THE INFLUENCE OF CLIMATE CHANGE ON THE LIVELIHOODS OF WOMEN INVOLVED IN RURAL AGRICULTURE IN KAKAMEGA COUNTY, KENYA

BY

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DISSERTATION PRESENTED FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN THE FACULTY OF ARTS AND SOCIAL SCIENCES AT STELLENBOSCH UNIVERSITY

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MARCH 2020

DECLARATION

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

March 2020

ABSTRACT

Climate change is a global challenge that negatively affects natural, physical, human, financial and social capital and the livelihoods of people. In Sub Saharan Africa and Kenya, the influence of climate change is more pronounced on the livelihoods of rural farmers due to their overreliance on natural resources. This study investigated the influence of climate change on women farmers in Kakamega County in Kenya and how they adapt, and the assets they draw on to cope with the effects of climate change on their livelihoods.

The study explored how gender roles, intersectionality and differential access to assets affect women's adaptation and resilience to climate change. To establish this, a qualitative cross-sectional exploratory study design was used to unearth the livelihood experiences of rural women farmers. The study was conducted over a period of four months between September 2017 to January 2018 across five sub counties including Lurambi, Malava, Mumias West, Lugari, and Lubao in Kakamega County. A total of 138 individual male and female farmers participated in the study; data collection was done over three months and involved ten life histories, sixteen key informant interviews and twelve focus groups and participant observations. Field notes and transcripts were thematically analysed.

A Sustainable Livelihoods Approach guided the study's framework for analysis, complemented by the Asset Based Community Development approach, resilience theory and feminist theory. Key findings show that the main aspects of climate change affect women are temperature changes and variable precipitation causing floods and droughts. Such have a negative influence on the livelihoods of women who mainly rely on crop production, livestock production and small businesses. Changes in climate generally have a negative impact on the livelihoods of rural men and women farmers and affect their health, energy, water availability, biodiversity, labour demands and social systems. The effects are more pronounced on women compared to men farmers due to their high dependence on natural resources to sustain their livelihoods. In addition, the influence on women is exacerbated by their reproductive roles that expose them to climate effects and disempower them to respond to the effects.

Given the gendered effects of climate change in terms of the division of labour and underlying societal values, the key factor that influence women's ability to mitigate the effects of climate change is patriarchy. This affects their ability to access various capitals and related assets. As a result of patriarchy, women's decision-making and ability to respond to climate change is compromised. Women overcome this by using various social networks and groups to access the necessary resources to build resilience to climate change. The need to address the effects of patriarchy and promote access to capital is necessary to build women's capacity to adapt and build resilience to climate change.

Key ways women use to adapt and cope with the effects of climate apart from social networks included the use of indigenous knowledge to predict climate change; to resort to off farm labour (human capital);draw on social networks and government support (social capital); crop diversification and mixed farming (natural capital); sale of livestock and loans from microfinance (financial capital). However, women have limited access to these forms of capital due to patriarchal nature of the society that promotes male dominance and give men privileges

and rights to ownership of assets compared to women. Women mostly access these assets through men or their husband, which limits their ability to adapt and respond effectively to climate induced shocks.

The study found that women are not passive victims of climate change but have developed various strategies to mitigate the influence of climate on their livelihoods. They have developed various resilience pathways to enhance their absorptive coping capacity, adaptive capacity and transformative capacity to overcome the influences of climate change. The resilience pathways are interconnected and exist at multiple levels from the individual to household, community; and even at national level and they overlap within social-ecological systems. Within this, the study found that social capital in the form of bonding, bridging and linking capital was essential to building capacity and resilience and strengthening the ability of rural farmers to deal with climate related shocks.

OPSOMMING

Klimaatsverandering is 'n wêreldwye uitdaging wat die natuurlike, fisieke, menslike, finansiële, sosiale kapitaal asook die lewensbestaan van mense negatief beïnvloed. In sub-Sahara-Afrika en Kenia, is die invloed van klimaatsverandering meer diepgaande op die lewensbestaan van landelike boere vanweë hul natuurlike hulpbronne afhanklikheid. Hierdie studie het ondersoek watter invloed klimaatsverandering op vroueboere in Kakamega Distrik in Kenia het, om te bepaal hoe hulle aanpas, die bates wat hulle gebruik om die gevolge van klimaatsverandering op hul lewensbestaan die hoof te bied.

Die studie het ondersoek ingestel na hoe geslagsrolle, interseksionaliteit en differensiële toegang tot bates, die aanpassing en weerbaarheid van vroue ten opsigte van klimaatsverandering beïnvloed. Om dit te bepaal, is 'n kwalitatiewe dwarsseksionele verkennende navorsings studie ontwerp om die lewensondervindings van vroulike boere in die platteland te ontdek. Die studie is uitgevoer oor 'n periode van vier maande vanaf September 2017 tot Januarie 2018 in vyf distrikte, naamlik Lurambi, Malava, Mumias-Wes, Lugari en Lubao in die provinsie Kakamega. Altesaam 138 individuele manlike en vroulike boere het aan die studie deelgeneem; data-insameling is oor drie maande gedoen en het tien lewensgeskiedenisse, sestien sleutel-informantonderhoude en twaalf fokusgroepe en deelnemende waarnemings behels. Veldnotas en transkripsies is tematies ontleed.

'n Volhoubare lewensbenadering raamwerk het die studie gelei, wat aangevul was deur die bates benadering raamwerk van gemeenskapsontwikkeling, weerbaarheidsteorie asook feministiese teorie vir die analiese. Belangrike bevindings toon dat die hoof aspekte van klimaatsverandering wat vroue beïnvloed, is temperatuurveranderings, en veranderlike neerslag wat oorstromings en droogtes veroorsaak. Dit het 'n negatiewe invloed op die lewensbestaan van vroue wat veral op oesproduksie, veeproduksie en klein ondernemings staatmaak. Veranderings in die klimaat het oor die algemeen 'n negatiewe invloed op die lewensbestaan van landelike mans- en vroueboere en beïnvloed hul gesondheid, energie, die beskikbaarheid van water, biodiversiteit, arbeidseise en sosiale stelsels. Die gevolge is meer prominent op vroueboere in vergelyking met mansboere as gevolg van hul groot afhanklikheid op natuurlike hulpbronne om hulle lewensbestaan te onderhou. Daarbenewens word die invloed op vroue vererger deur hul voortplantingsrolle wat hulle blootstel aan klimaatseffekte en hulle bemagtig om op die gevolge te reageer.

Gegewe die geslagseffekte van klimaatsverandering, asook die verdeling van arbeid en die onderliggende samelewingswaardes, het patriargie 'n belangrike invloed op die vermoë van vroue se om die gevolge van klimaatsverandering te verminder. Dit het hul vermoë om toegang tot verskillende kapitale en verwante bates te bekom beïnvloed, wat hul besluitneming en die reaksievermoë ondermyn. Vroue oorkom dit deur verskillende sosiale netwerke en groepe te gebruik om toegang tot die nodige hulpbronne te bekom om weerbaarheid teen klimaatsverandering te teenstaan.Om die gevolge van patriargie aan te spreek en toegang tot kapitaal te bevorder, is dit nodig dat vroue se vermoë en weerbaarheid op gebou word sodat hulle die kapasiteit het om aan te pas by klimaatsverandering.

Die kern maniere wat vroue gebruik om by die gevolge van klimaat aan te pas, behalwe sosiale netwerke, is die gebruik van inheemse kennis om klimaatsverandering te voorspel; hulle arbeid verkry vanaf die plase (menslike kapitaal); oes diversifisering en gemengde boerdery (natuurlike kapitaal); verkoop van vee en lenings van mikro-finansiering (finansiële kapitaal). Vroue het egter beperkte toegang tot hierdie vorme van kapitaal as gevolg van die patriargale aard van die samelewing, wat man's voorregte en regte gee ommeer bates te besit in vergelyking met vroue. Vroue verkry meestal toegang tot hierdie bates deur mans of hul man, wat hul vermoë beperk om doeltreffend aan te pas en te reageer op klimaat skokke.

Die studie het bevind dat vroue nie passiewe slagoffers van klimaatsverandering is nie, maar dat hulle verskillende strategieë ontwikkel om die invloed van die klimaat op hul lewensbestaan te verminder. Hulle het verskillende weerbaarheidsroetes ontwikkel om hul absorberende vermoë, aanpassingsvermoë en transformatiewe vermoë te verbeter om die invloede van klimaatsverandering te oorkom. Dit is alles onderlangs verbind en bestaan op verskillende vlakke van individu tot huishouding, gemeenskap; distrik, nasionale en hulle word binne sosiaal-ekologiese stelsels oorvleuel. In die studie word daar gevind dat sosiale kapitaal in die vorm van verband-, oorbrugging- en koppeling kapitaal noodsaaklik is om kapasiteit, weerbaarheid en die vermoë van landelike boere om klimaatsverwante skokke te hanteer, te versterk.

ACKNOWLEDGEMENTS

I thank God for giving me the ability, wisdom and strength to complete this project. Your grace has been sufficient for me. I am so grateful. In this long journey God has been everything and he will always. All honour and glory be to you.

I dedicate my sincere acknowledgment to my supervisor, Professor Lindy Heinecken for her dedicated and consisted support in my project work. Her careful sense for detail, strictness with deadlines balanced with flexibility and readiness to guide me even at odd hours challenged to bring out the best in me. She did not only supervise me but also mentored me in various ways to see me through my studies. Your commitment and sacrifice towards the success of this project is unquantifiable. I could not have done it without your guidance and scholarly mentorship. Challenging my thinking by helping me question assumptions and view issues from multiple perspectives. You once told me in our conversations. “Pauline keep moving on you cannot do what you did yesterday and expect same results”. Thanks for your invaluable critique. Your words of encouragement helped me to persevere.

I am indebted to Graduate School of Arts and Social Sciences, Stellenbosch University through which the opportunity to access doctoral studies came. My gratitude goes to the Gerda Henkel Foundation in partnership with PANGea. Without such a scholarship, my dream to pursue my PhD would have been shelved. I am grateful to Dr. Cindy Steenekemp, for all the commitment both academic and administration support. You kept us under regular review and this became the guiding spirit of our research.

Many thanks to Prof. Peter Wasamba, I will forever be grateful for being my role model.

Not forgetting my employer, the University of Nairobi for granting me the opportunity for a 3 years study leave. Special thanks to The Principal, College of Humanities and Social Sciences, the Chairman, Sociology department.

I attribute much thanks to my family especially my Mum, Mama Joina Ndeso for the daily encouragement she always gave me. Your prayers and the spirit of hard work kept me standing through the long academic route. You remain a star in my life and source of strength to me during life’s challenges.

Special thanks to my friend Maureen Amimo. Your endless support and amazing friendship are a blessing. Thanks for being a true sister, you’ve walked me a long through this journey. Whenever I sounded too low or sick, you were always there to hold my hand. Several times you offered me a shoulder to cry on, without forgetting Nobert Basweti for his daily encouragement.

I also thank my family to whom I owe a great deal. To my brothers Ben, Fred, and Hezron, thank you for your moral support. Also thanks to my sisters, Rasoa, Rebah, Makonjo Hellen, Margaret, Pamela, Jennipher, Joyce, Jane, Maureen and Alfred for your prayers and word of encouragement.

I would like to thank my mentors and friends, Josephine Misaro & Shadrack Okumu who encouraged me to pursue this degree. Their insight and advice helped me realize my own strength, which also inspired this dissertation. I am forever grateful.

To my fellow PhD candidates, Hildah Doro, Dande, Lloyd, Abena, Steve, Itai, Tasfasion, Admire, Nuwamanya, Mary-Jane, Trevor, Thulani, Nerisha, Martin, and the late Mohammed Makaato. *May his soul rest in peace*. I am appreciative for the fellowship and support we had together.

I am also indebted for the help and editing expertise on my thesis provided to me by Dr. Karen Graaff and Fisayo Ajala. I must also thank Dr. Sallek Musa for his great mentorship and support, and Neil Kramm for always sharing academic ideas whenever I felt lost.

And to the administration of Sociology Department, Ms. Genay, Nwabisa and Marinice, thank you all for your kindness and support. Your professionalism was shown by your prompt delivery of Student's requests and needs. I am grateful for your help.

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DEDICATION

To my late dad, who unfortunately didn't stay in this world long enough to see his daughter get a PhD degree. Thank you for showing me that the key to life is happiness. You believed in me and you always wanted the best for me. My beloved late brother Murunga Walutsachi, thank you for teaching me that my job in life was to learn, to be happy, and to know and understand myself; only then could I know and understand others. To my late step mum Esther Watekhwa for her love for education. Special love for you.

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LIST OF ACRONYMS

(GHA)	Greater Horn of Africa
ABCD	Asset Based Community Development
CIAT	International Centre for Tropical Agriculture
ESNO	El Niño–Southern Oscillation
FGD	Focus Grou Discussions
FPE	Feminist Political Ecology
GDP	Gross Domestic Product
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter-tropical Convergence Zone
IUCN	International Union for Conservation of Nature
LM	Lower Medium
LULUCF	Land-Use, Land-Use-Change and Forestry
MAM	March–May
MDG	Millennium Development Goals
NCCRS	National Climate Change Response Strategy
ND- GAIN	Notre Dame Global Adaptation *Initiative*
NGO	Non- Governmental Organizations
OND	October–December

RVF	Rift Valley Fever
SAT	Surface Air Temperature
SDGs	Sustainable Development Goals
SIDA	Swedish International Development Cooperation Agency
SLA	Sustainable Livelihood Approach
SSA	Sub Saharan Africa
SSTs	Sea Surface Temperatures
TAR	Third Assessment Report
UM	Upper Medium
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFPA	United Nations fund for Population
US	United States
WASH	Water Sanitation and Hygiene
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background

Climate change is one of the most severe global issues affecting the planet in the 21st century (Feulner, 2015; Swai, Mbwambo & Magayane, 2012) and the impact of climate change on the livelihoods of men and women is overwhelming all across the world (Annecke, 2002). Africa is no exception. The continent has been identified as one of the most vulnerable to the influence of climate change due to high geographic exposure to incidences of droughts, floods and other natural disasters; low income limiting people's ability to cope with the effects of climate change; overreliance on climate-sensitive sectors, especially rain-fed agriculture; and limited capacity to adapt to climate changes and related shocks (Niang et al., 2014; Serdeczny, Adams, Coumou, Hare& Perrette, 2016). Consequently, the effects of climate change are felt in various sectors and livelihood sources, including but not limited to health, energy, agriculture, water, tourism, livestock and environment (Vogel *et al*., 2007). The effects vary across regions due to differential geographic exposure and intensity of the impact of climate change (Huho& Mugalavai, 2010; Ochieng, Kirimi, & Mathenge, 2016). In addition, variations in the effects of climate change differ by gender, due to underlying gender roles and power dynamics that affect access to resources and subsequently the adaptive capacities of women and men (Goh, 2012).

