Ndwedwe-Cibane land issues are attended to through customary tenure and traditional authorities.

Women may also have access to additional land that is allocated to another family provided permission is granted by that particular family, but have no control over that land. Land is not owned by either men or women living in the traditional area, it is owned by Chief Cibane according to women. However, the researcher understands that land is state owned and that the Chief administers the land. So what is the role of the Ingonyama Trust Board? According to the Chief it “*protects/looks after the land. It is a board we set up as our treasurer*”. Jacobs (2014) confirms that land is under the Chief’s authority and often held under customary tenure however on behalf of a clan group, in this study the Cibane clan.

Smith (2012:83) asserts that “*one of the foundational building blocks of the tribal system is the lack of ownership rights for individuals; the land is allocated with the permission to occupy (PTO) to a household, this includes an area to build a homestead and arable land. Once the land is, either, abandoned or else not used for a period of three years or longer it becomes available to be reallocated by the Inkosi (traditional leader) to a new member of the community*”. The Chief confirmed Smith’s view. Usually land is obtained after paying R300 for the PTO and after providing meat and alcohol beverages to the villagers. When residents permanently leave the area, they are expected to pay R1000 because they have excavated the land and built. In Ndwedwe-Cibane there is only one case where land was bought by the Roman Catholic Church. That land is therefore owned by the church and the Chief has no control over it even though it has been abandoned for more than three years. The Chief asserts that, “*To own land, you get a different receipt and not a PTO. It happens but is not common. When it happens the Chief no longer has a say over that land*”.

Single and married women have equal rights to land access and control. This is not the norm in other regions within Africa. Even within South Africa land allocation to unmarried women in rural areas is discouraged (Flatø *et al.*, 2017; Shackleton *et al.*, 2014). Unmarried women are either not allocated land or are allocated to a smaller land area compared to male counterparts (Shackleton *et al.*, 2014). The Chief shared that unmarried women and men are discouraged from accessing land because such arrangements are believed to lead to social ills. But when they are given land, there are terms and conditions to abide to. The Chief commented: “*We look at the persons background, situation, for example family, number of children, if you come from another area we expect a recommendation letter from previous councillor/headmen to understand your character to avoid allowing people with difficult backgrounds who will give us problems in the future*”. No significant ownership, control and access distinction to natural resources were found between single and married women. Access to natural resources is granted to all villagers subject to the communal land tenure system.

### **5.3 Food, energy and water resources identified**

Identification of food, energy and water resources provides the necessary context for identifying climate change impacts and adaptation strategies. The results presented in table 5.3.1 below show the main food sources, which are agricultural produce and purchased food. Both single and married women reported agricultural produce as a food source. However, more single women than married depend mainly on agricultural production. This study supports Tibesigwa and Visser (2015) assertion that in female-headed rural household’s agriculture contributes more to food security when compared to male-headed households. Women are mainly responsible for agricultural production in the study area however males assist with some agricultural tasks. Small vegetable gardens and field crops are grown by both single and married women mainly for household consumption, in some cases for gift giving but not income generation. The findings authenticate Sharaunga *et al.* (2015) assertion that subsistence agriculture’s contribution to household income is low in South Africa. Contrary to vegetable gardens and field crops, livestock are kept by both groups of women for income generation and occasional household consumption. Livestock are not consumed daily but on special occasions. For example, during a traditional ceremony or when a family member is visiting. Similarly, Laube *et al.* (2012) assert that livestock acts as currency in social and cultural practices such as funerals and marriages.

Mehar *et al.* (2016) add that livestock provides manure to improve soil fertility, is a source of power for farming and can be sold in times of need and is therefore considered a form of insurance (Mehar *et al.*, 2016).

Table 5.3.1: Main food sources in Ndwedwe-Cibane (n=7 single and n=13 married women)

Food source	Scores	
	Single	Married
Agricultural production	1111	1
Purchased foods	111	111111111111

Common crops grown in the area include maize, cocoyam, beans, potatoes, sweet potatoes, pumpkins, and nuts. Crops are only available in certain seasons and in small quantities since women have reduced their agricultural fields and now grow crops closer their homesteads. The only time they grew crops further away from their homesteads was when they were a part of functional co-operatives. These were formed with assistance from an extension officer and the Chief who allocated land to them, thereby increasing their access to land and decision making pertaining to the land. This kind of arrangement improved household food security since the yield was large and split among members. A married woman shared that she did not buy vegetables because she got it from the group and wished the group was functional. Co-operatives are no longer functional due to the absence of the extension officer and lack of encouragement. A woman shared that lack of encouragement stems from “*no fencing and we do not have money to fix it, cows destroy our crops, and extension officer ran away, there is no water*”. The Chief shared the same sentiments: “*There are no co-operatives anymore. They used to encourage women to work together*”.

Both single and married women reported purchasing food. Purchased food is the central food source for most women while agricultural production plays a supplementary function reinforcing de-agrarianization (Pereira *et al.*, 2014). This is not new, it has been reported previously by Pereira *et al.* (2014). Food self-sufficiency by agricultural production reduces vulnerabilities arising from the over-dependency on retail provision given the uncertainties arising from

increasing food prices, climate change impacts and high unemployment rate which translates into the inability to derive an income with which to purchase food.

In addition to agricultural production and purchased food, some women mentioned that they receive food aid when an election is coming up and perceive this as a bribe to vote for a particular party. Women relayed: “*they bring us vouchers, but only a selected few get these vouchers. They are not consistent, usually once a month but they come especially if there is an election. They use food to attract us to political organizations and it works*”. Women confirmed that food aid was unreliable since it was distributed usually once a year and only a selected few received it. According to Tibesigwa and Visser (2016) in South Africa’s rural areas agricultural production forms a bigger proportion of household food among female-headed households in relation to male-headed households. This study confirms Tibesigwa and Visser (2016) assertion since almost all married women cited purchased food as the main food source. Each homestead needs to diversify methods to access food to build resilience against shocks (Pereira *et al.*, 2014).

Table 5.3.2: Main energy sources in Ndwedwe-Cibane (n=7 single and n=13 married women)

Fuel source	Scores	
	Single	Married
Firewood	1111111	11111111111111

Table 5.3.2 above shows that the main energy source for both single and married women in Ndwedwe-Cibane is firewood. This was expected since firewood rivals other sources of energy in developing countries particularly in rural areas (Specht *et al.*, 2015). Firewood is used for cooking and heating. Mainly women and girls are responsible for firewood collection and storage in Ndwedwe-Cibane. This finding resonates with Meyiwa *et al.* (2014) who assert that a greater proportion of women than men are involved in fuel collection. Women reported that previously there was a man who would collect and sell them firewood for R100 or R150 and that he does not collect firewood anymore due to illness. Generally firewood is gathered from *Ichameni* forest or deadwood from non-forest sources. When asked how long it takes daily to collect firewood and how many times per month firewood is collected. Women shared that:

- *“It takes me four hours to gather firewood, once a day, twice a month”.*
- *“I go three times a month, we also rotate. It takes me four hours. You rest along the way home”.*
- *“It takes me five hours. We rotate firewood collection, I go once a month, you come back very tired”.*

Women shared that sometimes they come back with scars that turn into sores after gathering firewood. It is clear from the above accounts that firewood collection is not only time consuming but also hard labour with safety issues as previously mentioned in literature.

A few homesteads have access to electricity but still rely on firewood for cooking and heating while electricity is used for lighting. Similarly, Hunter *et al.* (2014) report that rural homesteads with electricity connection in the South African context still heavily rely on firewood as the main source of energy because of the high cost of electricity and electrical appliances. A women’s account: *“We heavily depend on firewood and candles for fuel and lighting. Most of us do not have electricity, only a selected few who have paid for it. Government has not provided all of us with electricity”.* The minority with access to electricity in the study area fall under the 12.5% of homesteads in ward 16 with electricity (Stats S.A, 2012).

The researcher observed that while the hosting homestead had access to electricity, firewood was used for cooking. The male head was adamant that he would never buy an electric stove because electricity was only for lighting and not cooking. He reiterated that the wife must gather firewood and make a fire for food preparation. It appears that other factors other than cost influence electricity usage in homesteads with access to electricity. When women were questioned as to whether there was a difference between single and married women with respective to electricity access the majority felt there was no difference. A single woman noted that there is no difference because she had electricity but did not have a husband. She further shared that it depends on affordability, you may have a husband but he may not be able to pay for it.

Besides firewood women shared that they use paraffin and gas stoves for cooking. Furthermore, single women shared that at times they cannot afford to purchase gas since it costs R600 to fill it

up. “Many studies are predicated on the energy ladder hypothesis which states that demand for fuel- wood, an inferior good, decreases as income increases, while that for gas and liquid fuels rises with income” (Jagger and Shively, 2014:4). Taking women’s accounts into consideration this study validates the hypothesis. Additionally, some of the single women reported that when firewood is scarce they burn cool drink bottles. The researcher observed one of them collect the bottles after a FGD for the above mentioned purpose.

Table 5.3.3: Main water resources in Ndwedwe-Cibane (n=7 single and n=13 married women)

Water source	Scores	
	Single	Married
River water	1111	111111111
Harvested water	111	1111

The main water source as identified by both single and married women is river water followed by harvested rain water stored in tanks. Homesteads with tanks use both the harvested and the river water. Beyond the dominant water sources participants on rare occasions have water delivered to them by a truck. The main uses of water include cooking, washing, bathing, drinking and agricultural production. Women and girls are mainly responsible for water collection and storage in Ndwedwe-Cibane as anticipated by researcher due to gender based roles and responsibilities. There is no difference in the way women gather water, they all use buckets and bottles to carry and store water. The river is relatively far from most homesteads. A single woman relayed: *“time spent gathering water from the river depends on one’s speed and the relief”*. If you are fast it takes approximately an hour but if you are slow it takes about two hours and on average women collect water three times a day.

The researcher observed that generally women did not purify river water. In the hosting homestead not once was the water purified either for cooking, drinking or bathing. During the FGD women admitted to not cleaning water obtained from the river. According to the World Health Organization/United Nations International Children’s Emergency Fund - WHO/UNICEF just above one billion people drink unsafe water (Misra, 2014). It is evident that Ndwedwe-Cibane inhabitants constitute this one billion. A single woman who works as a local health care

worker noted that she cleans her water either using Jik bleach or alum. She voiced that they teach people ways to clean water but they do not follow them. Some women claimed that they do purify harvested rainwater stored in jojo tanks. Women shared that they clean along the water course by removing grass, weeds and trees especially when winter is approaching. Moreover, they also remove dirt in the water. In addition, a fence is erected along the water course in winter since cattle are let loose without supervision and get into the water (plate 5.3.3.1). Women noted that cattle compete with them for water. “*We do not compete for water as humans we compete with livestock such as cattle*” (a women’s account). In addition women are afraid to go to the river because sometimes there are snakes.



Plate 5.3.3.1: *Ichameni* river with fence (Source: author)

#### **5.4 The vulnerability context**

A vulnerability matrix for Ndwedwe-Cibane was prepared (table 5.4.1). Both groups of women identified increasing temperature, decreasing rainfall, storms, strong winds and tremors as indicators of climate change. Prioritized resources were crops, livestock, firewood, and water. Each stress/shock was scored against all resources with significant impacts on the resources. Based on the table below, the most harmful stresses/shocks as identified by single women were

increasing temperature and decreasing rainfall while married women identified storms followed by tremors as harmful conditions.

Taking into account the scoring, the results show that all perceived stresses/shocks by single and married women have negative impacts on crop farming and water supply. With regards to livestock single women revealed that some of the stresses/shocks have high while others have medium negative impacts whereas strong winds have no impact on livestock. According to married women all stresses/shocks have negative impacts on livestock. According to single women all stresses/shocks have positive impacts on firewood supply either because they cause wood to dry (increasing temperature and decreasing rainfall) or lead to the falling of wood from trees (storms, strong winds and tremors). With reference to firewood, married women shared the similar sentiments but in addition they noted that decreasing rainfall, storms and tremors have high negative impacts on firewood supply. The vulnerability matrix indicated that single and married women are most vulnerable to changes in water supply and least vulnerable to changes in firewood supply. In section 5.7, a further exploration of climate change impacts is presented and discussed.