Similar to the rest of Africa, Kenya has livelihood systems that are highly dependent on natural resources (Ayugi& Tan, 2018; Nyanjom, 2014). Rain-fed agriculture is the dominant source of livelihood and the major means of food production for the majority of the rural poor (Okoti, 2019). Agriculture is the mainstay of the Kenyan economy, contributing approximately 26% of the GDP directly and 25% indirectly. Similarly, the sector provides about 18%of the formal employment and more than 70% of the informal employment in the country, predominantly in rural areas (Republic of Kenya, 2010a). Over 80% of the Kenyan population live in rural areas and depend directly or indirectly on agriculture for food security (Huho & Mugalavai, 2010). This makes the country highly vulnerable to the effects of climate change and weather variability.

The aspects of climate change experienced in Kenya include rising Surface Air Temperatures (SAT) (Ayugi & Tan, 2018; Hulme et al., 2001; IPCC, 2001a), sporadic precipitation (Few, Ahern, Matthies, & Kovats, 2004), and increased drought (Bizimana, Bessler Regents, & Angerer, 2016; Hastenrath & Stefan Polzin, 2006; Huho & Mugalavai, 2010). Rising temperatures caused by human activities and continuous emission of greenhouse gases into the environment are a problem across the globe. Though general trends globally and in Africa show rising temperatures, the trends are not uniform and differences have been observed across different regions, with variability in different parts of East Africa including Kenya (Ayugi & Tan, 2018; Niang *et al*., 2014). These variations are as a result of differences in land surface and geographical features, making some regions report general cooling signals, especially the marine ecosystems such as inland lakes, but upward trends in temperature in the urban regions (Ayugi& Tan, 2018; Niang *et al*., 2014). The consequences of such variations include negative effects on crop yield, water resources, parasites, and vectors breeding, and consequently on human health (Awojobi, 2017).

Another significant aspect of climate change is sporadic rain patterns which negatively impact small-scale farmers whose livelihoods directly depend on agriculture (Awuor, Orindi, & Adwera, 2008; Ongoro & Ogara, 2011). Sporadic rain patterns have a large impact in Kenya because 98% of agriculture in Kenya is rain-fed and farmers rely on the timing of the onset and end of rainy seasons to determine planting and harvesting. Due to changing rain patterns, Kenyan farmers have recently been adversely affected as the traditional two rainy seasons, March to May's "long rains" and October to December's "short rains", have changed and become unpredictable (J. Ochieng et al., 2016a). Recent years have seen consistent delays in the onset of the rainy seasons, with 2019 recording the worst delay with the onset only coming in late April. With sporadic rain patterns, there are also times when the rains come in time, but stop earlier than expected, leading to massive crop failures, which is detrimental to the livelihoods of small-scale poor rural farmers, the majority of whom are women.

Apart from changing rain patterns, droughts have also become a common climate and weather-related event in Kenya. According to Huho & Mugalavai, (2010), droughts in northern Kenya have increased in frequency from once every ten years in the 1970s, to once every five years in the 1980s,once every two – three years in the 1990s,becoming an annual occurrence since the year 2000. Frequent droughts adversely affect agricultural production (Huho & Mugalavai, 2010) and lead to famine. Hence, food insecurity and famine relief has become a regular feature

in some parts of the Arid and Semi-Arid Lands (ASALs), such as Machakos, Laikipia, Turkana and Isiolo Districts (Schmidt, Peter Uhe, Kimutai, Otto, & Cullen, 2017). The effects of drought are widespread, resulting in deficiency in precipitation and moisture, biotic loss, and crop failure (Coulibaly, Gbetibouo, Kundhlande, Sileshi, & Beedy, 2015). The effects are even more severe when there is rapid recurrence of drought-related shocks, leaving little or no recovery time before the next shock occurs (Omolo, 2011). Due to annual recurrent droughts, most crop farmers in Kenya are losing their livelihoods and capacity to feed their families, since they rely heavily on rain-fed agriculture.

Women play a major role in rural agriculture in Kenya, providing between 42% and 65% of the agricultural labour force in the country (Alston, 2013). Rural women, who constitute the majority of small-scale farmers, are hard hit by climate change as they depend heavily on rain-fed agriculture (Hannan, 2011). Furthermore, studies show that women suffer more from the effects of climate change than men, due to gender inequalities that persist in terms of access to, control over and utilisation of productive resources such as land, livestock, labour, education, extension and financial services, and technology (Diiro*et al.*, 2018; Ongoro & Ogara, 2011). In Kenya, there has been very little research on the influence of climate change on the livelihoods of rural women farmers and how they are adapting to the different effects.

In Kakamega County, agriculture employs over 80 per cent of the population in the county who mainly live in the rural areas. In fact, the agricultural sector p is the backbone of the County's economy and accounts for over 65 per cent of the total earnings. The larger part of the proportion of the county's population is employed either directly or indirectly in agriculture. The Country's total land acreage is 305,130Ha with 27,075Ha under forest cover and 255,483 under crops. Cash crops are mainly male driven take a larger portion of the land (141,429Ha), compared to food crops which are female driven and covers 114,053.6ha (County Government of Kakamega, 2018).

Women traditionally lack access to land rights and ownership, best, they have insufficient rights, typically restricted by their husbands (Ondiba & Matsui, 2019). Customary practices and patriarchal systems play an important role in this unequal division of land. These practices often marginalise women, particularly those without husbands, including young girls, widows and divorced women, as female access to land is defined by their relationships to male relatives. Yet, it is women who are the main producers of edible crops.

The major crops produced in the County include maize, beans, sweet potatoes, cassava, bananas, sorghum, finger millet, local vegetables, rice, tea, sugarcane and horticulture. The majority of farmers are women who practice small scale farming, although this varies in scales. The southern part of the county mostly practice small scale farming, medium scale is practiced towards central and northern and large scale farming is only performed in the northern part of the county. About 85.5% of the County is rural (Ondiba & Matsui, 2019) and the County is ranked among the poorest in Kenya with a poverty incidence of 49.2% (Ondiba & Matsui, 2019). The County government provides safety net programs to the poor, old and vulnerable members of the community. The most pronounced is the shelter improvement program where the county government constructs housing units for the old and vulnerable members of the society and in addition provides the beneficiary household with food subsidy and beddings (County Government of Kakamega, 2018).

Climate change and poverty is specifically more pronounced arid and semi-arid parts of the country which form a greater part of the northern and North Eastern regions of Kenya mostly occupied by pastoralists and agro-pastoralists. Most studies on climate change in Kenya have therefore been done on Northern and North Eastern regions with the assumption that the arable agricultural regions such as Kakamega are least or never affected by climate changes. Consequently, few studies have focused on the effects of climate change on livelihoods in arable cropping regions such as the Kakamega County, which is considered the food basket of the country. In fact, even slight changes in climatic conditions can have detrimental effects on food production and the livelihoods of people in these regions.

1.2 Rationale for the study

As seen the agricultural sector provides informal employment to 70% of rural dwellers, and being the main source of livelihood for the majority of Kenyans, whatever detracts agriculture remains important for scrutiny (Kenya Institute for Public Policy Research and Analysis (KIPPRA), 2017; Republic of Kenya, 2010a). Furthermore, in Kakamega County, agriculture accounts for 65% of the total earnings of the county (County Government of Kakamega, 2018) and remains the main source of livelihood for rural women and men in western region despite the effects of climate-related shocks (Parry, Echeverria, Dekens, & Maitima, 2012). Though several studies have been done on climate change in Kenya and Africa, (Awojobi, 2017; Goh,

2012; Niang et al., 2014) few have specifically investigated the specific influence of climate change on women's livelihoods in Africa and none has been done in Kakamega County. This study therefore bridges the gap by asking "what are the effects of climate change on the livelihoods of women in Kakamega?"

Secondly, the existing literature shows that women's livelihoods are often highly affected by climate change in comparison to men (Annecke, 2002; E. R Carr & Thompson, 2013), with their coping mechanisms or adaptations to climate-related shocks influenced by gender roles, power imbalances and differentials in terms of access to various forms of capital (Christopher Paul, Erika Weinthal, Marc Bellemare, 2016). As such, women are often presented as vulnerable victims of climate changes rather than agents of change and development. In fact the contributions of women to climate mitigation, adaptation and resilience building have often been downplayed. The study bridges the gap by focusing on the role of women farmers in climate change mitigation, adaptation and resilience building.

In the third place, the influence of patriarchy and constraints this places on women's access to different forms of capital limits women's ability to adapt and build resilience to the influence of climate change on their livelihoods (Shakya, Cooke, Gupta, & Bull, 2018). Most rural women have limited access to assets due to the effects, of patriarchy. The question of what assets women cling to in order to cope with the effects of climate change remains critical to our understanding of how they adapt. In addition, it is essential to understand how the socially ascribed roles and categorization influence women's ability to adapt to effects of climate and build their livelihoods.

In addition, the SLA provides a useful lens through which to analyse the several layers of livelihoods, considering the involvement of local actors, external agents, different forms of capitals and the roles they play in both enhancing livelihoods and building resilience. However due to the limitations of the SLA, including overemphasis on external agencies, over-concentration on the micro and limitations in explaining power inequalities, the approach is complemented with other theoretical underpinnings including feminism, ABCD and resilience. Such provides a unique lens to understand how climate change influences the lives of rural women farmers. As such the theoretical framework provides a new complex way of investigating rural livelihoods.

The study links with the global sustainable development goals including goal number one- to end poverty in all its forms everywhere; goal two- which works to end hunger, achieve food security and improved nutrition and promote sustainable agriculture; goal three which works to ensure healthy lives and promote well-being for all at all ages; goal four working to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all through agricultural extension training work; goal five working to achieve gender equality and empower all women and girls and goal 13 working to take urgent action to combat climate change and its impacts (Ngigi, Mueller, & Birner, 2018). As such the study contributes to six of the seventeen sustainable development goals (Janouˇ, 2016). In addition, the study contributes to the achievement of the Kenyan Vision 2030 and are in line with the president's big four agenda, especially that of food security.

Besides contributing to Kenya's development agenda and priorities, the study seeks to identify climate challenges that are specific to women farmers in non-arid and semi-arid areas and how they respond to this at grassroots level. Once one understands this, it is much easier to make recommendations on how to deal with the issues that affect rural women farmers' ability to sustain their livelihoods and to provide food security.

1.3 Research questions

The aim of this study is to investigate the influence of climate change on women in Kenya in general, and in Kakamega County in particular. To date, there has been no study that has looked at the multi-faceted effect of climate change of women in this region who are the mainstay of agricultural production and food security (Rights, 2015). This study aims to bridge this gap by examining the effects of climate change on women in Kenya. The primary research question is: How do women cope with the influence of climate change on their livelihoods and what capitals do they draw on to adapt and build resilience?

1.4 Research objectives

The study aims to achieve the following objectives:

1. To explore the influence of climate change on the livelihoods of rural women farmers in Kakamega County.

2. To examine the assets that women draw on in coping with the effects of climate change on their livelihoods.
3. To explore how gender roles, intersectionality and differential access to assets affect women's adaptation and resilience to climate change.
4. To establish how women in Kakamega County adapt and build resilience to the effects of climate change on their livelihoods.

1.5 Research design and methodology

This study adopted a qualitative approach aimed at exploring the lived experiences of poor rural women practicing small-scale agriculture. A qualitative approach is most suited to studies that seek to understand the lived experiences of people and how they make sense of it (Bryman, 2012; Musa, 2018). This approach allows participants to describe how incidences of climate-related shocks affect their daily lives, and how they cope with such effects. The approach is suitable for exploring in-depth issues, and produces rich and detailed data from lived experiences (Bryman, 2012:36), which was necessary for this study.

The study was conducted over a period of four months between the months of September 2017 to January 2018 with a total of 138 participants from five different sub-counties of Kakamega County. Qualitative data collection methods were used, including life histories to elicit individual experiences, focus-group discussions to bring out group views, and key informant interviews to capture the ideas of knowledgeable stakeholders in the sector. All the data from these methods were audio-recorded and transcribed verbatim in the local language (Luhya). The transcripts were then translated and back-translated to avoid loss of meaning, after which the finalised transcripts were coded into computer-aided qualitative data analysis software known as NVIVO 11. The coding was based on themes which emerged from the data, allowing for thematic analysis and fulfilling the requirements of an inductive study as described by Thomas (2006). The research methodology is discussed in detail in Chapter Five.

1.6 Theoretical approach and conceptualization of the study

The study is anchored on sustainable livelihoods approach (SLA) complemented with Asset Based Community Development Approach ABCD, feminist theory, and resilience theory.

1.6.1 Sustainable livelihoods approach (SLA)

The SLA puts emphasis on the context in which the rural poor live as a key contributor to their vulnerability. The framework is premised on the understanding that individuals, and the institutions and organisations they relate to, are key in mediating poor people's access to the various capitals and assets that help them cope with livelihood shocks. Through such arrangements, the rural poor are able to adopt strategies to achieve certain livelihood outcomes (Morse & McNamara, 2013).