Table 5.4.1: Vulnerability matrix

Resources	Single					Married				
	Stresses and Shocks					Stresses and Shocks				
	Increasing temperature	Decreasing rainfall	Storms	Strong winds	Tremor	Increasing temperature	Decreasing rainfall	Storms	Strong winds	Tremor
Agriculture:										
Crop farming	3	3	3	3	3	3	2	3	3	3
Livestock	3	3	2	0	2	3	2	3	3	2
Forests:										
Firewood	x	x	x	x	x	x	3	3	x	3
Water	3	3	3	3	3	3	3	3	3	3
Total score & rank	9 (1)	9 (1)	8 (2)	6 (3)	8 (2)	9 (4)	10 (3)	12 (1)	9 (4)	11 (2)

Scores:

3= high negative impact

2= medium negative impact

1= small negative impact

0= no impact

X=positive impact

Exposure, sensitivity, and adaptive capacity influence the vulnerability of rural women's livelihoods. Women's livelihoods in Ndwedwe-Cibane are exposed to increasing temperature, decreasing rainfall and to a less extent storms, strong winds and tremors. The assessment of exposure focused on air temperature and rainfall trends. Over a 50 year period (from 1965 to 2015), there has been an increase in annual mean minimum and maximum temperatures by 0.02 and 0.03°C, respectively each year (figure 4.2.1.1 and 4.2.1.2) and a non-significant decrease of 126.5 mm of annual rainfall for the 50 year period (figure 4.2.2.1). The change in climate variables is perceived to be worsening the climate state. Single and married women's exposure to the above-mentioned climate conditions is comparable. Assessment of exposure is important because it influences vulnerability and adaptive capacity (Badjeck *et al.*, 2010). Projections as discussed under section 4.3 indicate future warming, wetting and change in the rainy season.

Sensitivity of both groups of women is comparable and due to their high dependence on agriculture for food, firewood for energy and the river for water supply due to limited development, and because of the roles ascribed to them at homestead and village level. FEW resources are sensitive to almost all the above-mentioned indicators of climate change as perceived by women. Section 5.7 elaborates on how single and married women's FEW resources are affected by changes in temperature and rainfall. Adaptive capacity is revealed in sections 5.2 and 5.3, and demonstrated in chapter 6, section 6.2. Homesteads with a greater diversity of assets and activities are likely to have greater adaptive capacity because of a greater capacity to substitute between alternative livelihood strategies in times of stress and shocks.

Marital status influences vulnerability to climate change related hazards, in particular vulnerability is increased for unmarried household heads than married household heads (Zhou *et al.*, 2016). Female headed households have been found to be vulnerable to climate variability, an element of climate change in the Eastern Cape and Limpopo province within South Africa (Flatø *et al.*, 2017). The exposure to climatic stresses and shocks may be the same for both groups of women in Ndwedwe-Cibane, however it is argued that intersectional based differences may influence adaptive capacity. These differences are explained by variations in asset pool and livelihood strategies. Flatø *et al.* (2017:42) insert below explains further:

*“The economic disadvantages of female headed households are coined as ‘triple burden’ for three main reasons. First, given that women have lower average earnings, fewer assets and less*

*access to productive resources such as land, financial capital, and technology than men, it follows that it is disadvantageous for a household to have a woman as the main earner. Second, lacking a male provider, female household heads are often the single earner and are consequently more likely to carry a higher dependency burden. Third, women who are heads of households with no other adult help have to carry a “double day burden” where they have to fulfill both domestic duties and the breadwinner role. Consequently, female heads face greater time and mobility constraints and may have to work fewer hours or choose lower-paying jobs”.*

The question of which group is more vulnerable than the other cannot be concluded. Women have different resources and face different contextual barriers due to the various dimensions of vulnerability. In addition, vulnerability is determined by many factors (other than marital status) not included in this study such as income level, education among other factors. Therefore strong conclusions pertaining to vulnerability cannot be drawn.

#### **5.4.2 Daily activity profile of women in Ndwedwe-Cibane**

The daily activity profile exercise was carried out to determine workloads of both single and married women (table 5.4.2). Specifically activities, roles and functions carried out daily. To establish if there was time available for climate change adaptation activities. At a quick glance, the activity profile is very similar between the two groups of women. However, upon closer inspection, subtle yet important differences are noted pertaining to the daily working hours and the times at which tasks are carried out. Single women begin their daily activities at 6:00 am and retire at 8:00 pm while married women begin their activities at 5:00 am and retire at 10:00 pm. Married women experience sleep deprivation because they wake up earlier and sleep later than single women. Married women shared that they sleep late because they have to spend quality time with their husbands.

Both groups of women collect water in the morning. Single women shared that they do not gather firewood daily. They alternate firewood gathering with gardening. Furthermore, single women gather firewood and carry out other agricultural activities in the morning while married women undertake these tasks in the afternoon. Single women collect firewood in the morning

because there are no snakes. While married women gather firewood in the afternoon because they have ‘free time’ and the sun is setting, the temperature is therefore cooler.

Table 5.4.2: Daily activity profile of women in Ndwedwe-Cibane

<b>Single</b> Time/activity	<b>Married</b> Time/activity
<b>6.00 am</b> Waking up	<b>5.00 am</b> Waking up
Preparing kids for school	Water collection
Gathering firewood or gardening	Cleaning the house
Cleaning the house	Hand crafts
Water collection	Petty trading
<b>1.00 pm</b>	Food preparation
Hand crafts	<b>2.00 pm</b>
Laundry	Gardening/agricultural fields
Food preparation	Laundry
Lunch	Gathering firewood
Bathing	Family needs
Relaxing	<b>6.00 pm</b>
Supper preparation	Bath
Children’s bath time	Supper time
Ironing	Listen to radio/TV
<b>6.00 pm</b>	<b>10.00 pm</b> Sleep
Supper time/prayer	
<b>8.00 pm</b> Sleep	

Laundry and handcrafts are done mid-day by both groups of women. Both groups of women spend a great amount of time collecting water and firewood due to the lack of basic services. A few women are formally employed under Zibambele and the Community Work Program - CWP, eight days a month which affects their daily activity profile on those particular days. In these

projects women's tasks include: *remove weeds at schools, clinics and along the road. If someone has passed on, we gather firewood for the family, we grow crops and distribute the produce among the poor and we also clean the community court* (women's account). The daily activity profile shows that women regardless of marital status hardly have free time for themselves. Therefore, there is limited to no time available for exploitation to plan and implement climate change adaptation strategies.

## **5.5 Transforming structures and processes**

The neglect of transforming structures and processes in most studies is common as mentioned by Mersha and Van Laerhoven (2016), this study attempts to fill this gap. The number, the significance and accessibility of institutions operating in Ndwedwe-Cibane were analyzed through venn diagrams (figure 5.5.1 and 5.5.2). These institutions are believed to contribute positively to livelihood outcomes. Single women mentioned seven institutions while married women mentioned six. All institutions mentioned by both groups of women are local. Looking at single women's venn diagram the top institution is the Department of Social Development - DSD evidenced by the size of circle and distance from the centre. Than the CWP follows and subsequently Zibambeke; the Department of Health - DOH (represented by the local clinic and mobile health care workers); the ward councillor; the DAEA (represented by the extension officer); and lastly the traditional council. Married women perceived the DOH to be the most important and accessible institution. Followed by the CWP, which is accessible but not as significant. The ward councillor was considered important but not easily accessible and traditional council was considered to be less important than the ward councillor but more accessible.

There are notable differences between both groups of women. Single women valued the DSD for welfare (in the form of grants and pensions) and the other two organizations (the CWP and Zibambeke) for monthly income. Zibambeke's significance and accessibility was lower than CWP because CWP has employed more single women than Zibambeke. Married women did not include Zibambeke in their venn diagram because none of them were employed by Zibambeke. Married women valued the DOH for health services and still regarded the role played by the

traditional council as important. They represented the traditional council with a bigger circle and closer to centre while single women represented the traditional council with a smaller circle and furthest away from the centre. This does not mean the traditional council is not important to single women, but when compared with the other institutions, it is the least. A married woman shared that “*before we take any step, we seek advice from him*”, by him they were referring to the Chief. While a single woman relayed that “*all land belongs to him and you are required to ask him for permission before doing anything. If I need assistance with anything he is the first one I ask*”. Existing literature supports women assertions, the traditional council preserves “customs and culture, allocate land to subjects, resolve disputes and faction fights, conduct mediation, attend to applications for business rights, promote the identity of communities and promulgate tribal regulations” (Ndlela, 2008:218).

With regards to the ward councillor, single women shared that he provides public services and married women shared the same sentiments: “*we tell him what we need and he goes to the relevant department on our behalf*”. However, there were mixed reactions with regards to the ward councillor’s performance. For example during the FGD, women shared that the ward councillor should be responsible for water provision however he was not assisting the village with water access. Married women placed the DAEA farthest away and represented the DAEA with the smallest size circle. Similarly, single women represented the DAEA with a small circle and further away from the centre. A married woman’s account: “*they have thrown us, we also throw them*”. They shared that the extension officer was no longer assisting them with anything. Married women considered their husbands to be more important and accessible than the DAEA because they assisted with water management by fencing around the river course and cleaning the river water. Single women as expected did not include husbands as individuals that play a role in their lives.

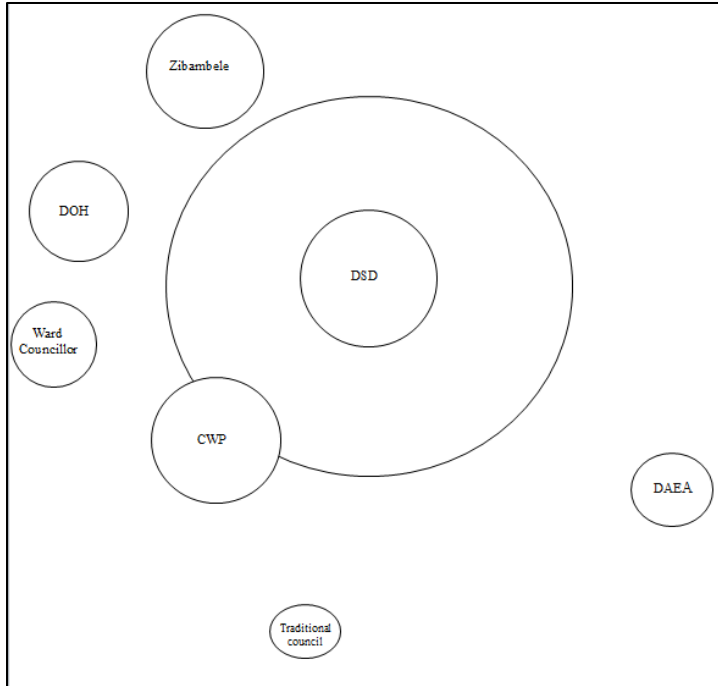


Figure 5.5.1: Venn diagram of Ndwedwe-Cibane by single women

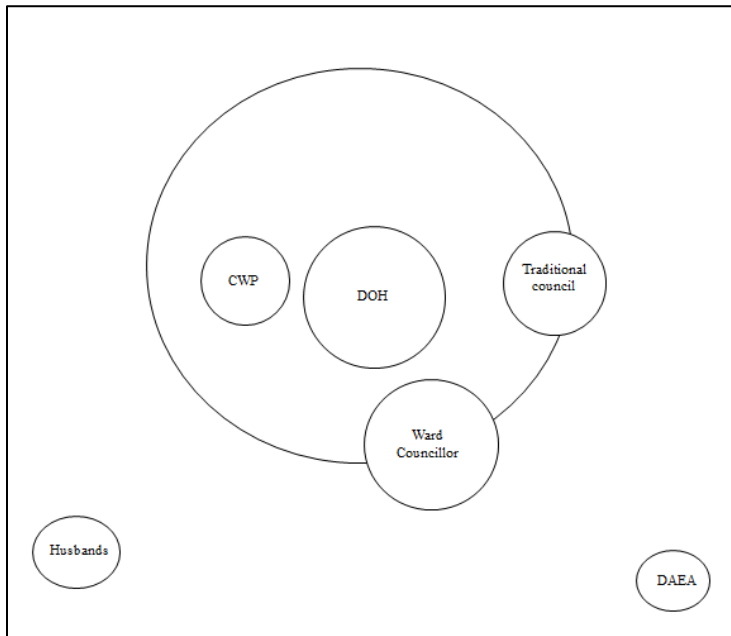


Figure 5.5.2: Venn diagram of Ndwedwe-Cibane by married women

Note: The size of the circle signifies the perceived importance of that institution to women. The distance of the circle from the centre illustrates the accessibility of that institution to women. The closer the circle to the centre, the more accessible it is.