Since rural agriculture is the main source of livelihood for the rural poor, especially women, SLA was considered useful lens through which to analyse the effects of climate change of rural farmers. This approach is suitable for exploring the variety of activities that people/communities undertake, often in combination, to make a living (Morse & McNamara, 2013). The approach is equally suited to analysing the livelihoods of poor rural women who often rely on a number of different economic activities for their livelihoods (Robert Chambers and Gordon R. Conway, 1992) .

Secondly, the approach was deemed suitable due to its ability to address the dynamic dimensions of poverty and well-being through the analysis of the assets which poor individuals, households and communities deploy to maintain well-being under changing conditions (Norton & Foster, 2001). By focusing on the multiplicity of assets that individuals and communities draw on to make their livelihoods sustainable, the approach enables one to have a holistic view of the combination of resources critical for poor rural dwellers. Such resources are categorised into five forms of assets: natural, human, physical, financial, and social capital (Norton & Foster, 2001). In addition to asset analysis, the approach also analyses the determinants and contexts of livelihoods, and as such is suitable for the analysis of livelihoods of women being affected by climate change.

Another crucial aspect of the SL approach is that it explores the underlying causes of poverty by considering a variety of factors, including levels of poverty, gender, and the social dimensions that directly or indirectly affect individuals' or communities' access to various assets and that consequently act as livelihoods constrains (Bermejo, Arto, & Hoyos, 2010). The livelihoods constraints often arise from formal and informal institutional and social factors at the communal/micro level, or may be as a result of prevailing policies, changing economic processes, and legislative frameworks at the macro level (Hussein & Nelson, 2000). SLA thus combines both micro and macro perspectives to provide broader and more suitable interventions amenable to rural livelihoods.

The approach also focuses on how individuals and communities develop livelihood strategies such as coping mechanisms and adaption strategies to realize their desired livelihood outcomes in response to a particular vulnerability context (Norton & Foster, 2001). Consequently, SLA becomes the most suitable tool to analyse and show how the poorest rural dwellers are also active decision-makers, rather than just passive victims of shocks, and struggle in their own ways to cope with the effects of climate change and shape their own livelihoods (Oliver, 2017). Intrinsically, the approach is appropriate for understanding the rural poor and coming up with pro-poor interventions.

Finally, the approach enables a holistic and comprehensive understanding of livelihood dynamics (Morse & McNamara, 2013). This is critical since individuals' or communities' strengths may change over time as the communal or individual coping strategies adjust in reaction to climate related shocks. The applicability of SLA to different settings and circumstances of uncertainty, and its capacity to be a consultative and participatory process for the cross-fertilisation of ideas and strategies between various stakeholders, makes it suitable for analysing livelihoods of individuals and households living in extreme poverty and outside the formal labour market, such as rural women farmers (Carney, 2002). Such households or individuals often extemporise their livelihood strategies due to high uncertainty and limited livelihood options. An example is a small-scale subsistence farmer who when hit by drought becomes a wage labourer on another farm, or in areas less severely affected, and later reverts to farming during the rainy seasons. Therefore, the SLA is a flexible approach that provides a framework to link communities' livelihood strategies with their asset base, as well as the ways they use available natural resources.

According to Carney (2002), the SLA approach is guided by certain basic principles; the first is that it should be "people-centred". This principle emphasises respect for the liberty and choice of the local people and should be the primary preoccupation in any development project, helping to understand poverty according to the people and how they adapt to or cope with the livelihood shocks they face. Secondly, the approach is guided by the principle of participation which maintains that it is essential for poor rural dwellers to be the main participants in choosing their livelihood and determining their livelihood trajectories. Thirdly, the approach emphasises the principle of empowerment and believes that the poor rural dwellers should have the knowledge and opportunity to exercise and defend their rights. This connects with the fourth principle of sustainability, which emphasizes environmental, economic, social and institutional sustainability, and all four factors of sustainability should be considered for a

livelihood to be considered sustainable. Fifth, the approach holds a multilevel and holistic approach that considers both the micro and macro levels, considering what affects livelihoods at the both local/communal and national/international level, through the ratification of policies and governance systems that help the poor to cope with and adapt to the effects of climate change on their livelihoods. This aspect makes it easier to trace the local level impacts of macro policies in adapting to climate-related shocks (Albore, 2018).

Another important principle is socio-cultural complexity, also referred to by Carney (2002) as detached principle. This principle maintains that in analysing livelihoods it is important to understand how assets, vulnerabilities, and strategies differ between groups, between men and women, and between social classes. This principle helps to analyse gender-differentiated effects of climate change and possible adaptation mechanisms for the different genders. Finally, SLA emphasises dynamism and flexibility, focusing on changes in livelihoods over time to cope and adapt in response to shocks. It also looks at the changing strategies that external agencies apply to help communities to cope with livelihood challenges (Carney, 2002).

When analysing livelihoods, SLA emphasises five forms of capitals/assets from which the rural poor derive their livelihoods: natural, physical, financial, human, and social capitals accumulated, developed, improved or transferred through generations (Park, 2017). These assets/capitals are the building blocks that mutually enhance livelihood resilience (Olivier, 2015). They are inter-related and can be substituted for one another, such as when as labour (human capital) is used to acquire wages (financial capital), and they can be augmented or abridged (Park, 2017).

To understand the SLA, the different forms of capitals must be elucidated. Natural capital is the first and key form of capital for most livelihoods. It includes all natural resources, such as land, water and the biological resources used by people to generate livelihood *(*Cleveland *et al*., 2014). It is key to rural livelihoods since most poor rural dwellers derive their livelihoods from natural resources (Ekesa, Bashaasha, & Muyanja, 2015) and are dependent on the land (Kameri-mbote, 2005). However, this form of capital is dynamic and changes for better or worse depending on human activities. While certain human activities such as tree-planting, cover cropping and general conservation have the potential to improve natural capital, industrialisation, pollution and clearing of tracts of land for farming often deplete natural resources. When coupled with climate change, this has detrimental effects on the livelihoods of the rural poor who directly depend on such resources. When the immediate environment in which the poor rural farmers live can no longer support their livelihoods due to a lack of natural

resources such as water, land, and forests, then it forces them to cope with such effects, either adapting to them or migrating to a more suitable environment. With the current burgeoning effects of climate change on natural resources, the SLA becomes instrumental since it presents a holistic method to view livelihood adaptation and resilience (Morse & McNamara, 2013).

Another crucial factor in natural capital is ownership and access. The critical nature of natural capital in production processes means it is key to all genders, but in most societies, gender and culture dictate the security of tenure (Kameri-mbote, 2005). Cultural beliefs in a patriarchal society dictate security of tenure, i.e. the right to own, inherit, rent, lease and remain on one's land or property while enjoying protection from arbitrary or involuntary removal, including forced evictions (Giovarelli, 2016). In patriarchal African communities, poor and rural women suffer the most since men tend to control household land – communal power is mostly vested in males to allocate the land to male heirs, who also double as the household heads (Kameri-mbote, 2005). Women therefore have limited access to land, and this limits their ability to adapt to climate change.

Another form of asset is physical capital, which includes public or private infrastructure, tools and technology used for production. Infrastructure includes roads, vehicles, shelter, water and sanitation, energy and communications. Tools and technology include production equipment, seed, fertiliser and pesticides. Physical capital is important since it helps turn raw materials into finished products and/or services (McLaughlin, 2008;Oliver, 2017). The third form of asset is financial capital which refers to the cash or commodities that may be exchanged for services or goods. They include stocks and inflows of money that people depend on for their livelihoods (Hodson, Ting& Goldman, 2009). Stocks include savings as well as liquid assets, such as livestock, furniture or jewellery, grains, and many other things that can be sold for money or exchanged for services. The rural poor keep livestock and also save in informal groups. Such stocks are helpful for cushioning livelihoods during seasons of scarcity.

The fourth form of asset available to rural women farmers is human capital. This is an embodied form of capital that includes skills, talents, leadership capacity and charisma possessed by individuals or members of a community (Tapati, Subhrangsu, Bengal, & Bengal, 2015). This form of capital is acquired and developed through training, apprenticeships and extension services, such as in agricultural settings, and enables community members to perform different livelihood activities and realise their various livelihood objectives (Birendra, Morais, Seekamp, Smith & Peterson, 2018). Human capital is necessary for both development and adaptation to climate change since it encompasses skills, health and labour force, all of which

are required for agriculture. Along with this, it contributes to technological improvement and innovation, which can help to advance the economy (Tapati *et al*., 2015). However, literature notes that women, especially poor rural farmers, have limited access to human capital and this exposes them more to the negative influence of climate change which adversely affects their adaptation to climate change.

Finally, and more critical in this study, is social capital which includes networks of relationships that an individual alludes to within a social system. According to Putman, (2000) in Claridge, (2018), social capital entails horizontal social groups such as associations, clubs, and voluntary agencies that bring individuals together to pursue one or more objectives in which they have a common interest. Social capital is an important component of sustainable livelihoods, since the social networks (bonds and trust) of the poor are one of the primary resources they have for managing risk and vulnerability (Birendra *et al*., 2018; Qi, 2018).

In this study, three forms of social capital were found to be critical for managing shocks and vulnerabilities: bonding social capital; bridging social capital; and linking social capital. Bonding social capital applies between friends and family members and may be based on trust or kinship ties. It refers to strong relationships that develop between people of similar backgrounds and interests, and usually includes family and friends (Claridge, 2018). This kind of capital is essential in providing material and emotional support during shocks and stress, and this kind of bonding strives to protect the interests of members in high-density relationships. These high-density relationships are composed of individuals belonging to networks that are interconnected by their knowledge, interactions, and trust of each other. Bonding capital in this study involved individual farmers who are closer and already know each other as family members, neighbours, friends or members of primary groups, as identified by Birendra *et al*. (2018) . During times of crisis, most women farmers turn to friends with whom they feel close for help. Women within specific localities also have family-based groups where they lend to and borrow from each other during scarcity. From the study, women farmers provide financial, emotional and social support to members who are affected by climate-related shocks. This has also been witnessed in other studies (Paul, Weinthal & Bellemare, 2016; Fajarwati, Tyas, Mei, Hasanati & Meilyana, 2016; Gonda, 2017)

Another capital form of social capital that was instrumental in the study is bridging capital, which plays a major role in linking people across societal cleavages including class, gender, religion, and race, among others (Claridge, 2018). This kind of social capital is different from bonding in that while bonding social capital puts emphasis on networks of people with a sense

of shared identity and belonging, bridging capital emphasises social relationships that promote exchange and association, especially between people with shared interests or goals but contrasting social identities (Claridge, 2018:3). In terms of bridging capital, churches, and especially the Friends Church, bring together people from different social statuses and break societal cleavages. The church provides financial, spiritual, emotional and physical support to the destitute affected by drought. Individual community leaders, such as members of county assemblies, and women representatives in the National Assembly, were also reported to provide food support to members of the community affected by climate change-related shocks.

The third form of social capital is linking. Linking social capital encompasses networks and vertical relationships created between people and formal institutions or people in charge of institutions. Such linkage increases access to key resources otherwise not accessed by the community members (Harcourt, 2017). Linking social capital is also associated with bestowal of power or authority back to the community as communities create strong ties (Claridge, 2018:4). It is an extension of bridging social capital and involves weak ties between individuals, groups or corporate actors from public institutions or agencies, such as schools, government institutions, non-governmental institutions and faith-based organisations or political groups (Babaei, Ahmad & Gill, 2012; Claridge, 2018). These were recognised in county and national government programmes to rural poor women, including cash transfers and shelter programmes to those affected by climate change. Social capital enables women to acquire other forms of assets including human and financial capital, which in turn enables them to cope with the effects of climate change on their livelihoods.

SLA, though a robust approach, it has certain limitations. These include: overemphasis on external agencies (institutional framework) rather than local communal efforts to sustain shocks (Albore, 2018); too much concentration on the micro level, i.e. at the local or communal level, and not enough on the macro level, that incorporates the state and global society (Oliver, 2017:22); inability to explain power inequalities and dynamics that determine access to different forms of capital (Scoones, 2009); and inadequate attention to gender and social hierarchies.

Due to these weaknesses of SLA, the approach cannot stand alone and is complemented by the Asset-Based Community Development approach (ABCD), resilience theory and feminist theory in order to generate a comprehensive wholesome system of analysis that takes care structure and agency, macro and micro, long and short as well as global and local livelihood issues.

The ABCD approach originated from an evaluation of community development case studies (Nel, 2015). It is based on the communitarian philosophy and emphasises the individual ties, norms and values that hold communities together (Collver, 2014). ABCD complements social capital, and emphasises the participation of the community in their own development, as well as helping to bridge the gap in SLA of overemphasis on external agencies. ABCD believes that linking community action and knowledge can help to produce solutions based on existing community assets, and therefore emphasises the local capacities, skills and assets of lower-income communities (Nel, 2015). In fact, the approach assumes that all members of a community, including the poor, possess sufficient resources to tackle their social issues (Collver, 2014), and that such stakeholders have the capacity to both identify and utilise their own assets to meet their needs as a community (Nel, 2015). The approach also illuminates the strengths and assets of the community and discourages the involvement of state as a primary actor in community development (Collver, 2014). The model encourages community development issues, such as climate change, to be tackled at the local level through consensus-building and increasing citizens' capacity and empowerment. This approach is instrumental in helping to analyse the local means that rural women famers use to adapt to the effects of climate change on their livelihoods and to promote their development.

Despite ABCD being instrumental in identifying and mobilising resources among the rural poor, the main challenge that underpins the approach is that in low-income communities, there are often limited resources to overcome livelihood shocks such as climate change. Furthermore, certain adaptations and intervention mechanisms require skilled and large-scale investments beyond the local capacity/resource base, which compels poor rural farmers to seek external support from organisations or institutions. In addition, ABCD is criticised for failing to integrate global long-term environmental issues and adaptations into rural development, a weakness observed by Scoones, (2009). In order to bridge these gaps, resilience theory is used to look at how both internal micro and external macro factors interact to promote adaptation and resilience among rural poor women farmers.