It has been established that the traditional area has weak ties with government departments and that it has no relationships with outside institutions and NGOs. To reduce vulnerability to climate change impacts, the local institutions roles in climate change adaptation should be known and how they can further facilitate building adaptive capacity for future changes (Wang *et al.*, 2013). Institutions identified to play a role in women's lives through venn diagramming did not play any direct role in climate change adaptation but rather focused on development issues. Nonetheless development pertaining to livelihoods may indirectly enhance climate change adaptation (Mubaya and Mafongoya, 2017). Only the DSD, Zibambele and the CWP (in the form of non-farm income) indirectly contribute to climate change adaptation. Mubaya and Mafongoya (2017) note that development without considering climate change impacts may increase the community's vulnerability.



Plate 5.5.1: Married women working on the venn diagram (Source: author)



## 5.6 Livelihood strategies

Table 5.6.1: Women’s livelihood strategies (n=7 single and n=13 married women)

Livelihood strategies	Single		Married	
	Tally	Rank	Tally	Rank
Child grant	1	2	1	3
Old age pension	1	2		4
Public work	11	1	11111	1
Petty trading			111	2
Agriculture	11	1	111	2
Sewing	1	2	1	3

To identify women’s livelihood strategies, a listing and ranking exercise was conducted. Women selected their primary livelihood strategy, but it is important to note that in reality each strategy is used in combination with others. Women’s livelihood strategies consisted of on-farm and off-farm activities. Table 5.6.1 shows the ranked relevance of women’s livelihood strategies. According to the ranking, public work and agriculture are the most important livelihood strategies for both groups of women. Agriculture in this study refers to crop farming, vegetable gardens and livestock husbandry. Public work refers to being formally employed by either Zibambele or the CWP. Petty trading as a livelihood strategy was reported only by married women and includes activities such as selling snacks to school kids, weaving mats and/or baking cakes and selling them.

In addition to agriculture, public work, and petty trading, sewing is also a livelihood strategy among women. Dependence on agriculture and sewing in Ndwedwe is not new, it was previously reported by Sotshongaye and Moller (2000). Child grant and old age pension were reported as livelihood strategies. Other livelihood strategies mentioned during the FGD include collecting medicinal plants, gathering water and firewood but for own use. Differences between single and married women’s livelihood strategies are subtle, but reveal important underlying factors that determine livelihoods. Women who are better off financially are likely to enter self-employment (in this study petty trading) while the poor engage in waged labour (Van Aelst and Holvoet, 2016). Overall women residing in Ndwedwe-Cibane have a small range of livelihood strategies.

Most of their strategies are dependent on external support or natural resources. What will happen when government funds are depleted? Climate change impacts have and will continue to affect natural resource availability and will therefore affect women’s lives since they depend on these resources for subsist.

### 5.7 Perceived impacts of climate change (temperature and rainfall change) on FEW resources

Experiences of past climate change impacts are a prerequisite for developing adaptation strategies. Single and married women expressed their observation of climate change in terms of its impact on agricultural land, agricultural yield, livestock, firewood and water supply over a 50 year period through illustrations (plate 5.7.1 and 5.7.2). Identified impacts are related to the effects of increasing air temperature and perceived decreasing rainfall. The focus is on temperature and rainfall because these are the two variables most studied in climate research due to their immediate impact on several socio-economic sectors (Ansah *et al.*, 2017).

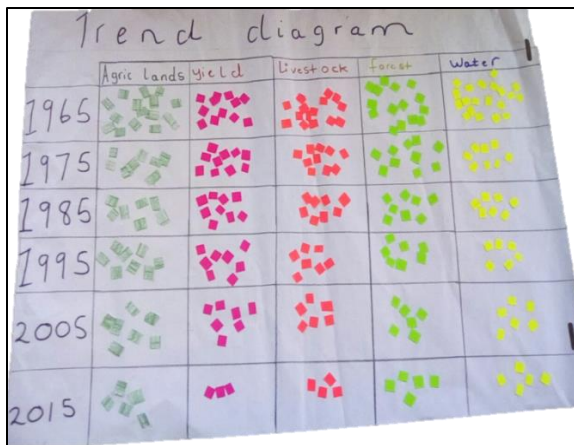


Plate 5.7.1: Single women’s trend diagram (Source: author)

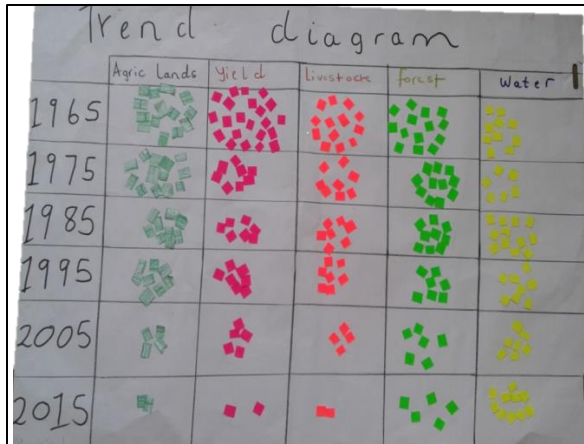


Plate 5.7.2: Married women’s trend diagram (Source: author)



Plate 5.7.3: Single women working on the trend diagram (Source: author)

### Agriculture (field crops and vegetable gardens)

Changes in temperature and rainfall amount or pattern are expected to affect agricultural activities (Gebrehiwot and van der Veen, 2013; Zampaligré *et al.*, 2014). The most significant impacts of changes in climate variables as perceived by women are on agriculture. Agricultural land under cultivation has declined since 1965 (plate 5.7.1 and 5.7.2). Single women recalled that “before we use to grow a lot of crops we did not have a choice. We do not have energy, more diseases, we cannot grow crops far like before and animals like monkeys eat our produce”. In addition, married women expressed that they have reduced agricultural land so they can feed less land more animal manure (cow dung), to enhance soil fertility so that the yield may be better.

The agricultural land under cultivation has not only declined in size but is also closer to the homestead. Therefore a shorter distance is walked to access agricultural land.

Women echoed that the agricultural yield had also declined over the years because agricultural land under cultivation had been reduced. In addition, women shared that they grow less crops because they do not have the energy, drought prevalence is high and in the past they were boosted by ploughing oxen but do not have them anymore. Both groups of women shared that they have witnessed crop failure. Crop failure may be induced by high temperatures that burn crops, increased pest prevalence or due to reduced rainfall which translates into insufficient water for growth. In support, Gandure *et al.* (2013) assert that high temperatures reduce yield, in addition, soil moisture content and moisture storage capacity are reduced. Also warmer temperatures lead to the proliferation of pests, diseases and weeds that negatively affect crop production (Gandure *et al.*, 2013; Olesen *et al.*, 2011; Savo *et al.*, 2016) leading to decreased yields. The extension officer highlighted that outbreaks of pests on crops are related to climate change. *“We have found new pests that destroy crops”* the officer shared. *“In addition, the planting season has changed. It not the same as before”*. *“Now it not easy to say when crops must be grown. It depends on when they start seeing the rain, than start for instance, the winter planting season starts in March/April but they just ordered seeds when they saw the rain, when they are actually suppose to be selling now”*.

All experienced climate change impacts on agriculture are negative. Due to the lack of fencing to protect crops from animal attacks, women suffer heavy losses in addition to changing climate conditions. Women shared that the agricultural produce is not enough for all their uses, hence they resort to purchasing food. Furthermore, women shared that they spend less time in agricultural fields. All mentioned changes influence food security, supporting Tibesigwa and Visser (2015), who predict that the use of agriculture to promote food security looks bleak in the future.

#### Agriculture (livestock)

Women’s accounts (as illustrated in plate 5.7.1 and 5.7.2) show that livestock numbers have declined since they are dying and because they are being sold. Livestock are dying due to the lack of fodder as a result of changes in rainfall amount. Water and grass dries up, consequently

livestock do not have enough food to eat and water to drink. The findings corroborate with the literature, rainfall variation, carbon dioxide and temperature increases affect the amount and quality of forage available for livestock (Rojas-Downing *et al.*, 2017). In addition, Rojas-Downing *et al.* (2017) assert that temperature increases affect livestock productivity in several ways, such as water availability, fertility, health and animal production. A married woman's narrative on livestock: "*livestock especially cows need a lot of water even if grass is less. When a cow drinks water, it must drink and urinate in the same water, this means it has had enough but that does not happen when the temperature is high. Livestock end up competing with each other for water*".

During the FGD women complained about the increasing prevalence of livestock diseases. Diseases mentioned were anthrax (*umbendeni*), *manqubulunjwane*, *amatele* and blood-sucking arachnids (*amakhizane*) (italicized names are diseases names in isiZulu). The extension officer shared that "*ticks have been increasing when it dry*". The findings authenticate Rojas-Downing *et al.* (2017) assertion that increased temperatures and rainfall variations cause livestock diseases (Rojas-Downing *et al.*, 2017). Women's observations of increased crop and livestock diseases are supported by IPCC (2007) reports. They also attribute the changes to increasing temperature and decreasing rainfall as a result of climate change. Women reported that water shortages lead to conflict between livestock and humans. Their claim is also supported by Savo *et al.* (2016) who share that limited water resources lead to conflicts between animal herds and humans. Climate change impacts on livestock translate to food security issues (Rojas-Downing *et al.*, 2017).

### Firewood supply

Forest's and therefore firewood supply appear to be less affected by changes in temperature and rainfall in Ndwedwe-Cibane. However literature reveals that increasing temperature increases the likelihood of forest fires thus exposing the firewood (Sonwa *et al.*, 2012). According to all women who participated in this study the forest area is more or less the same size (in comparison to 50 years ago) but the canopy layer (depletion of forest density) is less and dry/dead wood has declined. Expectedly women shared that the time spent collecting firewood has increased. The time spent collecting firewood has increased due to the scarcity of dry/dead wood. The distance walked to collect firewood is still the same though because they collect firewood from the same

forest. Due to increased temperature, single women shared that they get scared to gather firewood because of the increased likelihood of snake encounters. This may be the cause for reduced firewood supply because not all areas are visited due to fear even though the avoided areas might have firewood in abundance. In addition, there are more people who collect firewood. The Chief commented that *“firewood collection is not a problem, we just need to be careful which trees we cut and when. Trees close to the water/river should not be touched. If you touch these trees the weather might change”*.

### Water supply

Most accounts are of a decline in agricultural land, yields, livestock number and water supply although married women also report an increase in water supply in 1985. Married women were able to recollect the high rainfall volume in KwaZulu-Natal accompanied by floods in 1987 and interpreted this as 1985 since the year 1987 was not available on the diagram. Both single and married women have observed a decrease in the river water level and visibility of previously submerged boulders since the water is drying up. The findings were confirmed by the Chief during the interview, *“river water dries up, livestock died because it needs water, besides livestock we also need water, no water in our plots, no one brings us water, we are dependent on water from the ground”*. Similar observations were shared by Brody *et al* (2008) as cited by Phiri *et al.* (2014) who assert that impacts of climate change include drying of water sources, and this in turn leads to water scarcity. Drying water caused stress and livelihood vulnerability because there is: not enough water for drinking purposes; scarcity of water for domestic purposes; not enough water for irrigation; not enough water for livestock to drink and conflicts/hostility in water use between livestock and humans as mentioned previously.

Water shortages are a threat to food security (and a challenge to adaptation) and this impacts women the most as food providers in their families (Abeka *et al.*, 2012). Contrary to Goh (2012) assertion that women will spend more time and walk longer distances in search of potable water, women in Ndwedwe-Cibane shared that the time spent collecting water and the distance walked to access water is still the same because they still collect from the same river. In addition, married women expressed that there has been more rain since 2015 and therefore more water.

Women have reasonable knowledge of climate change impacts. After the FGD it was concluded that there is no striking differences in climate change impacts of single women relative to married women. Interestingly, the research findings show that the Chief being male is convinced of climate change impacts as the women participants. It is important to note that observed impacts may not be due to climatic changes only but to non-climatic factors as well, this in turn is a limitation for this study.