Resilience theory complements SLA in explaining community's adaptation to climate change effects and disasters on the livelihoods of rural women farmers. It is focused on how rural farmers use resources or capitals - social, economic, human, physical and natural to adapt to climate and build resilient livelihoods (Borquez, 2017). Each of these five forms of capital corresponds to a number of the characteristics of resilient systems. For example, a strong base of social capital in the form of trust, norms and networks would lead to a high degree of

coordination and cooperation in the community, as evidenced by the presence of numerous non-profit organisations. Similarly, human capital in the form of education, health, skills, knowledge and information provides a high capacity to develop and implement an elective risk-reduction strategy and be able to cope with the effects of climate change on livelihoods. Given the risk and impacts of climate change on rural livelihoods, rural farmers adopt different pathways to build resilience and adapt to climate change (Bours & Pringle, 2014).

The adaptation strategies are undertaken by individuals, communities and organisations, such as NGOs and governments, through policies and activities that build communal resilience and boost livelihoods (Holling, 2013). One of the adaptation measures taken by individuals includes migration to less-affected areas. Migration is a coping mechanism that has been used over generations as a means of managing climate-related shocks, involves individuals and their families. During climate-related disasters, most families or individuals migrate to urban centres in search of formal employment.

However, SLA, ABCD and resilience theory all fail to properly explain the power dynamics and brokerage systems, as well as the gender and social relations that control the allocation and access to assets. As such, feminist theory is applied in explaining the gender dynamics and intersectional issues affecting adaptation to climate change among rural women farmers. Feminism is a theory and praxis used to explain, understand and analyse gender discrimination. Feminist theories are varied and emphasize different ideologies in explaining women insubordination, however common to the ideologies is the idea of how gender inequality and women oppression is perpetuated in the society (Turner, Maschi, Turner, & Maschi, 2014).

Liberal feminists emphasize women's bias access to institutions social, economic and political as the main cause of women's insubordination. However, radical feminists view women's insubordinations to be the results of control of women's sexuality by men. The proponents of radical feminism argue that women's bodies are controlled by men through social institutions violence and objectification. The third and most widely discussed viewed of feminism is fronted by the Marxist and Socialist feminists. According Marxist and socialist feminists, feminism has its roots in capitalism which is the breeding grounds for patriarchy. While Marxist feminists believe that patriarchy is a product of capitalism, the socialists believe that capitalism and patriarchy work separately to enhance women insubordination, distribution of roles as well as power. The study therefore picks feminist theory to explain power dynamics and differences in decision making as well access to resources.

Despite the general argument by feminist that women homogeneously are subject to oppression, the black feminists have argued that oppression of women is a binary process coupled with multiple factors and is better understood as constituted by multiple, converging, or interwoven systems. The black feminist woman scholar Kimberlé Williams Crenshaw, 1991 focuses on how factors of social exclusion vary based on sex, race, tribe age among other factors and argues that these factors should be assessed each at a time (Crenshaw, 1991; Kaijser & Kronsell, 2014). This gives the study another angle of not only viewing women as homogeneous group but one with intersectional differences that should be analysed in respect to discrimination and access to resources which both directly and indirectly influence adaptation to climate change.

1.7 Definition of key terms

Capabilities: Refers to what an individual, household or community can do to sustain a livelihood. There are four livelihood capabilities:(1) the ability to gain a livelihood, (2) the ability to cope with stress and shocks, (3) the ability to be adaptable and dynamic, and (4) the ability to explore and exploit opportunities.

Livelihood sustainability: A sustainable livelihood is one that can adapt to, cope with, and recover from stresses and shocks; It is a livelihood that amidst the shocks can still sustain or heighten the capacity of the practitioners to accumulate assets and use them to adapt in the immediate context and in future without interference in the ecosystem.

Livelihood: Describes the set of capabilities, assets (stores, resources, claims and access) and activities required to secure a living.

Shocks: These are impacts which are typically sudden, unpredictable, and traumatic, such as fires, floods, storms, epidemics, thefts, civil disorder, and wars. In this study, climate-related shocks include sudden drought, floods, and landslides, among others.

Stores: These are valuable stocks, such as food, gold, jewellery and woven textiles, and cash savings in banks and credit schemes.

Stresses: These can be defined as gradual events that cumulatively create livelihood pressures. The events are often predictable and continuous or cyclical. For example, changes in air pollution, population increase, changing weather patterns/seasons, and declining soil fertility,

Vulnerability is susceptibility to physical or emotional harm or injury. Individuals or communities are considered vulnerable when they are negatively affected by shock and they manifest lack of or inadequate capacity to adjust or to such and get back to normalcy. It can also be defined as the level to which a community, individual or household is exposed shock, risks and other livelihood, with limited or no capacity to mitigate such risks.

1.8 Chapter outline

The study has seven chapters, ordered as follows:

Chapter one introduces and provides the general background of the study, including the aims, objectives, research questions, rationale, research design, and outline of the study. The chapter also contains the key definitions and how the theoretical approach links to the study.

Chapter two contains literature on climate change and women's livelihoods in sub-Saharan Africa (SSA). The chapter begins with an overview of the nature and context of climate change in Africa, followed by the impact of climate change on agriculture, health, ecosystem and biodiversity, social systems, economic and political systems. The chapter then discusses the gendered consequences of climate change, and the adaptive mechanisms and mitigation strategies women use to overcome the effects of climate change on their livelihoods.

Chapter three describes theories relevant to climate change and livelihood analysis. It then focuses on SLA as the main approach that the study is based on. Other theories and approaches complementing SLA, such as ABCD, resilience theory, and feminist theory, are also discussed to elucidate their strengths.

Chapter four presents the effects of climate change on livelihoods in Kenya. The chapter begins with an overview of the effects of climate change on women's livelihoods in Kenya, before examining the extent of climate change and its general effects on the livelihoods of Kenyans. The chapter then focuses on the gendered consequences of climate change in Kenya, and the adaptation strategies that men and women in Kenya adopt to mitigate the effects of climate change on their livelihoods.

Chapter five contains the research methodology, with details of research design, study site, sampling design, data collection methods and procedures, data analysis, and field reflexivity.

Chapter Six provides the research findings in the following order: (1) The aspects of climate change experienced in Kakamega County; (2) The livelihoods of rural women in Kakamega; (3) Effects of climate change on the livelihoods of women farmers;(4) Assets women draw on in order to cope with the effects of climate change on their livelihoods; (5) How women farmers

mitigate the effects of climate change on their livelihoods; and (6) the role of social capital in promoting resilience to climate change among women farmers in Kakamega County.

Chapter Seven contains the discussion and conclusions of the research findings in terms of: aspects of climate change in Kakamega, effects of climate change on rural women farmers, assets women draw on to cope with the effects of climate change, and how women adapt to and build resilience to climate change. This is followed by the conclusion and recommendations.

CHAPTER TWO

CLIMATE CHANGE AND WOMEN'S LIVELIHOODS IN AFRICA

2.1 Introduction

Climate change is a worldwide challenge. It affects every individual, but does not affect every individual equally (Goh, 2012); the effect depends on location, gender and access to resources. As such, climate change magnifies existing inequalities between groups, between continents and countries, and even within different genders. The vulnerability and capability of women and men to cope with climate change, and by extension to manage their livelihoods, are affected differentially (Rights, 2015). The impacts of climate change – including floods, drought, extreme temperatures, increased incidence of disease, and growing food and water insecurity – disproportionately affect the world's poor, the majority of which are women. It impacts severely on weather patterns and the environment on which women heavily rely for their livelihoods (Annecke, 2002). This calls for studies on how climate change affects women and their livelihoods.

This chapter reviews the literature related to climate change and women's livelihoods in sub-Saharan Africa (SSA). The chapter begins with an overview of the nature and context of climate change and how it is experienced in Africa, followed by a review of the impact that climate change has across various spheres and aspects of life in SSA, particularly agriculture, health, bio-diversity, economics, politics, and the ecosystem in general. The chapter concludes with a discussion of the gendered consequences of climate change, and the adaptive mechanisms and mitigation strategies women adopt to deal with its effect on their everyday life.

2.2 The nature and context of climate change

Across the globe, there appears to be consensus that there is increasing variability in the world's climate (Giannini *et al.*, 2013; D. Thomas, Twyman, Osbahr, & Hewitson, 2007). The Intergovernmental Panel on Climate Change (IPCC) refers to climate change as a noticeable alteration in the state of the climate that can be identified by changes that persist for an extended period, usually decades or longer (IPCC, 2007b). It results from natural internal or external processes. Internal processes operate from within the planet Earth and include alterations in

atmospheric composition ending up in El Niño or La Niña. On the other hand, external processes operate outside planet Earth, and include changes in the global temperatures or energy balance due to variations in the earth's orbit as it goes around the Sun, and changes in the amount of energy received from the sun[1]. Other climate forcing processes include the impacts of collision of large comets or meteorites as well as volcanic eruptions. There are also persistent anthropogenic changes in the composition of the atmosphere or in land use. For example, studies have indicated that human actions have an impact that alters the global climate system, especially through emissions of greenhouse gases and industrial waste (Stern & Kaufmann, 2014; Vizy & Cook, 2012).

Studies indicate that climate change is causing an environmental epidemic which manifests in numerous ways, including disasters such as flooding, drought, global warming, and landslides (Few *et al*., 2004). The extent of these catastrophes have resulted in climate change being viewed as the worst threat to nature and livelihoods of humans in the 21st century (Bazylevych & Kupalova, 2014, p. 6; Schreiner, Henriksen, & Hansen, 2005, p. 3). However, while there is global concern about the effects of climate change, some have expressed scepticism about its destructive consequences and question the role of humans in causing climate change (Dunlap, 2015). For example, President Donald Trump of the US recently withdrew the country from the Paris Agreement, and former President George W. Bush did not ratify the Kyoto Protocol either (Dunlap, 2015). Similarly, Tony Abbott (the former Australian Prime Minister) argued that the impact of humans on climate as a whole is less clear. According to him, climate change being trans- generational phenomena, the impacts of humans on climate may just be a political issue that is aggravated by scarcity of resources in the 21st century (Pryck & Gemenne, 2017:5).

2.2.1 Extent of climate change in Africa

As in several parts of the world, Africa is exposed to numerous aspects of climate change, including rising, high, and extreme temperature levels, which are associated with increased warming (IPCC, 2001b). Other aspects are increased incidences of droughts (Hulme *et al*., 2001), and changes in precipitation (Thomas, Twyman, Osbahr & Hewitson, 2007; Songok, Kipkorir & Mugalavai, 2011). While the incidence rate differs by region, the effect of climate change on the continent is ubiquitous. Studies indicates that many areas in Africa have climates

[1] Enviropedia.co.uk

that are among the most variable in the world on seasonal and decadal timescales (Niang *et al.*, 2014).

The threats caused by these changes are already being felt in numerous ways across the continent. According to the IPCC Third Assessment Report (TAR) (2001), by Much, Block, & Foster, (2001), temperatures in Africa have indicated a greater warming trend since the 1960s. Although these trends seem to be consistent across the continent, the changes are not always uniform. For instance, warming rates of 0.29°C per decade have been recorded in the African tropical forests (Malhi & Wright, 2004), compared to 0.1 to 0.3°C in South Africa (Kruger & Shongwe, 2004). In Ethiopia and South Africa as well, minimum temperatures have increased slightly faster than the maximum or mean temperatures (Conway, Mould & Bewket, 2004; Kruger & Shongwe, 2004). Furthermore, Vogel *et al.*, (2007) observed a decreasing trend in the number of extremely cold days and an increasing trend in the number of warm periods along the Southern and Western part of Africa between 1961 and 2000. Serdeczny, Adams, Coumou, Hare, & Perrette, (2016) also documented decreasing trends in temperature from weather stations along the coastal areas and regions surrounding major inland lakes. Generally, countries in Southern Africa, as well as areas of Ethiopia, Kenya, South Sudan, and Uganda, are highly affected by temperature rise (Niang *et al.*, 2014). The concern is that these temperature changes are associated with extreme weather events and this has several consequences for both the environment and human livelihoods.

Literature further shows that temperature in Africa is expected to rise faster than the global average during the 21st century (James & Washington, 2013), with experts projecting a possible 2 – 6°C rise over the next 100 years (Hulme *et al*., 2001; Niang *et al.*, 2014; Engelbrecht, 2015). Although a general rise of temperature is projected for Africa, there is a variation in the extent of change across regions. For instance, the projected temperatures in equatorial Eastern Africa show that, by 2050, the days are expected to be 2°C warmer compared the average temperatures between the years 1981 and 2000 (Anyah & Qiu, 2012). Ethiopia also shows warming in all seasons, which may cause more frequent heat waves in the region (Chambers & Conway, 1991; Conway & Schipper, 2011). In Southern Africa, the mean land-surface warming is expected to exceed the global mean across all seasons, with high warming rates projected especially for Botswana, Namibia, and the areas of South Africa that border these countries (Engelbrecht, 2009). The challenge is that high and extreme temperature levels imply very hot days (when the maximum temperature exceeds 35°C) and heat waves, which increase

the danger of wildfire and its impact on both the lives and livelihoods of Africans (Vizy & Cook, 2012; Niang *et al*., 2014; Engelbrecht & Engelbrecht, 2015).

Climate change in Africa is experienced in numerous ways. A typical example is flooding, which has become a recurrent phenomenon in some African countries, and in some cases has been linked with the El Niño–Southern Oscillation (ENSO)[2] events. When such events occur, economic and human losses result, as was experienced in Mozambique (Osbahr, Twyman, Adger, & Thomas, 2010). The problem is further worsened because flooding creates health problems, particularly diarrhoea, cholera, and malaria (Few *et al*., 2004). Another aspect of climate change experienced in Africa is drought, which often poses serious threats when it occurs with high intensity. The challenge is that drought can lead to displacement and forced human migration, cultural separation, and the collapse of prehistoric and early historic societies (Pandey, Gupta, & Anderson, 2003). This is especially problematic in Africa as about one-third of the population live in drought-prone areas, and are therefore vulnerable to the impacts of droughts (The & Rijsberman, 2000). Droughts have mainly affected the Sahel, the Horn of Africa, and Southern Africa, particularly since the end of the 1960s (Brooks, 2004; Fauchereau & Rouault, 2001) . Given this, it becomes clear that Africa faces enormous threats from the effect of climate change, especially because a significant part of the population relies on subsistence rain fed farming for their livelihood. Having highlighted the extent of climate change in Africa, the following section examines the key causes.

2.2.2 Causes of climate change in Africa

Generally, two factors have contributed to the incidence of climate change: natural factors (Holocene) and human factors (anthropogenic) (Ruddiman *et al.*, 2015). Holocene factors usually occur as a result of the interaction between natural processes such as water and energy cycles with the sun. Other natural factors include a slow shift in the earth's orbit, changes in the solar system, and the effects of volcanic activities. However, human or anthropogenic factors are numerous, and have had an explosive impact on the climate, especially in the last three centuries. In part, this is because of population expansion, as the global population has expanded from about 750 million people in 1750 to 7.6 billion people in 2017, and is expected

[2]**El niño Southern Oscillation** (**ENSO**) is a periodic shift of the ocean-atmosphere system in the tropical Pacific that impacts weather around the world. The warming phase of the sea temperature is known as **El Niño.** It happens every 3-7 years (5 years on average) and typically lasts nine months to two years. It is associated with floods, droughts, and other global disturbances.

to go as high as about 9.8 billion people in 2050 (UNFPA, 2017). Such a population expansion does not necessarily account for climate change, but is known to put pressure on natural resources through human activities especially the exploitation of natural resources, have placed immense stress on the earth's resources (Awojobi, 2017).

Agriculture and the burning of fossil fuel dramatically increases greenhouse gases, which have reached their highest level in the last 400 millennia (Crutzen, 2003). As a result, it is estimated that the earth will become warmer by 1.4 – 5.8 degrees in the 21st century (Crutzen, 2003). In addition to resource exploitation, other human activities which contribute to greenhouse gas emissions, which are considered among the leading causes of climate change. The consequence of this includes global warming, and other environmental challenges such as drought and flooding that have become regular challenges in the 21st century. However, despite the consensus that anthropogenic and natural factors are the major contributors to climate change, there is a growing debate on the extent of each factor's contribution, (Stern & Kaufmann, 2014; Tung & Zhou, 2010).

In the African context, studies indicate that numerous factors contribute to induced climate change, particularly drought (Caminade & Terry, 2009; Dutra, Giuseppe, Wetterhall & Pappenberger, 2013; Giannini *et al.*, 2013). These include anthropogenic factors, such as aerosol emissions, land-use practices and resulting land–atmosphere interactions (Gerber, Nkonya & Braun, 2014; IPCC, 2007a; Stern & Kaufmann, 2014). Natural factors such as the cold phase of ENSO and La Niña events also cause droughts in both Southern and Eastern Africa. For example, Tung and Zhou (2010) indicated that a strong La Niña[3] event was the main cause of the 2010 – 2011 droughts in the Horn of Africa. Fer, Tietjen, Jeltsch and Wolff (2017) also confirmed that the 2010–2011 droughts were not caused by human intervention but La Niña events. In addition, Tierney, Peter and Zander (2017) observed that the recent droughts experienced within the Horn of Africa resulted from the La Niña conditions common in the tropical Pacific. Other natural factors such as Sea Surface Temperatures (SSTs) and land atmospheric feedback also play a crucial role in influencing climate change, especially because they affect rainfall variability which results in droughts (Manatsa, Chingombe, Matsikwa & Matarira, 2008).

[3] La Niña is a climate pattern that describes the cooling of surface ocean waters along the tropical west coast of South America. La Niña is considered to be the counterpart to El Niño, which is characterised by unusually warm ocean temperatures in the equatorial region of the Pacific Ocean.

Similarly, Mutai (2010) argues that the low rainfall in the Horn of Africa occurs during fast westerly winds which are usually accompanied by anomalously cold waters in the north-western and warm anomalies in the south-eastern extremities of the equatorial Indian Ocean basin. He explains further observes that these anomalies are the precursor to extreme dry spells and was associated with long drought in the Horn of Africa in the year 2005. Tierney *et al.* (2017) further suggests that the Indian Ocean which being a major water body in East Africa alters the local Walker circulation[4] and drives variability in rainfall along the region. However (Manatsa *et al.*, 2008) contend that El Niño and the effects of the Indian Ocean are not a sufficient predictor of droughts in certain parts of Africa. In southern Africa for instance, Manatsa et al., (2008) observed that March – June extreme positive Darwin sea level pressure anomalies[5] may be responsible for droughts in the regions of Zimbabwe and Southern Africa and should therefore be considered as additional candidate for drought monitoring and forecasting. Using this African instance, it is apparent that climate change on the continent results from both natural and anthropogenic factors. What this means is that, as with other parts of the globe, Africa is vulnerable to the incidence and effects of climate change, and hence the need to understand its effect for society.

2.3 Effects of climate change in SSA

Climate change is a long-term challenge that has myriad effects on livelihoods globally, including through its impact on physical and natural resources. SSA has witnessed diverse effects of climate change as a result of changes in temperature and variability in precipitation (Niang *et al*., 2014), changes which result in extreme events such as floods, droughts or heat waves that have devastating effects on the physical, natural, economic, social and political environments. The effects are already being felt in key sectors, including but not limited to biodiversity, agriculture, economy, health, and energy, and have both political as well as social

[4]The Walker Circulation comprises east–west atmospheric circulation cells along the equatorial belt. The most dominant component is the Pacific branch, which consists of easterly winds at the lower troposphere, westerly winds at the upper troposphere, rising motion over the western Pacific, and subsidence over the eastern Pacific. The Walker Circulation possesses pronounced variability on seasonal, intra-seasonal and inter-annual timescales, and is an integral component of the El Niño–Southern Oscillation climate system. Fluctuations of the Walker Circulation can lead to extreme weather conditions in different parts of the world.

[5]Darwin sea level pressure anomalies are deduced from a period of prolonged ENSO conditions between 1990–95, so anomalous that it is "highly unlikely" to be due to "natural decadal-timescale variation" [*Trenberth and Hoar*, 1996]. A study of the Darwin sea level pressure anomaly record found that the 1990–95 period would occur randomly about once every 1100–3000 yrs. Taking into account the uncertainty in number of degrees of freedom in the Darwin time series, we find that conditions like those of 1990–95 may be expected as often as every 150–200 years at the 95% confidence level.

implications for the livelihoods of Africans (Ongoro & Ogara, 2011). This section discusses the effects of climate change on different sectors of society, with reference to SSA.

2.3.1 Climate change and Agriculture

Agriculture is key to Africa's economy since about 70% of Africans and roughly 80% of the continent's poor live in rural areas and are dependent on agriculture for their livelihood (United Nationa Economic and Social Council, 2007). Agriculture caters for about 20% of Africa's GDP, 60% of its labour force and 20% of the total merchandise exports, thereby making agriculture a major source of income on the continent (Park, 2017). Added to this, it also provides income for about 90% of the rural dwellers in Africa, which makes agriculture crucial to the livelihoods of a significant portion of African population (Philip K Thornton & Herrero, 2015). Given that a high proportion of Africans rely on agriculture, any disruption to their farming activities, such as those caused by climate change, means a threat to their source of livelihood. In fact, the agricultural sector in many African countries already experienced episodes of floods and droughts during El-Niño and La-Niña. For instance, in the last 200 years, climate variability in East Africa has been following a pattern that is evidently a remote effect of the ENSO phenomenon known as El Niño/La Niña. During the cold phase of La Niña, there is marginal rainfall and stronger winds in East Africa, while the El Niño warm phase leads to weak wind conditions with frequent rain. The droughts and floods alone led to a loss of 2 – 7% of Gross Domestic Product (GDP) in West Africa, and 2 – 4% of GDP in Central Africa (Guha-sapir, Hoyois, & Below, 2011). Thus, it becomes clear that the threats that climate change poses to agricultural production in Africa are overwhelming, especially because there appears to be an over-reliance on rain-fed agriculture for more than 95% of farming activities in SSA (Onwutuebe, 2019).

Studies show that the agricultural sector in SSA is very sensitive to changes in climate, especially extreme weather events such as floods and droughts (Awojobi, 2017; Dutra et al., 2013). These events affect crop and animal production both directly and indirectly in Central, West, South and East Africa. For instance, the high temperatures experienced during a drought have direct negative effect on crop yields since it impacts on the growth and development of certain crops (Coulibaly *et al.*, 2015). Ochieng *et al*. (2016) also found that increasing ambient air temperatures affect the growth and development of staple crops, particularly maize (which serves as a major staple across Africa), thereby affecting the yields. Southern, West and East

Africa are the regions most affected by this problem. Similarly, Parry *et al.* (2012) established that drought has a negative effect on water availability and is a major cause of water scarcity in the sub-Saharan region. This affects the growth of crops since Africa depends on rain-fed agriculture for cropping. Added to this, studies show that countries in tropical regions where water availability is low are at higher risk of reduced crop yield, even at 1 to 2° C warming. This is because rising temperatures result in increased evapotranspiration, with low moisture levels adversely affecting crop growth and development (J. Ochieng *et al.*, 2016a)

Climate variability, especially unusual increased and decreased temperature levels, has further effects on agriculture. High night temperatures increase dark respiration of plants, which diminishes biomass production, while higher cold season temperature may lead to early ripening of annual crops, thus diminishing yield per crop (J. Ochieng et al., 2016a). In addition, high temperatures may reduce the killing of pests during cold seasons, resulting in greater crop losses. In fact, reductions in crop-yield due to heat and drought have been greatly experienced in Africa. For example, in their study in the Southern African region, (Knox, Hess, Daccache, & Wheeler, 2012) observed that the yields of maize, sorghum, and millet (which are staple foods in Africa) are set to decline by 5%, 14.5%, and 9.6% respectively. In fact, Southern Africa could lose more than 30% of its maize crop production by 2030, which will be highly detrimental given that maize is a major staple food, and contributes the greatest calories (mean contribution of 16%, range: 0-60%), and is grown across the greatest area (land mass) (Philip K Thornton & Herrero, 2015). Thus, the likelihood of a food shortage is high.

Furthermore, dry spells not only affect crop yields through high temperature but also through the depletion of water resources necessary for agricultural activities. Aridity and droughts are a natural cause of water scarcity and reduce the water and soil moisture available for growth of crops. This has particularly negative effects on rural smallholders farming tropical cereal crops such as maize and rice (Campbell, 2016), and as such affects food security both in the region and globally.

Along with this, climate change affects crop yields by affecting the length of cropping seasons, and thereby disrupting normal farming patterns. For instance, insufficient water at critical stages of crop growth in the season will negatively influence crop production (Coulibaly *et al.*, 2015), while fluctuating weather patterns mean difficulty in determining when to begin major farm operations such as ploughing, planting, weeding and harvesting because these activities are heavily reliant on prevailing weather and rainfall. Also affected is the preparation necessary for planting seasons. Farmers find it increasingly difficult to predict the dry and rainy seasons,

and timely crop operations are therefore affected, resulting in crop failures (Coulibaly *et al.*, 2015). This has greater effects on crop yield in Africa, mostly due to shortened cropping seasons (Campbell, 2016).

Another way that climate change affects agriculture is in the form of precipitation. Typically, a decrease in precipitation coupled with increased temperatures results in loss of arable land due to decreased soil moisture. Arable land becomes less suitable for crop production, resulting in a decline in crop yields (Campbell, 2016). Desertification has become a common phenomenon in Africa causing a decline in maize and beans of between 20-40% in East and South Africa (Knox *et al*., 2012).

Another problem associated with climate change is an increase in agricultural pests, which ultimately affects agricultural yield. The spatial and temporal distribution and proliferation of insects, weeds, and pathogens is determined to a large extent by climate because temperature, light, and water are the major factors controlling their growth and development. (Campbell, 2016) observes that in a warmer climate, pests may become more active and can expand their geographical spread (range), thereby resulting in increased damage of crops and reduced yields. An example is the maize leaf weevil (*Tanymecusdilaticollis*), which affects maize and sunflower crops. The weevil is very active in high temperatures and low humidity, while low temperatures and high rainfall interfere with their activity. Where the weevil attacks the plant at the early stages of its vegetation, it can destroy the plant and is responsible for huge crops losses in Africa (Emil & Luxita, 2015).

Projections, show that by 2020, the yield for crops in some countries will halve and the net revenues from crops are expected to drop by 90% by the year 2100 (Vogel *et al.*, 2007:448). The IPCC also forecasts that parts of the Sahara region are particularly vulnerable, with potential agriculture losses totalling about 2-7% of GDP. Western and Central Africa are estimated to have lost about 2-4%, while the impact on Northern and Southern Africa is estimated to be about 0.4-1.3% (Kotir, 2014:447). Some models suggest a decrease of suitable rain-fed land for crops, and an increase of 5-8% in arid or semi-arid land by 2080. They further claim that wheat production may disappear from Africa, and that maize production in Southern Africa will be notably reduced. However, despite the major negative impacts of climate change/variability on Africa, the Ethiopian highlands and Mozambique are likely to gain longer growing seasons because of the change in climate (Kotir, 2014:448).

Although the discussion has focused mostly on crop production, this does not mean that climate change does not or will not affect animal or livestock production in SSA. A significant number of farmers in the region are involved in rearing livestock, or in both livestock and crop production (Philip K Thornton & Herrero, 2015), and climate can affect livestock both directly and indirectly (Campbell, 2016). Direct effects of climate variables, such as air quality, temperature, humidity, wind speed, and other climate factors influence animal performance such as growth, milk production, wool production, and reproduction. These can have a negative effect on nutrition, particularly for pastoral communities that depend on animal products for food. An example is the Horn of Africa where droughts have not only affected livestock production, but also claimed the lives of livestock (Philip K Thornton & Herrero, 2015). In addition, climate affects the quantity and quality of feed stuffs such as pasture, forage, and grain, and the severity and distribution of livestock diseases and parasites (Ngigi et al., 2018).