## **5.8 Conclusion**

There were no significant differences between women's ownership, access and control of natural resources which are particularly important in this study. The results provide some important location-specific insights into the land issue. A vulnerability matrix scored each climatic stress/shock against impacted resources. Women are exposed to increasing temperature and perceived declining rainfall followed by strong winds, storms and tremors. Looking at exposure, the findings of this chapter suggest that the agricultural sector and water resources are negatively affected by changes in climate conditions. This chapter finds that both groups of women are sensitive to climate change impacts because of their great dependence on agriculture, firewood for energy and the river for water supply. The vulnerability context was relatively homogenous between the two groups of women.

Both groups of women have a limited set of livelihood strategies. Agricultural production and public work are the main livelihood strategies. The only difference was the lack of single women who practice petty trading. The daily activity profiles of both groups of women reveal time poverty to invest in climate change adaptation strategies. Interestingly, differences were noted between single and married women's venn diagrams. The DSD was identified as the most important and accessible institution by single women while the DOH was identified as the most important and accessible institution by married women evidenced by the size of circle and distance from the centre. With regards to traditional leadership, married women considered them accessible and helpful while single women nuanced this view. The chapter demonstrates that changes in climate variables are considered negative by women. Temperature increases and perceived rainfall reduction are associated with reduced agricultural productivity and water

supply. Overall the results indicate no marital-status based differences in climate change impacts. The following chapter explores climate change adaptation strategies.



## **CHAPTER 6: WOMEN'S ADAPTATION TO CLIMATE CHANGE IMPACTS**

### **6.1 Introduction**

Associated impacts of temperature increase and perceived rainfall decrease require coping and adaptation (Jiri, 2016). The marital status of the household head is very important in climate change adaptation (Jiri, 2016). Single and married women's social position differs. It may be expected that their adaptation strategies to climate change will also differ. Women were asked to share strategies they have implemented to respond to climate change impacts during a FGD. This study went beyond providing a list of adaptation strategies to include timing, actor, degree of spontaneity and the cost level as perceived by women (table 6.2.1). This chapter consists of two sections: adopted adaptation strategies and resources essential for adaptation.

### **6.2 Adaptation to increasing temperature and perceived decreasing rainfall**

Discordance in farmer's climate change perception and adaptation has been noted in literature (Esham and Garforth, 2013). Yet in this study there has been agreement since women not only perceived climate change but adapted using various strategies. Makate *et al.* (2017) caution that the relationship between climate change perception and adaptation is not simple and linear. Therefore, the observed agreement in this study is applicable to this study only and is not transferable to any setting. Identification of current adaptation strategies also informs future vulnerability and therefore future planning. Adopted adaptation strategies are likely not for a specific climate condition.

#### Agriculture (field crops and vegetable gardens)

Using the marital lens to identify the uptake of adaptation strategies (table 6.2.1), firstly, single and married women have diversified from large crop lands to small homestead gardens, and now grow several vegetables to compensate for reduced crop yield. These vegetables can be manually irrigated unlike crops that are rain fed which are increasingly vulnerable to drought conditions. Shift from field crops to homestead gardens has also been reported by Smith (2012) and Tiwari

*et al.* (2010) in Nepal where this act is motivated by the need to reduce the use of agricultural inputs and labour and the increased ability to irrigate vegetable gardens to improve productivity (Smith, 2012). “Literature cites a direct correlation between the abandonment of field cultivation and the expansion of garden crop cultivation” (Smith, 2012:96). Secondly, increased irrigation of vegetable gardens using buckets is a form of adaptation. It is not feasible to irrigate field crops because fields are large in comparison to gardens. Women in Ndwedwe-Cibane irrigate their crops with either clean water or reused water from washing dishes.

Thirdly, the researcher found out that single women used fertilizers to improve soil fertility and pesticides such as dichlorodiphenyltrichloroethane - DDT for pest control. On the other hand married women enhance soil fertility using liquid fertilizers which supposedly protect the water. This strategy is common and cited in Abeka *et al.* (2012). A plausible explanation for the use of liquid fertilizer by married women is that they are more likely to access information about new technologies than single women due to the influence of the male heads (Atinkut and Mebrat, 2016). Fourthly, agricultural adaptation practices include mulching but only when crops are still young and short in length. Fifthly, some women reported doing nothing as a form of adaptation as illustrated by the quote from a married woman: “*You either do nothing, they die and you eat whatever is left*”. According to the extension officer, the DAEA has not adopted any strategies to directly deal with climate change impacts on agriculture in Ndwedwe-Cibane.

#### Agriculture (Livestock)

With reference to livestock both groups of women indicated that they pour water in basins for livestock to drink when there is a water shortage in the river and also make livestock drink honey. In addition, single women shared that they reduce the number of livestock through sales, to avoid death due to hunger and/or dehydration. Makate *et al.* (2017) and Mehar *et al.* (2016) have also reported livestock sales as a form of strategy to cope in times of climatic stress. The sale of livestock as a response strategy to climatic stress was not mentioned by married women. Instead married women shared that they boil cooking oil, let it cool and make cows drink it. Apparently this softens the inside of the cow and will prevent them from getting too thirsty. In addition, in a bid to insure livestock survival married women invest in vitamins for livestock.

The researcher observed that married women were very knowledgeable about cattle compared to single women probably because they owned cattle with their husbands.

### Firewood supply

With specific reference to firewood supply, both single and married women indicated that they collect wet firewood when there is no dry/dead firewood as a form of adaptation. Harvesting trees for wet firewood (and drying them over a period of time) is detrimental to forest species and yet is practiced due to the lack of alternative energy sources. This response should be regarded as maladaptation. In addition, single women shared that they burn plastic bottles as a source of energy and occasionally use gas stoves. Liyama *et al.* (2014) assert that the lack of energy sources in sub-Saharan Africa has led to the burning of cow dung, crop residues (potential fertilizers), plastics, and wood from tree species that emit harmful smoke and has also led to incorrect food preparation.

### Water supply

To cope with changes in water availability women have had to walk longer distances in search of water resources (Figueiredo and Perkins, 2013; Kevany and Huisingsh, 2013; Phiri *et al.* 2014). This was not the case in this study. Both groups of women still collect water from the same river (*Ichameni*) regardless of reduced water level. “*Water does not completely dry up, you still get water even though it not enough*” (a married woman’s account). In addition, both groups of women practice rainwater harvesting during the wet season from rooftops and conserve the water in basins (plate 6.2.1). Women undertake rainwater harvesting on their own however local government has also facilitated this by providing simple harvesting technology and jojo tanks to a few homesteads, this project is still underway (plate 6.2.2). Water conservation techniques are also in place, for example less amount of water is allocated to body cleansing. However, this act has negative health implications. Women have been advised to plant trees to ‘attract rain’ around the homestead but they do not because it draws lightning and snakes and exposes them to danger.



Plate 6.2.1: Homestead rain water harvesting (Source: author)



Plate 6.2.2: Homestead rain water harvesting (Source: author)

Table 6.2.1: Adaptation to increasing temperature and reduced rainfall

	Resources	Response/ adaptation strategy	Timing	Actor	Degree of spontaneity	Cost level
Single women	Agriculture: Farming	Irrigation	reactive	private	autonomous	low
		Use fertiliser	reactive	private	autonomous	high
		Use pesticides	reactive	private	autonomous	high
		Mulching	reactive	private	autonomous	low
	Livestock	Pour drinking water in a basin for livestock	reactive	private	autonomous	low
		Livestock sales	reactive	private	autonomous	Low
		Honey	reactive	private	autonomous	low
	Forest:					
	Firewood	Harvest trees (wet firewood)	reactive	private	autonomous	low
		Burn plastic bottles	reactive	private	autonomous	low
Water	Rainwater harvesting	reactive	private/public	planned	low	
	Water conservation	reactive	private	autonomous	low	
Married women	Agriculture: Farming	Do nothing	anticipatory	private	planned	low
		Irrigation	reactive	private	autonomous	low
		Use liquid fertilizer	reactive	private	autonomous	high
	Livestock	Pour drinking water in a basin for livestock	reactive	private	autonomous	low
		Cooking oil	reactive	private	autonomous	high
		Honey	reactive	private	autonomous	high
		Vitamin	reactive	private	autonomous	high
	Forest:					
	Firewood	Harvest trees (wet firewood)	reactive	private	autonomous	low
		Water conservation	reactive	private	autonomous	low
Water	Rainwater harvesting	reactive	private/public	planned	low	

The findings show differences in climate change adaptation based on marital status (table 6.2.1). Single women reported adopting a wider variety of adaptation strategies for homestead gardens than married women because they are heavily dependent on the success of these gardens. This reflected women's priorities depending on livelihood strategy. This finding corroborates Mugi-Ngenga *et al.* (2016) finding in Kenya, Chuka where female headed households showed a high probability of adoption of agriculture related adaptation strategies in response to climate variability. Female headed homesteads are more likely to adopt adaptation strategies because they are agricultural producers with greater experience in agriculture (Mugi-Ngenga *et al.*, 2016). Gwenzi *et al.* (2015) further note that female heads practice agriculture due to flexible hours that allow them to perform their several household roles.

Female-headed household's probability of being poor is higher than in male-headed households (Fosu-Mensah *et al.*, 2012; Hatch, 2009; Tibesigwa *et al.*, 2015). Consequently, they are heavily dependent on agriculture for their livelihoods (Tibesigwa *et al.*, 2015) and are more likely to adapt their agricultural practices to climate change (Fosu-Mensah *et al.*, 2012). In support of Fosu-Mensah *et al.* (2012), Mehar *et al.* (2016) study revealed that families with food shortages are likely to opt for agriculture specific strategies. "Also, being married increases the likelihood of reporting food security, and this is more significant in male-headed households" (Tibesigwa and Visser, 2016:6).

From the FGD it is evident that single women have little interest in taking adaptive strategies pertaining to livestock since they only provide drinking water and/or honey while married women engage in a much more diverse set of adaptation strategies for livestock (including pouring drinking water in a basin; cooking oil; honey; vitamins). Livestock diseases in Ogalleh *et al.* (2012) study area were managed by seeking assistance from veterinary services and using local knowledge. In this study there was no mention of adaptation to diseases other than administering vitamins to livestock. This may be due to lack of access to veterinary services. This study supports Tibesigwa and Visser's (2016) assertion that female-headed households invest more in crop farm extensions while male-headed households invest more in livestock farm extensions. Both groups of women irrigated their vegetable gardens but irrigation as a prominent adaptation strategy is not sustainable in the long term and is therefore classified as maladaptation (Barnett and O'Neill, 2010).

In terms of adaptation to temperature and rainfall changes, a greater consensus was observed between women regardless of marital status regarding water and to a less extent firewood

adaptation strategies. In rural societies women's gender responsibility includes water collection thus it makes sense why they have preference for water harvesting as an adaptation strategy (Nabikolo *et al.*, 2012). Water harvesting is a common adaptation strategy among southern Africa farmers (Deressa *et al.*, 2008). Harvested water may be contaminated and needs to be purified before use (Dube *et al.*, 2014). This introduces health related issues.

A striking revelation was that almost all women participating in the study spent less time performing agricultural activities. This is contrary to literature where women are spending more time performing agricultural activities in the face of climate change. Continuing de-agrarianization in Ndwedwe-Cibane is due to climate change impacts but also non-farm employment opportunities particularly public work. More women irrespective of marital status are engaged in public work projects, for example the CWP and Zibambele to generate an income. Other non-farm income generating strategies include petty trading and sewing services (table 5.6.1). Generally employment improves adaptive capacity (Buechler, 2009). Income diversification is not a direct adaptation strategy, yet it can be regarded as a form of long term and anticipatory adaptation. Non-farm income may increase the adoption of adaptation strategies as farmers invest more in agricultural activities (Gebrehiwot and van der Veen, 2013). On the other hand, Gebrehiwot and van der Veen (2013) assert that non-farm income generating activities can inhibit adaptation if they compete with on-farm managerial time. This might be the explanation for the reduction in time spent performing agricultural activities in Ndwedwe-Cibane.