Another effect of climate change on animal production takes the form of high costs/unavailability of feed for livestock, increased feed transportation costs, high livestock mortality rates, and the disruption of reproductive cycles (such as delayed breeding, or more miscarriages). Other effects include decreased stock weights, reduced productivity of rangeland, reduced production, forced reduction of foundation stock, and the limitation of public lands for grazing. Added to this is the high cost/unavailability of water for livestock, the cost of new or supplemental water-resource development (wells, dams, and pipelines), increased predation, and range fires (Kristjanson, Waters-bayer, *et al.*, 2010).

Generally, food availability in Africa is threatened by changes in climate that undermine agricultural production (Philip K Thornton & Herrero, 2015). Thus, climate-related events most often shorten or disrupt growing seasons of certain crops that are sensitive to climatic change (Philip K Thornton & Herrero, 2015), and when agricultural yields fall due to climate change, such as droughts or floods, the basic livelihood of a huge proportion of people is affected, especially where they lack coping mechanisms to adapt to the changes. The implication is that this could result in susceptibility to food insecurity (Orewa & Iyangbe, 2009). In Africa, this could be even more debilitating because a significant portion of the population, particularly rural dwellers, relies on subsistence agriculture for their survival. Staple crops such as maize and rice are already at the limit of their temperature tolerance, meaning that increases in mean temperature and climate variability in tropical countries could result in more years of lower yields (Much *et al.*, 2001). All this has a direct impact on the livelihoods of people, not only in terms of income but also in health.

2.3.2 Climate change and health

The World Health Organization (WHO, 2003) defines health as a state of complete physical, mental and social wellbeing, rather than merely the absence of disease or infirmity. Extreme temperatures, air quality and pollution, rising sea levels and flooding, and extreme weather and natural disasters all have direct or indirect effects on human health and wellbeing (Awojobi, 2017). The most common effects of climate change in terms of health are fatalities and injuries due to extreme weather events or disasters, such as flooding or landslides following heavy rain (Few *et al.*, 2004). The table below illustrates flooding data according to (Debarati, Philippe, Pascaline, & Regina, 2016)

Table 1: Deaths in Africa as a result of flooding in selected years

Year	Country	Number of human deaths
2006	Ethiopia	498
2007	Sudan	150
2010	Uganda	388
2011	Namibia	108
2012	Nigeria	363
2015	Ethiopia	364
2016	Angola	54
2016	DRC Congo	50
2016	Algeria	171
2016	South Africa	8
2016	Niger	50

Sources: Debarati *et al.*, (2016): Annual Disaster Statistical Review 2016; The numbers and trends Annual Disaster Statistical Review 2016 The numbers and trends.

Along with causing fatalities, floods are associated with an increase in infectious diseases (Serdeczny *et al.*, 2016), such as the spread or resurgence of malaria in the highlands of East Africa. In fact, studies (Endo, Yamana, & Eltahir, 2017; Le, Id, Ruiz, Mbogo, & Muturi, 2019)

have shown that there is a correlation between rainfall and high maximum temperatures in the highlands and the spread of malaria. In fact, it has been established that climate change and harsh weather conditions, such as high temperature and severe rainfall events, are initiating factors in malaria epidemics in Kenya, Uganda, Ethiopia, Tanzania, Rwanda and Madagascar (Rogers *et al*., 2002). The present frequency and severity of malaria epidemics in East Africa appears to be increasing in correlation with increasing occurrence, magnitude and perseverance of the El Niño phenomenon throughout the past two to three decades (Endo et al., 2017)

The warming of temperatures in areas that were formerly considered cool such as the East African highlands, is suggested to have brought changes in the ecosystem and enabled the spread of malaria in populations that had not previously been frequently exposed to the disease (Bhunu, Masocha, & Mashonjowa, 2016). This further explains why SSA is prone to malaria and in 2017; the region was home to 92% of malaria cases and 93% of malaria deaths globally[6]. Most studies on climate-malaria association in Africa Shows that increased rainfall in generally dry areas and temperature increases in generally cooler regions such as high altitude areas is associated with both malaria transmission and outbreaks of the epidemic (Endo *et al*., 2017; Le *et al*., 2019). However, despite various studies on the impact of climate change on malaria, debates are on-going on the magnitude of its impact (Bhunu *et al*., 2016; Endo *et al*., 2017). Some have also argued that climate change may not be the main driving factor for the spread of malaria (Parham & Michael, 2010) and that the effects of climate change may be negligible (Endo *et al.*, 2017).

The effects of climate variability have also been noted on other vector-borne diseases such as Rift Valley Fever (RVF), a disease transmitted via mosquito or domestic animals hosting the virus, which mostly affects the semi-desert Karoo biomes during strong La Niña years, but then shifts to the central grassland areas of South Africa during El Niño episodes (Martin, 2008). In Eastern Africa, RVF outbreaks are known to follow periods of abnormally high rainfall (Oyas *et al*., 2018). For example, from 1950 – 1998, ¾ of the RVF outbreaks occurred during warm ENSO event periods. The high amount of rainfall in East African during El Niño events is often associated with RVF outbreaks (Fer *et al.*, 2017), This is because the high downpour causes flooding and a sudden upsurge of mosquito populations. Outbreaks tend to occur after a long dry spell followed by an intense rainfall event and projections of increased rainfall variability in the Sahel point to a likely increase in incidence in this region. As such, Northern Senegal

[6] https://www.who.int/news-room/fact-sheets/detail/malaria

and Southern Mauritania have been identified as risk hotspots, given the relatively high livestock densities in these areas (Caminade *et al.*, 2014).

In addition, climate change and changes in the distribution of the disease vectors *Aedesaegypti* and *Aedesalbopictus* have raised the likelihood of transmission of other diseases in the region, such as dengue fever, Zika, and other infections. The Avian influenza epidemic in South Africa in 2017 was also attributed in part to climate change (Caminade, Mcintyre, & Jones, 2019). Similarly, warming was found to alter the distribution, breeding and survival of the snail species implicated in schistosomiasis, whose choice of habitat is highly sensitive to water temperature (King, 2015). It is therefore evident that climate change impacts on the persistence and dispersal of water-and food-borne pathogens in a myriad of ways.

Apart from vector-borne diseases, water supply health related issues have been noted in several studies to affect human health (Ibnouf, 2014; Martin, 2008; Cambell, 2016). For instance, droughts in Africa have been associated with water scarcity, which affects water usage, and in turn impacts on water, sanitation and hygiene (WASH) practices (Gonda, 2017). While most diarrhoeal diseases associated with poor WASH tend to be endemic, some are epidemic in nature – notably, cholera and typhoid fever. Cholera is an acute diarrhoeal disease that can kill within hours if left untreated, and it is a continual public health problem in many parts of the world (Bi *et al.*, 2018). Researchers have estimated that every year, there are roughly 1.4 million to 4.3 million cases suffer, and 28,000 to 142,000 deaths related to water problems occur annually worldwide (Ali, Lopez, You, Kim, & Sah, 2012) .

The majority of reported cholera cases and deaths occur in Africa as a result of poor WASH, associated with water scarcity because of droughts or contaminated water due to floods (Cowman, Njeru, Achia, & Bartram, 2017). This is because poor WASH increases an individual's exposure to faecal pathogens through multiple pathways, leading to diarrhoea-related deaths. Poor water and sanitation are connected to climate-induced droughts and flood; in fact, studies show that poor water sanitation and supply account for over 20% of the disease burden on the African continent (UNESCO, 2018). Droughts often negatively affect water availability (Bizimana et al., 2016) and (Ahopelto *et al.*, 2019) highlights how water scarcity directly contributes to unsanitary living conditions which cause diseases like diarrhoea, cholera, dysentery, typhoid, and polio. Although sanitation and hygiene promotion are effective interventions for controlling endemic diarrhoea (Relief web, 2019), droughts and high precipitation worsen water quality, and hamper hand-washing and other hygiene practices (Chersich, Wright, & Venter, 2018). For example, in food processing plants, water scarcity

hampers efforts to clean food processing machines, and may also result in shifts in the water sources used for agriculture and domestic purposes, raising the risk of exposure to Listeria and other pathogens, as witnessed in South Africa and other parts of SSA (Chersich *et al*., 2018; Gonda, 2017).

Added to this, regular flooding leads to water contamination, as dirty run-off mixes into major water drinking sources, causing diarrhoea (Sun *et al*., 2016). According to (World Health Organization, 2012), 1.8 billion people drink water that is contaminated by human or animal waste, and globally, approximately 502,000 diarrhoea-related deaths trace back to contaminated water (Kapwata, Mathee, Jacobus, & Wright, 2018). In fact, diarrhoea is a leading cause of health problems related to contaminated water in Africa (Kapwata *et al*., 2018; Relief web, 2019). The link between this and climate change is found in the weather variability, as experienced by increased rainfall. Studies indicate that cases of cholera surge after increased rainfall, hence the seasonality of the disease (Ali *et al*., 2012; Cowman *et al*., 2017; Relief web, 2019). In addition, locally measured variables such as temperature and rainfall have been positively associated with increased cholera incidence in multiple studies. One such study was in Zanzibar, located in the same geographic region as Zanzibar which proved that heavy rainfall and consequent flooding increases the risk of sewage contaminating the drinking water. In Zanzibar, the most common toilet facility are pit latrines, which allow untreated waste water to overflow or seep through the ground into the drinking water found in wells or pipes *(Bi et al*., 2018).

Besides the physical health risks, climate change also affects psychological and mental wellbeing due to the stress it causes (Deb & Haque, 2016), including increased depression resulting from financial loss, injuries, and/or the need to relocate. Psychological effects commonly persist for several years following a disaster, especially where people have been displaced and are residing in shelters where they are not well-protected. Other possible health-related risks that arise due to climatic events include the effect on pollution, which can result in health problems such as asthma and other pulmonary illnesses, heat stress, and other related illnesses (Chersich et al., 2018; Sun *et al*., 2016).

2.3.3 Climate change, ecosystems and biodiversity

Biodiversity is the rich variety of life (plants and animals) on earth, and is comprised of the different plants, animals, and micro-organisms, the genes they contain, and the ecosystems they form. It refers to the genetic variation, ecosystem variation, and species variation (number of

species) within an area, biome or planet. However, there is evidence that climate change is already affecting biodiversity and will continue to do so. The Millennium Ecosystem Assessment ranks climate change among the main direct drivers affecting biomes (Pryck & Gemenne, 2017; Vu, Nguyen, & Nguyen, 2011), and having a marked effect on the species composition and diversity in Africa (Parham & Michael, 2010). This has affected species distributions, population sizes, and the timing of reproduction or migration events, as well as the frequency of pest and disease outbreaks. The rapid temperature increment, together with other environmental stressors such as droughts and floods come with changes in land use and habitats disruptions. Such disruptions interfere with the connectedness among species by transforming existing species' communities and creating variable movements of species in the ecosystems. Such climate induced movements lead to localised extinction of several species.

Climate change can affect the ecosystem and the important services they provide, such as oxygen production. Furthermore, climate change decreases biodiversity and wetland regions, leading to the loss of soil and trees. Not surprisingly, there is increasing evidence that climate change is affecting forests and forest ecosystems in Africa, as well as the livelihoods of forest-dependent communities (Dutra *et al*., 2013; Vu *et al*., 2011). In a study on climate change and impacts on ecosystem services and livelihoods using secondary and primary data in Ghana, Boon, Cottrell, King, Stevenson, & Millar, (2012) found a steady decline in the production of cocoa between 1990 and 2009, owing to the persistent reduction in rainfall patterns, high temperatures, and lingering droughts. They also highlighted the impact of climate change on the community water supplies in terms of quality and availability affirm that climate change affects biodiversity and demonstrate how this impacts on ecosystems (Awojobi, 2017; Boon *et al*., 2012; Vu *et al*., 2011).

Certain plant species are already becoming endangered due to changes in weather patterns. For instance, there are 2770 species, 81 subspecies, and 70 varieties of dicotyledonous plant species endangered since they are not able to respond to climate change (Bartholomeus & Bodegom, 2011). The result is increased vulnerability of ecosystems to natural and anthropogenic disturbance, resulting in species diversity reductions (Case, 2006). The anthropogenic disturbances not only affect plant species, but also both land and sea animal species. Among the mammals affected is the *amur* leopard, which is classified by the International Union for Conservation of Nature (IUCN) as critically endangered (Rinjan, 2016). This species of leopard is currently thought to number fewer than 70 individuals. In fact, scientists argue that climate change's impact on African biodiversity is largely responsible for the decline in most species

of mammals, such as leopards, elephants and rhinos (Rinjan, 2016). The loss of animal diversity has a direct effect on the tourism industry, which is a source of livelihood for both men and women.

Another effect of climate change on ecosystems and biodiversity pertains to the wide-scale disappearance of forests due to climate change-induced die-back and degradation (Vu *et al.*, 2011). Added to this is land use by humans that interfere with forests. The consequence of forest disappearance is carbon cycle interference, which is important for the survival of plants and animals. (Case, 2006; Mutai, 2010) research revealed that tropical trees suffer severe water stress at the beginning of the growing season because a warmer climate accelerates the depletion of deep-soil water that tree species depend on for growth and survival. A consequence of this is that deep-rooted trees find it difficult to survive, leading to their gradual extinction.

In SSA, several ecosystems, particularly grass and shrub savannahs, are highly affected by to water scarcity caused by variable rain patterns and climate changes (Case, 2006). Since grassland and shrub vegetation generally possess shallow and dense roots, they cannot draw water from far below the ground. Instead, they draw moisture for survival from water that exists in the upper layers of the soil. As such, three factors are critical for the growth of most savannah grass and shrubs including rainfall timing, intensity, as well as duration. Periods of drought means a high likelihood that such vegetation will not survive, as they are shallow-rooted. Climate projections suggest that during dry months, less precipitation occurs, and this most likely reduces the resilience of these plants (Case, 2006). The shallow rooted plants go into extinction creating changes in plant species distribution and composition in the ecosystem. The changes have negative impact on ecosystem resilience since the ecosystems being less diverse become more exposed and sensitive rainfall variability. In fact, ecosystems with homogeneously herbaceous plant cover especially the savannah plant communities, are highly sensitive to rainfall variability as compared to plant communities with mixed plant species including shrubs, herbaceous and tree species with high species diversity (Kristjanson, Waters-bayer, *et al*., 2010).

Climate change can decrease the genetic diversity of populations due to directional selection and rapid migration. Directional selection is a mode of natural selection in which an extreme phenotype is favoured over other phenotypes, causing the allele frequency to shift over time in the direction of the favoured phenotype. While this system preserves plants with the stronger/favoured phenotype, it could affect ecosystem functioning and resilience since plants with weaker phenotypes are naturally eliminated, and plant varieties are reduced (Pourbabae,

Rahimi, & Adel, 2014). Further, climate change has led to phenological shifts in flowering plants and insect pollinators, causing mismatches between plant and pollinator populations that lead to the extinctions of both the plant and the pollinator, which impacts on the structure of plant–pollinator networks (Pourbabae *et al.*, 2014). The extinction of such plants can create food insecurity since the leaves, fruits and roots are major sources of food. The extinction of biodiversity is therefore a threat to both human and livestock survival.

2.3.4 Social effects of climate change

While many studies have examined the environmental and infrastructural (physical) effects of climate change, few have focused on the social effects (Adger, 2014a). One of the first studies examining the social impacts assessment done by the World Bank in the year 2002 (Stephane Hallegatte, Mook Bangalore & Marianne Fay, Tamaro Kane, Ulf Narloch, Julie Rozenberg, David Treguer, 2016). The assessment noted that climate change was making the realisation of the millennium development goals (MDGs) difficult because it reduced access to drinking water, decreased food security, and evoked adverse health effects (Steinbach, Kaur, Manuel, & Saigal, 2017). In fact, it was noted then that climate change potentially affects a much wider range of social aspects, such as food security, employment, incomes and livelihoods, gender equality, education, housing, poverty, and mobility, in direct or indirect ways. For example, Stern & Kaufmann, (2014) noted that climate change was expected to increase poverty because of its effects on agriculture, flooding, malnutrition, water resources, and health. In addition, the World Bank's Global Monitoring Report (2008) also established a link between climate change, poverty, and development (Woolcock & Narayan, 2000). Since then, studies have focused on the social effects of climate change, particularly poverty (Asfaw S., Nancy McCarthy, Adriana Paolantonio, Romina Cavatassi & Food, 2015; Atela, Gannon, & Crick, 2018; Steinbach *et al.*, 2017), while others have focused on the effects of climate change on the urban social environment (Newell, Meerow, Newell, & Stults, 2016; Serdeczny et al., 2016).

One of the social consequences of climate change is its tendency to induce conflict between communities, especially farming communities, because of the resource scarcity it creates. Studies show that environmental stress and changes are catalysts that create societal insecurity that may evolve into conflict (Caminade et al., 2019; Omolo, 2011; SIDA, 2018). However, the connection between climate change and conflict is contested. SIDA (2018) summarised

recent studies on the relationship between violent conflict and climate change and stressed that, climate does not have a direct connection with conflicts. However, meta-analyses by Burke, Hsiang, & Miguel, (2015) suggest that deviation from normal precipitation and mild temperatures increase the risk of conflict. A change in climate leads to extreme weather events, including floods and droughts. Such events have the potential to negatively affect the availability of resources, and therefore trigger resource-based conflicts. In Sudan, for instance, a study conducted (Salome, 2011) revealed that resource-related conflicts are exacerbated by various factors, such as inequitable access to natural resources, continuous failure of development programmes in terms of natural resource management, and the misuse of natural resources. These have led to more pressure on resources, and more marginalised areas less capable of biological productivity. Although resource-based conflicts vary in time, space and intensity, their common consequences include genocide, displacement, homelessness, and the destruction of socio-economic structures in the affected regions (Salome, 2011).

A good example of a resource-based conflict was experienced in Sudan where more than 20% of the population are pastoralists, and about 80% make a living through agriculture and livestock production (Salome, 2011). Here, competition over scarce natural resources – water, and land for grazing and farming, exacerbated by climate and environment change – has become a key issue and a cause of conflict among pastoralists and farmers (Burke *et al*., 2015).The problem arises because most of the pastoralists are nomadic farmers who practice open-field migratory grazing of livestock. The pastoralists migrate between the north and the south according to the seasons to benefit from the seasonal rainfall which brings fresh vegetation and arable lands for animal grazing. They follow dry-season grazing and wet-season grazing, generally in a north-south (dry season) and south-north (wet season) direction. Some stock routes are hundreds of years old, while others were established during the colonial period, and move through agricultural and forest areas and cross state and country boundaries.

Livestock farmers often move across state lines, especially after drought, and increasingly due to desertification, and their management and administration are thus problematic. The problem arises because migratory routes are very much part of the pastoralist identity and their way of life (Burke *et al*., 2015). However, during migration from one region to another, they encounter problems with local farmers because the animals often trespass into farmlands while grazing, and this has resulted in periodic conflict over the years. This is exacerbated when the resources available to local farmers, such as farmland, are in limited supply due to population growth, making it difficult to accommodate the pastoral nomadic farmers.

The impact of climate change can also be seen in the rates of human displacement, as well as increased internal and international migration. Studies have shown growing evidence of climate change impacts, such as flooding, drought, deforestation, and land degradation, leading to migration in Africa (Serdeczny *et al*., 2016; Tierney *et al.*, 2017; Torres & Casey, 2017). Rising sea-levels, wetter coasts, and drier midcontinent areas might instigate the gravest impacts of climate change by compelling sudden human migration (Oli, 2008) and severe drought, shoreline erosion, or river and coastal flooding have displaced millions of people (Tierney *et al*., 2017). Unfavourable weather conditions caused severe flooding and landslides in 2010, and as a result, around 48,000 people in Uganda and 55,000 in Kenya, Namibia, Rwanda and Zambia were provisionally displaced (Serdeczny *et al.*, 2016). In Burkina Faso, (Borderon, 2018) observed a correlation between environmental factors and inter-provincial migration, and using the demographic data from the population census survey, they found that, migration is influenced by biophysical changes in the environment. In Mali, decreasing rainfalls led to poor harvests which prompted farmers in the affected regions to migrate to the country's cities, and particularly the capital, in search of jobs. What these cases indicate is that numerous aspects of climate change events in Africa have resulted in a social displacement/migration problem, where typically the decline in rainfall leads to increasing rural-urban migration (Borderon, 2018).

As discussed above, studies support the long-standing claim that, on both long and short timescales, dwindling supply and uneven access to resources have the potential to instigate competition between different groups and heighten the threat of conflict (Omolo, 2011; Salome, 2011). Such conflicts have often led to death, destruction of property, disrupted agricultural production, and consequent economic meltdown. Important to note, however, is that conflict can also lead to or exacerbate climate change, particularly because of environmental degradation and increasing the vulnerability of populations to a range of climate-generated stressors (IPCC, 2014).

Apart from resource-based conflicts, climate-related calamities and extreme weather events have often resulted in migration or displacement. The costs of migration and forced displacement include loss of social ties, sense of place, and cultural identity (Borderon, 2018). However, Ahimbisibwe, (2016) observed that migration takes two major forms: forced and voluntary. Similarly, climate induced migration also takes two forms with the first and most common involve evacuation from a given area or region following unavoidable threats of disaster or outcome of the same. Secondly, climate related migration can also be planned.

Households or a community can plan relocate as an adaptation strategy as they venture into better alternative livelihoods (Oli, 2008). Such mobility, whether planned or unplanned, is critical to climate change exposure, sensitivity, and adaptive capacity. However, forced migration also has an impact on host communities.

New arrivals to urban areas are frequently poor, often cannot secure land rights, use substandard materials for housing, and may have no choice but to make shelter in precarious locations (Serdeczny *et al.*, 2016). In such areas, decent houses are expensive and limited incomes also limit the immigrants' access to formal settlements. In most cases these urban immigrants settle in in shanties with poor or no sanitation facilities and adopt livelihood practices that predispose them to serious public health risks. In the shanty environments the immigrants become subject to cholera and other airborne diseases as a result of pollution (Tierney *et al*., 2017). The best example is the rapid current and projected growth of cities in low-elevation coastal zones. This rapid expansion of city population is associated with emigration of rural poor from villages to least secure, cheap and risky parts of the city rarely served with basic amenities (Gallaher *et al.*, 2013). In several instances these new urban immigrants become more exposed to effects of climate change as a result of both financial and environmental deprivation.

The rapid influx into urban space by initially rural dwellers is already causing alarm especially in Africa (Ahimbisibwe, 2016). The overpopulated urban settlements and mushrooming of slums are a problem in African cities, yet projections show that more half of the world population will be urban dwellers by 2050. The pressure already exerted by the by exponential growth on limited urban resources are overwhelming (Gallaher *et al.*, 2013). The urban immigrants only access vulnerable locations with poor housing. Apart from poor amenities and housing most poor urban dwellers resort to urban crime and drugs.

In fact, livelihoods based on migration, whether nomadic pastoralists' seasonal movements, rural urban migration in search of job opportunities or even relocating to new residence is often sensitive to climate changes including temperature, rainfall and droughts. As such migrants often suffer without access to key forms of capitals and resources to build their livelihoods immediately after relocation. As proposed in the SLA, the assets increase the migrants' livelihood options and enhance their adaptive capacities. Even migration in itself requires assets for mobility. Without assets, especially financial capital and social capital in the destination, one may not be able to adapt immediately (Borderon, 2018).

2.3.5 Economic effects of climate change

Extensive research has been conducted on the economic effects of climate change, and the literature is replete with the potential ways in which extreme temperature due to climate change could affect economic activities. For example, the damaging effect of changes in temperature on the growth rate of GDP is informed by both al and empirical evidence. First, the destruction of ecosystems by erosion, flood and drought, the extinction of endangered species, and human deaths resulting from extreme weather all cause permanent damage to economic growth (Adger, Huq, & Hulme, 2003). Second, the resources required to counter the impact of warming also reduce investment in economic and physical infrastructure, research, development, and human capital, thereby affecting growth (Christopher Paul, Erika Weinthal, Marc Bellemare, 2016).

The effects of climate change on economy may occur at both macro and micro economic Levels. In the macroeconomic view, climate changes directly influence the level of agricultural output. For example, rainfall variability has a direct negative effect on agricultural yields, agricultural exports and consequently hampers the general growth of the economy. Further, such changes negatively affects investments by institutions that influence productivity as the focus is often diverted to mitigation measures (Adger *et al.*, 2003; J. Parry *et al.*, 2012). Climate change already has consequences for various subsectors, including crop production, livestock, pasture- and rangeland, and aquaculture. Of the various climatic drivers, the impacts of climate change (including changes in regional temperatures and precipitation patterns) on crop productivity have been studied most comprehensively, and these studies suggest that at the global level, the impacts will be largely negative due to moderate to high levels of warming, increased greenhouse gases, and anthropogenic factors (Stephenson, Newman, & Mayhew, 2010).

Based on microeconomic level, climate changes and shocks directly or in-directly affects physical and cognitive labour through related health defects, stimulate conflict due to struggle over scarce resources and are associated with un planned expenses causing and cause even political factions (IPCC, 2007a). For instance, increased temperature leads to political instability, which in turn may impede factor accumulation and productivity growth. Evidence from a panel of 136 countries over the period 1950-2003 found three primary results (Park, 2017). First, higher temperatures substantially reduce economic growth in poor countries, with

a 1°C rise in temperature in a given year reducing economic growth by 1.3 percentage points. Second, higher temperatures appear to reduce growth rates, not just the level of output. Third, higher temperatures have wide-ranging effects, reducing agricultural output, industrial output, and political stability (P. Omondi *et al.*, 2014).

Christensen, J.H., B. Hewitson, A. Busuioc, A. Chen, X. Gao, I. Held, R. Jones, R.K. Kolli, W.-T. Kwon, R. Laprise, V. Magaña Rueda, L. Mearns, C.G. Menéndez, J. Räisänen, A. Rinke, (2007) in discussing the link between climate change and economy using simulation model, they argue that the negative impacts of climate change have a high capacity to reverse economic growth and decline in per capita income. In their projection, they estimate that in case the rate of global warming strikes 3^0C, then such will cause at least 15% decline in GDP. They argue that the effect may be higher especially in terms of capital accumulation and saving among citizens.

Similarly Ochieng et al., (2016) observes that rapidly increasing temperature have and continue to affect agricultural productivity. Consequently, farm-based income and food security are often negatively affected. However, the effects of changes in temperatures differ between tropical regions and mid or high-latitudes areas. Projections show that temperature increases may boost crop productivity in mid and high altitude areas hence strengthen farm based economies while for tropical regions, temperature increments are likely to negatively affect production and consequently household incomes for farm agriculture based rural economies (J. Ochieng *et al.*, 2016a). In fact, According to Ochieng *et al*., (2016), 2^oC rise in temperature in the mid- and high-latitudes increased wheat production by about 10%, whereas in low latitude regions, wheat production reduced by the same percentage. As such effects of climate change on economy can be location specific.

In addition, Omondi *et al*., (2014) observes that the effects of climate change on economy could also be regionally varied and indicated that the effect of rising temperatures on agriculture was observed to be more severe in SSA than other developing country regions. This highly affected the economies of countries within the SSA region since their economy is highly natural resources and rain fed agriculture. Ayinde, Muchie, & Akinsola, (2011), on the other hand argue that the effects of climate change on economy may be shock specific. In his study, he suggested that temperature increased in Nigeria had negative effects on economy while increased rainfall exerted a positive effect on agricultural productivity and economy of Nigeria.