Interdependencies in food, energy and water supply highlight the need for intersectoral adaptation strategies. All adopted adaptation strategies in Ndwedwe-Cibane are not new, they are well established and known. Therefore it is debatable that these strategies are adopted in response to anthropogenic climate change impacts. Others may argue that they are traditional practices however they have become useful to counteract the negative and exploit the positive impacts of climate change (Alemayehu and Bewket, 2017). These strategies were probably developed to adapt to natural climate variability and environmental change. Ndaki (2014) affirms that humans have been adapting throughout history to climatic changes but anthropogenic climate change is the biggest phenomenon humans have had to face.

Of the eight adaptation classes mentioned in chapter two, four apply in this study. They are: bear losses, prevents effects, change use, and change location. Analysis of adaptation strategies by women irrespective of marital status reveals that most of the strategies were relatively simple and low cost. Based on the degree of spontaneity, most adaptation strategies in this study are

autonomous rather than planned (table 6.2.1) and based on timing, most adaptation strategies are reactive and are therefore likely to be unsustainable (Masere, 2011). One might argue that adaptation strategies are reactive because they are implemented during or after climate change impacts but also anticipatory because to some degree they are based on some assessment of future changes in climate variables. Vincent and Cull (2012) argue that adaptation should be planned, proactive and anticipatory. Some of the adaptation strategies (for example, harvesting trees and burning plastic) do not improve women's well-being and do not contribute to any development goals. In fact most adaptation strategies were found to be very limited and some still render women vulnerable to future changes since they do not consider climate change in the long-term. Successful/sustainable adaptation strategies should not only reduce vulnerability but also enhance resilience to long-term climatic changes (O'Brien and Leichenko, 2007).

Through venn diagrams and discussions, it was revealed that none of the institutions operating in the area played a significant direct role in climate change adaptation. All adopted adaptation strategies have been developed by the women without external assistance. It is great to see that women are using indigenous knowledge to undertake private adaptation and not waiting for external assistance. Simple rainwater harvesting technology and jojo tanks (adaptation strategy) were provided by government for service delivery purposes with no intent to adapt to climate change. Also public work was not initiated primarily for adaptation purposes but is a form of adaptation.

The lack of government support was not surprising, government support in relation to climate change adaptation is very limited throughout Africa (Tadesse, 2010). The extension officer believed that the DAEA at the head office level has the necessary capacity to plan and implement climate change adaptation strategies for agricultural production. She further shared that based on her knowledge there are no plans to address climate change impacts on agriculture at the local level but only at the head office level. The officer further admitted to not knowing any long-term goals pertaining to climate change adaptation. If the officer who should be sharing knowledge and her expertise is not versed in climate change adaptation, adaptation is inhibited.

During the interview the Chief expressed that they were doing nothing tangible to adapt to climate change impacts as the traditional council but were considering formulating portfolios, and one would address climate change related issues. This is not surprising as reviewed literature does not highlight any role played by traditional councils in climate change adaptation efforts yet. Chiefs' account: *"I would be lying at the moment the council has done nothing. At the moment drought has*



*been a problem, we do not know what to expect. We do not have a plan, as to what will help us in the future. I would be lying. We were thinking of having portfolios and someone will be deployed to focus on climate change but we are still communicating as the traditional council and have not gone to the villagers”.*

It has been demonstrated that indigenous knowledge supports women’s adaptation efforts. However, indigenous knowledge alone is not sufficient to deal with climate change impacts because it may be outdated and ineffective under current and future climatic changes (Masere, 2011). This highlights the need for the integration of indigenous knowledge with modern scientific knowledge. Furthermore, none of the adaptation strategies promote a female collective agency, they are all carried out individually.

Differences in roles, responsibilities and differences in access to resources influence single and married women’s adaptation strategies. Marital status especially for women has positive socio-economic impacts and entitlements that influence adaptive capacity (Van Aelst and Holvoet, 2016). Married women enjoy privileges and recognition and are better off than single women because they can discuss adaptation concerns with their spouses and make better informed decisions than single women (Jiri, 2016). With regards to agriculture the spouse may also be a source of support by providing labour and the income needed to purchase agricultural inputs (Kutir *et al.*, 2015). Cattle are perceived as assets in many rural communities, those who own cattle seemingly have more resources and better access to adaptation information (Jiri, 2016). Therefore, it is assumed that married women are better off in terms of access to information and resources since they own cattle.

This study has attempted to illustrate heterogeneity in climate change adaptation by focusing on single and married women. Social and financial differences between single and married women are likely to increase as climate change continues unabated. Other than marital status, the adaptation process is driven by several factors. Nielsen and Reenberg (2010) affirm that adaptation is a heterogeneous process influenced by several factors including gender, class and culture among other factors. This study therefore argues that women have contributions to make to climate change adaptation because of their gendered and intersectional knowledge. Furthermore, treating women as a homogenous group masks inequalities that are based on marital status.

## 6.2.2 Resources used for adaptation

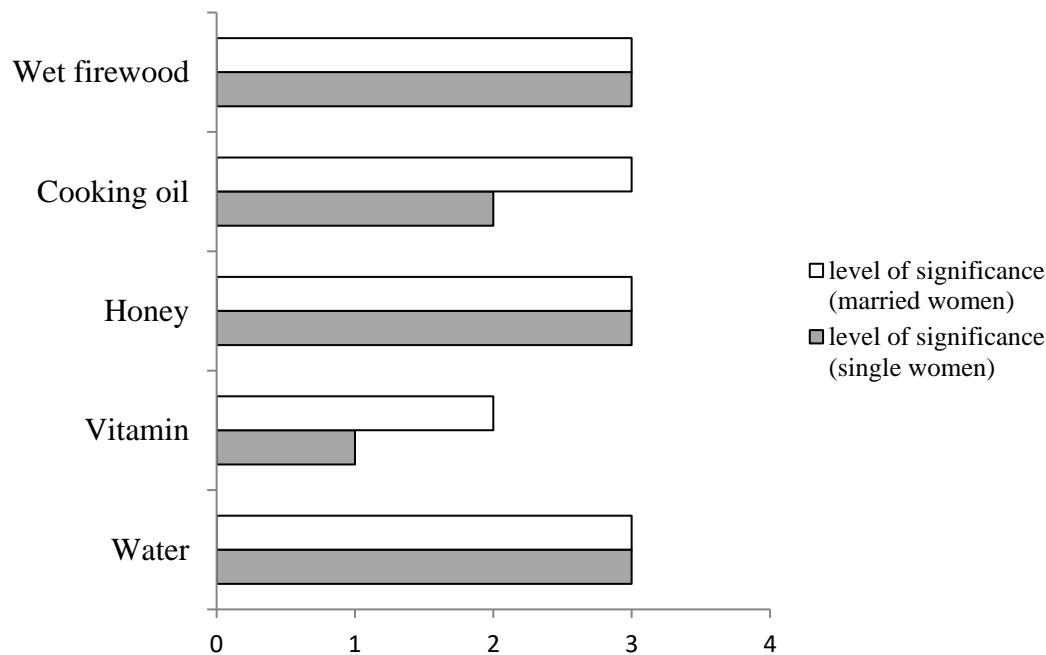


Figure 6.2.2.1: Important resources for FEW based climate change adaptation and their level of significance

Note: 1:Low; 2:Medium; 3:High

The above figure (figure 6.2.2.1) shows that natural (for example, natural resources such as tree species for firewood and water) and financial resources are important for climate change adaptation in Ndwedwe-Cibane. Financial resources are important because they are the means which allow women to purchase cooking oil, honey and vitamins. Both groups of women scored honey, wet firewood and water a high level of significance as resources essential for climate change adaptation. Women get livestock to drink honey because it is affordable and available in 20 litres bottle which is considered a sufficient amount. Women also consider wet firewood to be an essential resource for adaptation when dry/dead firewood is unavailable and water an important resource for all agricultural and domestic activities.

Single women's level of significance for vitamins is low, they cited lack of knowledge on vitamins. While the significance of cooking oil is medium because they rarely use it on livestock since they do not own cattle just sheep and goats. Unlike their single counterparts married women own cattle because male heads buy them and borrow them from other males so they can breed. Married women scored vitamins medium significance because they possess knowledge about vitamin use but seldom use it because vitamins are said to be expensive and cooking oil was scored high significance because it usually available and used.

With regards to adaptation resources, the DAEA extension officer shared that “*there is money. There was a drought and the DAEA had a relief program giving people feed supplement for cattle and tanks to harvest water*”. In this case the DAEA efforts were reactive and the use of resources in short term relief programs diverts limited resources from long term developmental projects which are probably sustainable (Faling *et al.*, 2012). When asked if the DAEA policies enable women to access and control resources essential for adaptation, the extension officer shared that the DAEA caters especially for women and the youth when there is a project. That is not to say men are not assisted but women are prioritized in general and not necessary in climate change adaptation since there are no projects pertaining to climate change adaptation in Ndwedwe-Cibane. However, resources provided by the DAEA may aid adaptation efforts. These resources include shade cloths, tunnels, jojo tanks, and watering cans among others. In addition, the officer shared that existing capacity and resource needs for climate change adaptation are trainings, campaigns and more funds. The Chief believes knowledge and communication of knowledge is essential because without knowledge you will not be able to make use of resources even if they are available to you.

Access to resources for adaptation remains unequal between single and married women. These findings reinforce that women are a heterogeneous group, with intersecting identities that influence access to resources essential for climate change adaptation. Differences in this section are attributable to inequalities in access to financial resources and knowledge. Married women appear to be better off financially in comparison to single women.

### **6.3 Conclusion**

Given the existing trends in temperature and rainfall and the observed impacts on FEW resources climate change adaptation is vital. This chapter identified FEW based climate change adaptation strategies in Ndwedwe-Cibane. Although women share the same climate, adaptation strategies are not necessary the same. There are both differences as well as similarities in adaptation strategies between single and married women. Single women are more adaptive to crop and garden changes an outcome of more profound need. They invested in several strategies concurrently while married women invested in several strategies for livestock. In addition, this chapter finds that single women are less adaptive to livestock changes than married women. Both groups of women adopted similar adaptation strategies to counteract climate change impacts on firewood and water availability. Most adaptation strategies identified are relatively simple, short term and reactive.

The findings are important in unveiling the realities of single and married women's adaptation to climate change impacts.

## **CHAPTER 7: BARRIERS AND OPPORTUNITIES FOR CLIMATE CHANGE ADAPTATION**

### **7.1 Introduction**

The previous chapter demonstrated that women were adapting to climate change impacts. This chapter is structured into two sections: the first being barriers to adaptation and second being opportunities for adaptation. Barriers hinder any adaptation efforts (Moser and Ekstrom, 2010) and can range from social to cultural to economic factors. Thus they must be identified and overcome by providing the necessary resources and information to facilitate adaptation (Archie, 2014).

### **7.2 Barriers to climate change adaptation**

Analysis using the marital lens shows that single women face financial barriers. For example when married women cited the lack of access to veterinary services as a barrier, single women cited the lack of money as a barrier to purchase medicine for livestock. A married woman's account: "*money is not a problem because we are able to buy honey*". This can be attributed to the fact that they are expected to benefit from an income-earning spouse (Hatch, 2009). Generally single women are economically disadvantaged compared to married women (Hatch, 2009). In addition, single women's financial limitations may be due to the subsistence nature of livelihoods in Ndwedwe-Cibane. Financial limitations to adaptation are common and are cited in many studies including (Gebrehiwot and van der Veen, 2013). Water scarcity was identified by both groups of women as one of the factors that hinder climate change adaptation. Recall the only 'consistent' water supply is the river and harvested rainwater. Water scarcity translates into inadequate water for irrigation and for livestock to drink.

Lack of regular contact with the extension officer was also universally important for both single and married women and seems to be the norm in South Africa. In Mpumalanga a study revealed that the majority of farmers did not have access to extension services (Kutir *et al.*, 2015). Lack of access to extension services translates into no adaptation or maladaptation since farmers are deprived of information pertaining to climate change and sustainable adaptation strategies to increase productivity in the face of adversity (Huyer, 2016; Kutir *et al.*, 2015). Several authors (Addisu *et al.*, 2016; Fosu-Mensah *et al.*, 2012; Mehar *et al.*, 2016; Zhou *et al.*, 2016) note that

access to extension services (on climate change and agricultural production) positively influences the uptake of adaptation strategies.

Literature reveals that women's access to extension services is often constrained because they are not always considered to be farmers like men (Huyer, 2016; Lahai *et al.*, 1999). In this study this was not the case since the interviewed extension officer revealed that extension services prioritize women and the youth in Ndwedwe-Cibane. The extension officer shockingly revealed that extension services offered are generally about agricultural productivity without any climate change aspect. She continued to state that she only knew about climate change because she is a master's candidate and her research focuses on disaster risk reduction. Pettengell (2010) as cited by Mzimela (2015) affirms the interviewed extension officers' statement that climate change awareness amongst extension officers is limited. The extension officer reported the lack of awareness campaigns and research as barriers to climate change adaptation. As perceived by the extension officer, a women's level of education and patriarchal practices (for example, seeking permission from husband before taking action) negatively affect their ability to adapt.

Again both groups of women cited lack of access to credit as a barrier. Yet access to credit increases farmers financial resources and accordingly their ability to purchase agricultural inputs and reduces cash constraints (Nabikolo *et al.*, 2012). In addition, credit increases chances of adapting to climate change impacts (Fosu-Mensah *et al.*, 2012; Ngo, 2016). For example credit may allow women to purchase improved hybrid seeds and fertilizers to increase productivity, thereby reducing the negative climate change impacts on production (Fosu-Mensah *et al.*, 2012). Women in this study have limited access to formal credit and prefer not to take it. One woman relayed that they prefer "*loans from savings clubs and not banks because we scared we will not be able to pay back and we do not qualify and the bank will rob us. We will pay back until we exceed the money we borrowed*". Flatø *et al.* (2017:43) further confirm that women face multiple "barriers in accessing finance, including lack of financial literacy, lack of financial confidence, limited use of networks, as well as cultural prejudices and negative stereotyping towards women as entrepreneurs".

Attribution of climate change to spiritual and cultural practices by both groups of women is a barrier to climate change adaptation. It classified by Le Dang *et al.* (2014) as a psychological barrier. "The problem is specifically that if you believe a phenomenon to have a divine cause then not only is it pointless to try and alter it but it is also an affront to the divinity to contemplate doing so" (Lata and Nunn, 2012:176). Unequal access to land for women is usually a barrier to climate

change adaptation (Ravera *et al.*, 2016). In this study this was not the case because women had access to land.

Both groups of women do not receive any climate related information. Limited information/knowledge implies lack of readiness to adapt. The Chief believes the lack of knowledge is the biggest challenge to climate change adaptation and remarks “*it is very important without knowledge there is nothing you can do. Maybe if we had knowledge since we are in rural areas, maybe there would be a lot of things we could deal with accordingly. Other factors can follow but knowledge is first*”. The above-mentioned factors are all barriers, however access to information, as stipulated by the Chief is considered a major barrier even in existing literature (see, Dasgupta *et al.*, 2014). There is a lot of uncertainty with climate change and access to information influences perceptions and adaptation responses (Dasgupta *et al.*, 2014). The study findings broadly resonate with literature that reveals barriers to climate change adaptation (Alemayehu and Bewket, 2017; Jones and Boyd, 2011; Moser and Ekstrom, 2010). The identified barriers fit into the three classes (natural, social, and human and informational resource) of barriers by Jones and Boyd (2011).

The results of the inquiry on barriers to climate change adaptation revealed shared barriers and divergences between single and married women. An example of such disparity is money. Financial barriers are more pertinent for single than married women. The results resonate with several authors (Flatø *et al.*, 2017; Shackleton *et al.* 2014; Van Aelst and Holvoet, 2016) who argue that women in female-headed households experience poverty due to limited resource base, but greater access and control of these resources compared to women in male-headed households (Van Aelst and Holvoet, 2016). For example in South Africa, “45% of female-headed households live below the poverty line compared to 25% of male-headed households” (Shackleton *et al.*, 2014:76). Understanding differences in barriers to climate change adaptation between single and married women within rural contexts is important in policy, plans and program development. Based on the results in this study, marital status is an important attribute to consider to overcome barriers and adapt to the changing climate.

### **7.3 Opportunities for climate change adaptation**

As shown in the previous chapters changes in climatic conditions have occurred and will continue to do in the future regardless of mitigation and adaptation efforts underway. Current adaptation

strategies have positive results however they are short term, reactive and unsustainable. In light of the above, this chapter presents potential adaptation strategies as identified by women. The researcher found no significant differences between single and married women's potential climate change adaptation strategies, therefore the findings are presented together.

When asked during the FGD "which institutions should be responsible for ensuring women's adaptation to climate change impacts?", with reference to agriculture women expressed that the "*ward councillor should communicate with department of agriculture*". The ward councillor was considered to be the individual who could play a vital role in agricultural adaptation to climate change impacts. And pertaining to firewood supply, women relayed: "*No one can help us. Electricity provision is the answer. We don't like gathering firewood anymore*". At first women believed no institution would be their breakthrough but electricity provision would be. In addition women expressed that firewood collection which is considered a traditional responsibility among rural societies is no longer a task they enjoy performing. Another woman's account: "*It is really difficult for us without husbands because men would buy primer stoves and paraffin. But now you go to bed without food and end up burning bottles (cooldrinks) because I do not have a stove nor paraffin. There is no one I can ask because even food, I eat because I pray*". With regards to water supply again women shared, "*No one can help us. The ward councillor can provide us with water using trucks but government assistance does not come on time*". At first no institution was believed to be able to assist, than the ward councillor was considered as an afterthought.

When asked during the FGD "What activities can women undertake to prepare for anticipated future climate change?", with reference to agriculture women shared that "*There is nothing we can do. Even if we ask the ward councillor for water delivery, it will only come once and never again*". Here the women were referring to the water truck. Pertaining to livestock a single woman shared that all she needs is money to buy medication. Another single woman remarked "*If only we had an advisor, who could tell us what our livestock need cause they die and we do not know what killed them*". Whereas a married woman shared: "*What we are doing is enough. Nothing else we can do*". And pertaining to firewood supply single women shared that burning bottles is the answer while married women's response was that there should be electricity provision and use of gas stoves. Concerning water supply, both groups of woman voiced that the ward councillor and the responsible department should provide water.

The findings reveal that no support pertaining to climate change adaptation was given to women. Women did however form savings clubs and agricultural co-operatives. These groups have the



potential to be involved in climate change related issues including the traditional council. In addition the CWP and Zibambele could play a greater role in climate change adaptation other being a source of income. It evident, women in Ndwedwe-Cibane want to opportunistically use development projects for adaptation purposes.

#### **7.4 Conclusion**

This chapter provides insights into women's barriers and opportunities for climate change adaptation in Ndwedwe-Cibane. It has been established that barriers have negative impacts on adaptation. Moreover, the study reveals that single women faced financial barriers while married women considered the lack of access to veterinary services as a barrier. In addition, both groups of women identified the lack of climate change information, the lack of access to credit and extension services among other factors as barriers to climate change adaptation. The findings reveal the lack of information as the most important barrier for climate change adaptation according to Chief. The lack of awareness campaigns, the lack of research and women's education level and patriarchal practices were the most important barriers in the extension officers' view.

This chapter provides a starting point for further exploration of opportunities for climate change adaptation. With the realization that climate change is projected to exist in the long term, women have identified key potential adaptation strategies, these are generally basic services such as the provision of water and electricity. The weight of service provision is placed on the ward councillor. The next chapter will present the summary of the study including recommendations.

## **CHAPTER 8: CONCLUSION AND RECOMMENDATIONS**

### **8.1 Introduction**

The study investigated rural women's (using a marital lens) perception of climate change; vulnerability to climate change impacts; the impacts of climate change on women's FEW resources; adaptation strategies in response to climate change impacts; and assessed opportunities and barriers faced by rural women relating to climate change adaptation strategies. This chapter is an outline of the final conclusions, it begins with a summary of the study. The remainder of the chapter discusses study recommendations, recommendations for future studies and the concluding remark.

### **8.2 Summary of key findings**

This study aimed to explore climate change perception among rural women, assess women's vulnerability, and identify FEW based adaptation strategies and barriers and opportunities for adaptation. For this purpose PRA techniques including key informant interviews were employed to collect data. Primarily, air temperature and rainfall data for the past 50 years was analyzed to determine trends using the MK test and the future climate projected using CSAG CIP website. Revealed trends were then compared to women's perception. The study established evidence of climate variability and change in Ndwedwe-Cibane. Climate change is evidenced through increasing temperature (single and married women observation). The perceived increase in air temperature is also evident in the meteorological data. Rainfall change perception among women was heterogeneous with some indicating increased rainfall (majority of married women) and others decreased rainfall (majority of single women). Rainfall perceptions were not confirmed by rainfall data, which revealed no change in rainfall amount but inter annual variability. In addition, projections under RCP 4.5 scenario revealed a possible warming and wetting trend over Durban for the next two decades accompanied by a shift in seasonal rainfall. The study also revealed misconceptions about the causes of climate change. A commonly held perception among single and married women is that God is the main cause of climate change and the desertion of cultural practices.

Secondly, to assess vulnerability and adaptation to climate change impacts, this study uses climatic shocks and stresses, the vulnerability context of the SLF. Vulnerability was explored using the

vulnerability matrix and climate change impacts were determined through the use of trend diagrams. The question of which group is more vulnerable than the other cannot be concluded. Women have different resources at their disposal and face different contextual barriers due to the various dimensions of vulnerability. Temperature and perceived rainfall change impacts on agriculture, firewood and water supply have been observed in Ndwedwe-Cibane. All impacts are perceived to be negative. According to women the threat of climate change on firewood supply is less than on agriculture and water supply. The study revealed no substantial discrepancies in climate change impacts between single and married women.

Thirdly the study contributes to the identification of adaptation strategies. Using the SLF, the study demonstrates that all women adapt to some degree to climate change impacts. These adaptation strategies are incorporated into livelihoods another element of the SLF and resources which facilitate adaptation are identified. Even with mounting evidence of climate change, there is little recognition of marital status as a determinant of climate change adaptation. However, the researcher observed dissimilarity in adopted adaptation strategies between single and married women. Single women reported adopting a wider variety of strategies for crops while married women adopted a wider variety of strategies for livestock. With regards to fuel supply both groups of women were resorting to collecting wet firewood. Concerning water resources women are opting for multiple adaptation strategies (for example water conservation and rain water harvesting) simultaneously to minimize climate change impacts on water availability.

Most adaptation strategies are reactive and private. From the findings it is evident that adaptation is not a homogenous process for women. Therefore adaptation strategies should not consider women as a homogenous group because they will risk reproducing biases and inequalities in plans, policies and programs if marital status is not considered. The study further shows the lack of collective agency among women to counteract negative climate change impacts. Marital status is important for determining access to certain resources for adaptation. Transforming structures and processes (a SLF component) which influence access to resources, livelihood strategies and decision making were all identified and role played in local climate change adaptation assessed. One important finding from this study is that institutions have not played a direct role in driving climate change adaptation in Ndwedwe-Cibane. Women's adaptation strategies are their own initiatives.

Lastly, barriers to adaptation and opportunities for adaptation were determined. Climate change adaptation barriers included the lack of access to extension services, the lack of access to credit,

attribution of climate change to God and traditional practices and the lack of knowledge among others. Financial barriers are mostly felt by single women. The study demonstrates that there is little recognition of preferences based on marital status pertaining to potential adaptation strategies. With the realization that climate change is projected to exist in the long term, women have identified key potential adaptation strategies. These are generally basic services such as the provision of water and electricity.

Drawing on the SLF in the context of climate change adaptation, and combining this with the ecofeminist framework demonstrated the importance of using more nuanced social analytical frameworks to understand rural women's climate change adaptation. All elements of the SLF explain vulnerability, adaptive capacity and adaptation. The ecofeminist framework has helped to focus not only on women but on differences between women based on marital status. These differences were either material (for example, differences in financial status) or symbolic (for example, married women have a higher social standing than single women).

Separating women into groups based on marital status during FGDs appears to have led to an awareness of self as a single or married woman and led to superiority of married women over the single women. There are differences among single and married women in social roles and financial status that influence vulnerability, adaptation, barriers and opportunities for climate change adaptation. Overall this study suggests how to implement an intersectional approach based on marital status which integrates PRA tools and techniques. The use of selected PRA tools and techniques gave insights into climate change adaptation. On the other hand it did not provide depth into understanding the vulnerability context. It was the most difficult to evaluate. However, marital status does play a role in climate change perception, adaptation and in barriers to adaptation.

### **8.3 Recommendations**

In view of the findings of the study, the following recommendations are proposed:

Discrepancies between women's perception and meteorological data raise concerns about the validity of women's perception (Boissière *et al.*, 2013) and highlights the importance of dissemination of climate change information. However discrepancies may also be due to unreliable meteorological data especially in areas with few meteorological stations. Hence, the importance of integrating climate change perceptions with meteorological data for complementary purposes (Boissière *et al.*, 2013). Seasonal forecasts should also be made available to ensure short term

planning, (for example, this information would influence crop type and time of planting) (African Technology Policy Studies Network- ATPS, 2013). These forecasts should target vulnerable groups including women and be delivered in such a way that it suits women in content and delivery. There is also a need for climate change projections and for them to be translated into usable forms for all stakeholders for planning and adaptation purposes (Jiri, 2016; Swai *et al.*, 2012).

Women's explanation of climate change being based on spirituality and traditional customs indicates the lack of scientific knowledge on climate change in the study area. Therefore, it is recommended that mass media (radio and television) the major source of information for women should be used to increase the level of climate change awareness. Climate change awareness programs should be on a continual basis to improve women's access to information. "Farmers can effectively use the mobile phone for weather information access if weather information voice messages are sent in the language they understand. This can promote easy understanding and appropriate adoption" (Anuga and Gordon 2016:284). Therefore the use of mobile phones as climate change information distributors should be exploited. Strong political will is required from all forms of leadership to address vulnerability and adaptation issues (Shackleton *et al.*, 2014). People who hold leadership positions such as the Chief, the ward councillor and headmen among others should be given tools that will inform decisions pertaining to the environment and climate change thereby strengthening institutional capacity (Lata and Nunn, 2012).

According to women, extension services are currently non-existent. This implies that there is a need for accessible and relevant extension services for all women. Extension officers should be well-informed about agricultural adaptation to climate change impacts to enhance women's adaptive capacity. The interviewed extension officer acknowledges that her climate change knowledge is fairly limited. Extension officer's knowledge can be improved through information dissemination and trainings on climate change adaptation. For example trainings on new seed varieties and trainings on communicating climate change information. The number of extension officers deployed in Ndwedwe-Cibane should also be increased. Women need to substitute current crops with drought tolerant species and varieties (Ajani *et al.*, 2013). Investment in agricultural research (for example, drought and disease resistance varieties, soil conservation measures, fertilizer use, land reform) is recommended (ATPS, 2013). Based on the findings of the study it is recommended that women should re-form agricultural cooperatives to improve homestead food security and to share individual knowledge thus increasing women's collective agency. Veterinary

services should be provided in the study area or close by (Sacramento *et al.*, 2012). Access to veterinary services may improve livestock productivity. Study participants should provide livestock with purchased feed and drinking water during times of water scarcity (Department of Forestry and Fisheries - DAFF, 2015). Farmers should also consider investing in goats rather than cattle and sheep because they are more drought tolerant and drought is likely to be a frequent hazard in the future (Sacramento *et al.*, 2012).

Concerning water supply, water harvesting should be encouraged in all homesteads. Technology should also be further developed for water harvesting practices (Addisu *et al.*, 2016; Misra, 2014). Irrigation of garden plots should be improved, this improvement could be facilitated by the Ndwedwe Local Municipality through communal or homestead piped water. Moreover, irrigation should be done in the morning and/or afternoon to avoid evapotranspiration and over-irrigation should be avoided since it can lead to problems like water logging (DAFF, 2015). Women should continue to practice water conservation and reuse water (DAFF, 2015). Government should introduce and promote the use of biogas and energy saving stoves to reduce the deforestation for firewood. In addition, investments in renewable and clean energy sources should be made and promoted by government and the private sector. These investments should incorporate women's traditional knowledge, roles and scientific expertise (Boissière *et al.*, 2013).

Government should strengthen infrastructure by providing electricity and water connection for all homesteads. Prior to any form of development, project planners need to carry out assessments to ensure that development supports or at least is not a barrier to climate change adaptation. Moreover, adaptation should be 'normalized' in core development activities (Davis, 2011; Picketts *et al.*, 2014). The national government should not devolve climate change adaptation to Local Municipalities without financial resources. In addition climate change adaptation should not only be implemented at the local or national level but rather an integrated approach that considers all levels of government should be adopted (Gentle and Maraseni, 2012).

Lack of access to credit is a barrier to climate change adaptation especially for single women. Means to increase women's access to credit should be in place and women should be taught more about the terms of credit facilities (Fosu-Mensah *et al.*, 2012). Livelihood diversification should be promoted through the creation of non-farm employment because its importance in rural women's livelihoods has been revealed.

Overall the use of indigenous knowledge for adaptation should be promoted but also integrated with modern knowledge and involve all relevant stakeholders (governments, locals, academia, and media). This may lead to appropriate and feasible adaptation strategies. More research pertaining to climate change at the local level should be conducted. Women's adaptation strategies are in general reactive and short-term. As a result, the implementation of medium to long-term adaptation strategies need to be based on policies (at all levels) that provide finance and technological assistance (Zampaligré *et al.*, 2014). Adaptation strategies should be planned and anticipatory (ATPS, 2013). Rural inhabitants should not only be informed about policies but must contribute in policy formulation.

Policies to address climate change adaptation that recognize not only women's vulnerability but differences even between women based on marital status should be formulated. In addition more focus should be diverted to single women to enhance their access to assets thereby improving their adaptive capacity (Djoudi *et al.*, 2016). FEW resources based adaptation to climate change impacts requires co-ordination and foresight. Plans and policies should be harmonized among FEW resources, taking into account interdependencies to tap synergies and co-benefits across the different resources.

#### **8.4 Recommendations for further study**

PRA requires a multidisciplinary team to assist participants (Quigley *et al.*, 2017). Therefore it is recommended that the PRA should be facilitated by a team of trained individuals. It is also recommended that single and married women's FGDs are conducted separately. This decision may allow members of each group to open up in the absence of judgment from members of the other group and may also allow for further probing. Future research should explore not only marital status but additional socio-economic categories such as age, income and educational level which influence climate change adaptation. Intersectionality was based on marital status, women could only be single or married. Instead of grouping women as single or married, perhaps future studies could explore further why women are single? Is it by choice or widowhood and so forth because this can also affect vulnerability and adaptation.

This study covers only two climate variables (temperature and rainfall) and is therefore limited. Variables such as relative humidity, sunshine and wind speed among others should be covered in future research because they affect FEW resources in one way or another. The assessment of vulnerability was limited, hence no strong conclusions were made regarding the vulnerability

level. There are many differences in the propensity of women to adapt and further analysis is required to understand underlying factors. Future studies should be more exhaustive and include several social, economic and biophysical indicators to come up with strong conclusions. The study scope was large, hence there was a tradeoff between data quantity and analysis depth. The study was not exhaustive however it serves as a basis for future studies pertaining to climate change adaptation using a marital lens for greater depth. A follow up study could incorporate other key informants such as the ward councillor, a SAWS representative among others. To study FEW nexus a framework to assess all of these resources and manage interactions is a must (Rasul, 2014) and therefore should be included in future studies. Climate trends and projections have taken no cognizance of the topography, soils, land uses, water bodies among other features in Ndwedwe-Cibane and are therefore not a true representation of the study area. Furthermore, climatic trends and projections should be on a seasonal basis to reveal more intricate information.

## **8.5 Conclusion**

The use of intersectional analysis is relatively new in the field of gender and climate change adaptation. In most studies women are treated as a homogenous group without considering underlying social factors. The researcher attempts to fill this gap by focusing on women and differentiating them based on marital status. The findings show that intersectional analysis is advantageous and reveals similarities and differences between single and married women relating to climate change adaptation. Hence, priori assumptions on the basis of a single/married women dichotomy have led to a better understanding of women's perceptions, adaptation strategies and barriers and opportunities for adaptation.



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## APPENDICES

### Appendix 1: Ethics approval letter



22 June 2016

Miss JHM Mzimela 211521992  
School of Agricultural, Earth and Environmental Sciences  
Westville Campus

Dear Miss Mzimela

Protocol reference number: **HSS/0707/016M**  
Project Title: **FEW climate change adaption strategies of rural women: A case study of Ndwedwe-Cibane, KwaZulu-Natal**

**Full Approval – Expedited Application**

In response to your application received 1 June 2016, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

**PLEASE NOTE:** Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....  
**Dr Shamila Naidoo (Deputy Chair)**  
Humanities & Social Sciences Research Ethics Committee

/pm

Cc Supervisor: Dr Fathima Ahmed  
Cc Academic Leader Research: Professor Onesimo Mutanga  
Cc School Administrator: Ms Marsha Manjoo

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Humanities & Social Sciences Research Ethics Committee

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## **Appendix 2: Focus group schedule**

### **Focus group schedule: Ndwedwe-Cibane community**

**University of KwaZulu-Natal, Westville**

**School of Environmental Science**

### **Focus group: Adaptation to climate change impacts**

#### **INTRODUCTION**

Welcome and thank you for attending these focus group discussions. My name is Jabulile Happyness Mzimela a Masters candidate from the School of Environmental Sciences, University of KwaZulu-Natal. The aim of this exercise is to inform my research, entitled: FEW climate change adaptation strategies of rural women: A case study of Ndwedwe-Cibane, KwaZulu-Natal. For the next four days (3-4 hours per day) the group will use PRA tools and exercises to discuss topics including: women's perception of climate change, vulnerability to climate change; climate change impacts on women's livelihoods in terms of agriculture, energy and water resources; climate change adaptation; opportunities and constraints faced by rural women when adapting to climate change impacts and steps women can take to support adaptation strategies.

#### **Ground Rules:**

- Your participation is voluntary and there is no penalty for refusing to participate
- All information shared here is confidential
- Please, feel free to speak openly.



## **DAY 1 (4 hours)**

### **Section 1: Women's climate change knowledge (1 hour)**

1. What is your experience of climatic changes in the past 30 to 50 years? (**Matrix scoring**)

*In this study climate/climatic change refers to long term changes in climate variables (temperature and rainfall) and climatic hazards.*

*Question 2 will be validated using rainfall and temperature data from the South African Weather Service to reveal whether or not women's perceptions are in line with scientific climatic data.*

- 1.1 What is the cause of climate change?
- 1.2 Are there traditional weather prediction systems and if so, are they still working and appropriate?
- 1.3 What information is available to you on climate change? (source, frequency and dissemination)
- 1.4 Is the climate variability and change information provided to the community in the appropriate manner routinely?
- 1.5 Is there any partnership between the community and South African Weather Service or any climate change research organization and if so elaborate on the nature and purpose of the partnership?
- 1.6 Is there any combination of indigenous and scientific knowledge with regards to climate variability and change to ensure effective adaptation?
- 1.7 Do you act after warning systems with regards to climate change and variability? If so, how do you act?
- 1.8 Will the past and current climatic trends continue into the future?

### **Section 2: To examine women's vulnerability to climate change impacts (3 hours)**

1. What is the role of women in their families?
2. What is the role of women in the community?
3. What are the key livelihood strategies employed by women in Ndwedwe-Cibane? (**Listing**)
- 4.1 Name important livelihood resources within the five categories of resources (**Resource and hazard mapping and listing**).
- 4.2 Do women own, have access to or control of the natural livelihood resources identified in the question above? Elaborate?
- 4.3 Is there a difference between single and married women in ownership, access and control of livelihood resources?
- 4.4 How does culture impact ownership, access and control of livelihood resources?
- 5.1 Where and when, frequency, severity, trends, changes are these hazards occurring? (**Resource and hazard mapping**)

5.2 Which land use/ land cover is within the area affected by climatic hazards (**Resource and hazard mapping**)

## **Section 2a: Resources, livelihoods and climate change**

### **Water**

- 2.1 What is the main source of water in the area? In addition, what are the other sources of water?
- 2.2 Where are the water sources located in Ndwedwe-Cibane? (**Resource and hazard mapping**)
- 2.3 Where does the community live in relation to water sources? (**Resource and hazard mapping**)
- 2.4 How does the community access water?
- 2.5 How far is the main water source?
- 2.6 Who owns the land where you find water resources and are there any issues surrounding the use of that land?
- 2.7 Who is responsible for water collection, storage and use?
- 2.8 What is similar/different about the way women in this community get water?
- 2.9 What are the main uses of the collected water?
- 2.10 How much time do women spend on a typical day collecting water? (**Daily activity profile**)
- 2.11 What costs are involved in getting water?
- 2.12 Do you have any concerns regarding water supply and use?
- 2.13 Are there any water management strategies? If so elaborate?
- 2.14 Do you have enough water for all uses?
- 2.15 Has water supply changed over the past three to five decades, if so, how?
- 2.16 What is the perceived cause of the change in water supply?

## **Section 2b: Resources, livelihoods and climate change**

### **Energy**

- 2.1 What is the main source of firewood in the area? And what are the other sources of firewood?
- 2.2 Where are the firewood sources located in Ndwedwe-Cibane? (**Resource and hazard mapping**)
- 2.3 Where does the community live in relation to firewood sources?
- 2.4 How does the community access firewood sources? (**Resource and hazard mapping**)
- 2.5 How far is it to the main source of firewood?
- 2.6 Who owns the land where you find firewood and are there any issues surrounding the use of that land?

- 2.7 Who is responsible for firewood collection, storage and use?
- 2.8 What is similar/different about the way women in this community get firewood?
- 2.9 What are the main uses of firewood?
- 2.10 How much time do women spend on a typical day collecting firewood? (**Daily activity profile**)
- 2.11 What are the costs involved in getting firewood?
- 2.12 Do you have any concerns regarding firewood supply and use?
- 2.13 Are there any strategies to manage firewood resources? If so elaborate?
- 2.14 Do you have enough firewood for all uses?
- 2.15 Has the supply of firewood changed over the past three to five decades, if so, how?
- 2.16 What is the perceived cause of the change in firewood supply?

## **Section 2c: Resources, livelihoods and climate change**

### **Agriculture**

- 2.1 Where is the agricultural land located in Ndwedwe-Cibane? (**Resource and hazard mapping**)
- 2.2 Where does the community live in relation to agricultural land? (**Resource and hazard mapping**)
- 2.3 How does the community access land for agricultural production?
- 2.4 How far is the agricultural land?
- 2.5 Who is responsible for agricultural production?
- 2.6 What is similar/different about the way women in this community perform agricultural work?
- 2.7 What are the common crops grown in the area?
- 2.8 What are the main uses of agricultural produce?
- 2.9 How much time do women spend on a typical day doing agricultural work? (**Daily activity profile**)
- 2.10 What costs are involved in agricultural production?
- 2.11 Who owns the land where agricultural production takes place and are there any issues surrounding the use of that land?
- 2.12 Do you have any concerns regarding agricultural land availability and use?
- 2.13 Do you have enough agricultural produce for all uses?
- 2.14 Are there any agricultural management strategies? If so elaborate?
- 2.15 Has the amount of agricultural produce/land under cultivation change over the past three to five decades, if so, how?
- 2.16 What is the perceived cause of the change?

### **DAY 2 (3 hours)**

**Section 3: To examine the impacts of climate change on women's livelihood in terms of agriculture, energy and water resources (1 hour)**

1. What are the impacts of climate change on agriculture, water and firewood sources (identify five impacts for each resource)?

1.1 Refer to agriculture, water and firewood resources. Score the impacts of climate change (**Vulnerability matrix**).

Level of significance

3= high negative impact

2= medium negative impact

1= small negative impact

0= no impact

X= positive impact

2. Concerning climate change impacts, has the time allocated to agriculture, water and firewood collection changed over the past 30-50 years, if so how?

3. Has the distance to access water, energy resources and agricultural land changed over the past 30-50 years, if so, how?

4. Has the land allocated to agriculture, water and firewood sources increased or decreased over the past 30-50 years? Is this change somewhat related to climate change? (**Trend diagramming**)

**Section 4: To assess adaptation strategies used by women in response to climate change (1 hour)**

1. Which adaptation strategies have women implemented to deal with the perceived impacts of climate change on agriculture, water and firewood resources?

1.1 Are these climate change adaptation strategies effective? Specifically:

- a. Do they increase the flexibility and capabilities of women's responses to climate?
- b. Do they complement long-term development?

1.2 Which livelihood resources are important for climate change adaptation and their level of significance?

1.3 Are these adaptation measures sustainable?

1.4 What are the cost and benefits of the adopted adaptation measures?

**SECTION 5: To assess the constraints faced by rural women relating to climate change adaptation strategies (1 hour)**

- 1.1 What have been the obstacles/barriers to climate change adaptation in relation to agriculture, water and firewood resources?

### **DAY 3 (3 hours)**

#### **SECTION 6: To identify steps/opportunities women can take to support adaptation strategies and reduce their vulnerability to climate change impacts (3 hours)**

1. What are the alternative adaptation strategies that women would like to adopt to reduce the negative impacts of climate change and make the most of the positive climate change impacts on agriculture, water and energy resources?
2. How will these adaptation strategies change in relation to the projected changes in climatic conditions?
3. What are the barriers to adopting these new adaptation strategies?
4. Which groups/individuals/institutions/organizations support women's adaptation to climate change impacts? (**Venn diagram**)
  - 5.1 Name and list activities of any internal or external organization/group/institution present in the area or having important positive or negative influence on climate change adaptation.
  - 5.2 Are the implemented strategies affordable, sustainable, effective, culturally acceptable and technology appropriate?
  - 5.3 Are you satisfied with the support given? Why?
  - 5.4 Is the support provided by the above-mentioned groups/individuals/institutions/organizations relevant to the needs and concerns of Ndwedwe-Cibane inhabitants?
  - 5.5 Are adaptation measures by groups/individuals/institutions/organizations holistic and concentrate on agriculture, water resources and firewood?
  - 5.6 Are the adopted adaptation measures simple to use or do they require inputs or some level of training?
  - 5.7 Do these groups/individuals/institutions/organizations consider issues related to gender?
  - 5.8 Which individuals/organizations/institutions should be responsible for ensuring women's adaptation to climate change?
5. Have you heard of government's climate change and adaptation policy? If so, can you elaborate on what you have heard?
7. Women of Ndwedwe-Cibane involved in climate change and adaptation policy development or planning processes?
8. Are the barriers to women's participation in climate change and adaptation policy development or planning processes?

9. What activities can women undertake to prepare for anticipated future change in climate variables and climatic hazards.

**Appendix 3: Key informant interview schedule (Leader of Traditional Authority)**

**Key Informant Interview: Leader of traditional council**

**University of KwaZulu-Natal, Westville**

**School of Environmental Science**

**Masters Research**

**Topic:** FEW climate change adaptation strategies of rural women: A case study of Ndwedwe-Cibane, KwaZulu-Natal

**Researcher: Jabulile Mzimela**

(All respondents and responses will remain anonymous and the information will be used strictly for research purposes)

Name of Institution:

Respondent's Position:

Duration: 45-60 minutes

**Section 1: Climate change information**

- 1.1 Does the local traditional council have access to climate change and adaptation information?
- 1.2 If so, what are the observed and predicted climatic changes and impacts on agriculture, water and firewood resources in Ndwedwe-Cibane?
- 1.3 What climate information is presented to the community to create awareness of climate change and adaptation (when, how and how frequent and by who)?
- 1.4 Are there local plans and policies to address climate change risk of agriculture, water and firewood resources in Ndwedwe-Cibane?

**Section 2: Climate change adaptation**

- 2.1 Does the traditional council have the necessary capacity to plan and implement climate change adaptation measures into their work?
- 2.2 Does the traditional council have the necessary resources to plan and implement climate change adaptation measures? What is the budget? Where do the resources come from?
- 2.3 What agricultural, water and firewood issues has the community encountered or reported to the traditional council?

- 2.4 What agricultural, water and firewood issues relating to climate change and variability has the community encountered or reported to the traditional council?
- 2.5 What initiatives has the traditional council adopted to assist communities within Ndwedwe-Cibane with climate change and adaptation?
- 2.6 Has the traditional council had any positive outcomes on its climate change and adaptation initiatives? If so elaborate?
- 2.7 Are the traditional council adaptation plans and measures for climate change adaptation sufficient and effective?
- 2.8 Are there any other effective support structures such as private companies and/or non-governmental organizations (NGO's) working with the traditional council supporting women in climate change and variability adaptation endeavors?
- 2.9 In the context of climate change adaptation what challenges has the traditional council faced?
- 2.10 What are the existing capacity and resource needs for climate change adaptation?
- 2.11 What new capacities may be needed to address changing conditions as a result of climate change?

### **Section 3: Women and climate change adaptation**

- 3.1 Which group, single or married women are the most vulnerable to climate change impacts, why and how?
- 3.2 Are local planning processes on climate change adaptation participatory?
- 3.3 Do women as a marginalized group have a voice in the traditional council climate change adaptation policies and planning processes?
- 3.4 What issues have women reported that negatively affect their ability to adapt their livelihoods to climate change?
- 3.5 Are women's livelihood adaptation strategies to climate change sufficient and effective?
- 3.6 Do local policies enable women to access and control critical livelihood resources, which are essential for climate change adaptation.
- 3.7 Are there any long term goals pertaining to climate change and variability adaptation? If yes, what are they and when will they be implemented?

*Thank you for participating in this project.*



**Appendix 4: Key informant interview schedule two (Extension officer)**

**Key Informant Interview: Agricultural extension officer -Department of Agriculture and  
and Environmental Affairs (DAEA)**

**University of KwaZulu-Natal, Westville**

**School of Environmental Science**

**Masters Research**

**Topic:** FEW climate change adaptation strategies of rural women: A case study of Ndwedwe-  
Cibane, KwaZulu-Natal

**Researcher: Jabulile Mzimela**

(All respondents and responses will remain anonymous and the information will be used  
strictly for research purposes)

Name of Institution:

Respondent's Position:

Duration: 45-60 minutes

**Section 1: Climate change information**

- 1.1 Does DAEA have access to climate change and adaptation information?
- 1.2 If so, what are the observed and predicted climatic changes and impacts on agriculture in Ndwedwe-Cibane?
- 1.3 What climate information is presented to the community to create awareness of climate change and adaptation (when, how and how frequent)?
- 1.4 Are there local plans and policies to address climate change risk of agriculture in rural areas, particularly Ndwedwe-Cibane?

**Section 2: Climate change adaptation**

- 2.1 Does DAEA have the necessary capacity to plan and implement climate change adaptation measures into their work?
- 2.2 Does DAEA have the necessary resources to plan and implement climate change adaptation measures? What is the budget? Where do the resources come from?
- 2.3 What agricultural issues has the community encountered or reported to DAEA?
- 2.4 What agricultural issues relating to climate change and variability has the community encountered or reported to the DAEA?

- 2.5 What initiatives has the department adopted to assist communities within Ndwedwe-Cibane with climate change and adaptation?
- 2.6 How often does the department monitor climate change adaptation measures?
- 2.7 Has the department had any positive outcomes on its climate change and adaptation initiatives? If so elaborate?
- 2.8 Are the department's adaptation plans, policies and measures for climate change adaptation sufficient and effective?
- 2.9 Are there any other effective support structures such as private companies and/or non-governmental organizations (NGO's) working with the department and supporting women in climate change and variability adaptation endeavours?
- 2.10 In the context of climate change adaptation what challenges has the department faced?
- 2.11 What are the existing capacity and resource needs for climate change adaptation?
- 2.12 What new capacities may be needed to address changing conditions as a result of climate change?

### **Section 3: Women and climate change adaptation**

- 3.1 Which group, single or married women the most vulnerable to climate change impacts?
- 3.2 Are local planning processes on climate change adaptation participatory?
- 3.3 Do women as a marginalized group have a voice in your departments' climate change adaptation policies and planning processes?
- 3.4 What issues have women reported that negatively affect their ability to adapt their livelihoods to climate change?
- 3.5 Do local policies enable women to access and control critical livelihood resources, which are essential for climate change adaptation.
- 3.6 Are there any long term goals pertaining to climate change and variability adaptation? If yes, what are they and when will they be implemented?

*Thank you for participating in this project.*