The Fourth IPCC Assessment Report of the provides some information about the impact of climate change on African development (IPCC, 2007a). For example, projected reductions in yields in some countries could be as great as 50% by 2020, while crop net revenues could fall by as much as 90% by 2100, with smallholders being the worst affected. It will also aggravate the water stress that currently affects about 25% of Africa's population (roughly 200 million people). The population at risk of increased water stress in Africa is projected to be 350 – 600 million by 2050, while 25 – 40% of mammal species in national parks in SSA will become endangered (Pryck & Gemenne, 2017).

Extreme weather events are likely to increase with changing climate, although regional changes vary. Tropical cyclone activity, including hurricanes, is likely to become more intense by the end of the 21st century, as global mean surface temperature rises (IPCC, 2014). The report also indicates that, with higher temperatures, extreme precipitation events over most of the mid-latitude land masses and wet tropical regions will likely become more intense and frequent by the end of this century. Similarly, river floods are also projected to increase in number and severity in most river basins. Reduced rainfall and increased evaporation can both lead to droughts, which are projected to be either prolonged or frequent, or both, in most regions of SSA and within given seasons (IPCC, 2007a). These trends and their related damage are projected to result in higher costs to the economy relative to a world without climate change. The main direct channels through which economies will experience this damage are impacts on physical capital (factories, houses, streets and bridges, machinery, computers, energy infrastructure), land (natural resources), and labour (the workforce). These have consequences for the economy, because they can disrupt electricity supply or transport, or cause a temporary halt to production and other economic activities.

The effects of climate changes on economy occur in a myriad way but the most experienced often occur through reduction in agricultural productivity. This happens due to the overreliance of African economy on rain-fed agriculture and other natural resources. The economies of African countries are therefore easy victims of climate shocks since agriculture is a major contributor to the GDP, and the primary employer of a majority of the African population.

2.3.6 Political implications of climate change

Literature on the effects of climate change on politics seems to be limited, especially in Africa (Kelman, Gaillard, & Mercer, 2015). While climate change may not affect political issues

directly, there is an indirect connection between the political system and its governance of the socio-economic impacts of climate change/variability. This effect is threefold (IPCC, 2007a): firstly, climate change's negative impact on the economy can act as a stressor/catalyst for conflict; secondly, weak political, economic and social institutions worsen the resilience of the vulnerable population; thirdly, the existence of polarised social identities further deteriorates the situation.

First, if climate change/variability results in a substantial decrease in resources such as water and land for grazing and agriculture, there may be heightened competition between elites and local communities over their exploitation. This is especially true if local and national dignitaries are dependent on such resources to uphold their patronage networks. Inspired by economic greed, hunger for power, or ideological or religious fervour, elites function as catalysts that turn potentially volatile situations into open warfare (Albore, 2018). During such rivalries, it may be tempting for elites to mobilise their supporters against the interests of other elites, at worst escalating into open violence, as in Ethiopia in the 1980s. Politicians, businessmen or communal leaders may also have incentives to organise violent acts even though they are not personally affected by climate change/variability. For political or economic reasons of their own, they may manipulate people's fears of economic and social marginalisation – due to food insecurity, droughts or floods – in order to mobilise support against other elites, as happened in Pakistan. Elites also have incentives to use access to food and water as a political tool, channelling scarce resources to their own followers and withholding them from their opponents, as a strategy of gaining concessions from the latter. This was observed in Cambodia, Bangladesh, and Sudan (Salome, 2011).

The second aspect noted by the IPCC is that climate change can weaken the state institutions responsible for supporting adaptation to climate change, leaving citizens more vulnerable to these impacts. There are two ways in which climate change/variability and weak institutions can interact to increase the risk of violence. First, alterations in temperature and precipitation are likely to affect the socio-economic systems particularly powerfully when there are weak institutions (IPCC, 2014). Low administrative capacity and insufficient infrastructure means that it is difficult for national and local institutions to distribute food, water, and health supplies to affected areas. This may not only undermine the legitimacy of the state, but also exacerbate communal conflicts between groups competing for scarce resources, as seen in Pakistan after the 2010 floods. Second, frail institutions are also less likely to have the capacity to regulate and control climate-induced tensions in a peaceful manner. If state structures are deemed weak

and partial, elites have incentives to use illegal measures – such as acts of violence, human rights abuses, and electoral tampering – to solve disputes between themselves. Similarly, communities engaged in resource disputes may take matters into their own hands. Rather than trusting the authorities to guard grazing areas, farmland, or freshwater supplies, they may feel pressed to ensure access to these resources by arming themselves. There could also be interaction effects between climate change/variability and weak institutions: fragile state structures have problems coping with the effects of climate change/variability, thereby increasing levels of poverty, undermining state legitimacy, and increasing societal tensions, which all further weaken the capacity and reach of institutions (Bhandari & Yasunobu, 2017).

Finally, even if economic problems as a result of climate-related shock, bad leaders, and weak institutions constitute vital ingredients for armed action to take place, most forms of collective violence are also dependent on a common social identity binding people together. For example, argues that "aggrieved people might have the resources and opportunities to protest, but they still need to construct a politicized collective identity to engage in collective political action". It is through the lens of a common identity – be it ethnicity, religion, class, ideology, regionalism etc. – that aggrieved individuals conclude that they are facing a common problem which they can collectively work to overcome (Wilke, 2006). It is usually by tapping into a group's shared perceptions of injustice and marginalisation that elites are able to mobilise men and women both politically and militarily. Such calls to action – based either on a genuine conviction of a just cause or used to hide more cynical motives – often have a strong appeal to wider constituencies (Hulme *et al.*, 2001:142). This is especially true in times of insecurity or impending crisis. Describing the societal processes leading up to the outbreak of civil war, some argue that, insecurity and the breakdown of larger networks lead people to seek protection in narrower family, clan, ethnic, and religious networks.

2.4 Gendered consequences of climate change

This section discusses how climate change affects men and women differently. First, it traces the adaptive strategies and coping mechanisms that men and women use when faced by the different aspects of climate change across SSA. Second, it discusses intersectionality and how it affects vulnerability and adaptation to climate change.

2.4.1 Gender differentiated consequences of climate change

In discussing the gendered consequences of climate change, this study defines gender as socially constructed differences in roles, responsibilities, and opportunities associated with being a man or woman. Such roles and responsibilities vary from one community to another and encompass the interactions and social relations between men and women (Ongoro & Ogara, 2011). Gender determines what is expected, permitted, and valued in a woman's or man's behaviour in specific contexts (Giddens, 2011), and is thus critical for understanding the specific effects of climate change on men and women (Codjoe, LK, & Burkett, 2012).

Studies of climate change consequences for men and women have become common in Africa, with emphasis on gender and energy (Annecke, 2002); gender poverty and climate change (Denton, 2002); and gender roles in adapting to climate change (Carvajal-Escobar, Y., Quintero-Angel, & Garcia-Vargas, 2008). Other studies (Caminade & Terry, 2009; Alston, 2013) indicate that climate change not only has different consequences regionally but also affects men and women differently. In fact, studies by (Arora-Jonsson, 2011; Ngigi *et al.*, 2018) all emphasise the fact that the differential effects of climate change on men and women is based on gender dispositions and the different roles ascribed to men or women as members of the community. Geraldine (2009) further observed that the gendered roles, responsibilities, status, and identities of women and men in households and communities are the major contributing factors to gender-differentiated consequences of climate change.

This study recognizes the fact that gender inequalities exits in societies apart from those exacerbated or influenced by climate change. As posited by Senay, (2013), inequalities based on gender exist in almost all societies but with varied degrees. The underlying factor behind gender discrimination, in Africa and across the world has been explained through patriarchy (Walby, 1990). Feminist theorists especially explain how patriarchy through trough institutions and societal structure and institutions help to dominate, oppress and exploit women (Onwutuebe, 2019). According to (Wood, 2019) the roots of patriarchy is strongly embed in society and is perpetuated through social institutions such family, religion, schools and work. As a result of patriarchy, women find themselves with less or no authority and rights over key livelihood assets.

In Africa women patriarchal nature of the society ensure that have: limited or no rights to access land; limited access to education, knowledge, skills and information; no power and authority to and access to participation in policy and decision-making processes; limited access to

financial institution and credit, limited networks since they are mostly confined at home (Wood, 2019). As such women remain deprived and fixed within a defined space. Women in patriarchal societies as such remain vulnerable to any shock as a result of their deprived state. In terms of climate change adaptation women find themselves disadvantaged due to their comparative limited access to resources to cope with climate shocks and stresses as compared to men. Furthermore decision-making authority being solely for men make women unable to respond in time to climate related shocks (Ngigi *et al*., 2018).

In Africa, the effects of climate change affects are exacerbated on women not only due to their limited access to essential resources but also due their differentiated gender roles and responsibilities (Dankelman, 2010; McLaughlin, 2008). In rural Zimbabwe, Hoddinott & Kinsey, (2000) found that the 1994–95 droughts adversely affected food intake for both men and women, but the drought only adversely affected the body mass of women, not men. Women reduced their food intake and, in many cases, skipped some meals in order to ensure that their family members had enough, because it is considered the role of the woman to provide meals to the family, and therefore go without food themselves for the sake of their families. However, not all women bore these effects equally. The study showed that wives and daughters experienced adverse effects, but daughters-in-law of the household head experienced no effects. In fact, according to Hoddinott & Kinsey, (2000), under such circumstances \ daughters-in-law may have access to resources outside the household, such as remittance income, that offset the impact of the drought. As such, daughters-in-law who were able to secure financial capital through their social networks were better able to survive the effects of droughts.

In a similar vein, literature shows that, as the main providers of food and meals for their families, women bear a greater burden than men during droughts since they have to fulfil this task when climate events occur, and may be worse affected since they face hardships while looking for food amidst the devastating effects of drought. For instance, Goh (2010) did a study on the impacts of hurricanes Mitch and Stan that led to flooding in Chiapas, Mexico, and found that although men mainly lost income from paid farm labour, women lost fruit, vegetables, chickens, and ducks from their home yards. Though both genders were affected, the losses mostly affected women and hindered their ability to feed their families since they previously obtained a significant portion of their daily food from their own yards. As much as men were affected, women felt the effects more since they not only lost their livelihood sources but were still expected to provide meals for the family.

In many developing countries, cultural traditions make women responsible for collecting water, even when this involves hours carrying heavy containers or travelling long distances. Rural women in most developing countries are also responsible for sourcing the fuel, such as wood, charcoal, and agricultural wastes needed for household activities such as cooking, boiling water, or keeping warm. Annecke (2002) explains that there is now a great deal known about the struggles of women to obtain fuel, as well as the social impacts of the continued reliance on biomass or low-grade fuels. She argues that in southern Africa, qualitative and quantitative research has documented the distances women walk to collect wood and the implications of wood collection on women's health and wellbeing. By examining the total amount of time individuals in Guinea spend working, whether in the labour market, domestic chores, or collecting water and wood, Wodon and Bardasi, (2006) found that the total working time is higher for women than for men in urban as well as rural areas. With climate change as well as other anthropogenic environmental degradation, it is natural capital such as water, wood, and other fuels used for energy generation that become scarcer in some regions of the world. In the case of some developing countries, women spend more time and labour on these collection tasks, contributing to their time poverty, and having negative effects on their health and wellbeing.

In Ethiopia, Asheber (2010) found that women have to collect water from sources that get further away as each drought take its toll. Dankelman (2010) reported similar findings in Senegal, where women were more severely affected by water shortages than men, largely due to their role as water collectors for the household. Women had to travel further in search of water, and spend more time checking different wells for water availability. In addition, difficulties in accessing fuel sources are often indirect impacts of climate change. Leduc, Shrestha and Bhattarai (2008) showed that decreasing snowfall in the past six years in Nepal is contributing to a longer dry season, which decreases crop production and increases famine, prompting income-driven deforestation by the community, which has severely reduced the availability of trees for fuel. Women have to walk much further to obtain fuel, and this was viewed as a dangerous task on steep slopes, which took about six hours every three days.

Water and fuel shortages caused directly and indirectly by climate change result in considerable time and labour burdens for women, more so than for men. The longer women spend searching for these natural resources, the less time and energy they have for performing other household tasks, indicating an increase in time poverty. The differential impacts of climate change are therefore attributed to the distinct role of women to source and secure water and fuel for the household, which may also negatively impact women's and girls' health (human capital) and

wellbeing in the longer run (Goh, 2012). Examples also indicate that women's vulnerability is connected with biophysical characteristics that are largely due to their societally-prescribed roles. Hannan (2011) explains that an increase in women's workload and burdens as a result of climate change may mean that they have to forego opportunities for economic empowerment, such as education, training, and income-generating activities. In some cases, women are forced to take their daughters from school to assist them with work on the farm or in the household, which has long-term detrimental effects on the empowerment of these girls (Hannan, 2011).

However, it is important to note that it is not only water scarcity that has a detrimental impact on women and girls, but other factors as well. Changes in water supply or quality also worsen gender inequality in terms of access to water, farming systems, the division of labour, employment opportunities, and incomes of men and women, with male-headed households and female-headed households impacted differently (Caizhen, 2009:324). Within the Horn of Africa, water scarcity in pastoralist societies have forced men to move to other parts of the country in search of water and pastures for their livestock, where they may lose their livestock to cattle rustlers, and will suffer the harsh weather while on the move. At the same time, women left at home have to feed children and travel long distances in search of water.

Based on the examples above, it can be argued that gendered roles and responsibilities expose a given gender to more consequences of climate change than the other, depending on the roles allocated to men or women in the society. Most examples discussed above show that women's roles expose them more to the effects of climate change, because they interact more with the natural environment. This exacerbates the consequences of climate change on women. While in certain situations men are equally affected, their decision-making roles are a great advantage. For example, men can make the decision to move to the urban environment in search of employment, but poses difficulties for their female counterparts: firstly, women are not traditionally the family-decision makers; secondly, women have to move with children which increases their burden; and thirdly, in most cases women lack the resources to cope with the effects of climate change as compared to men.

The literature highlights a number of gender differences in preferences, power dynamics, and decision-making. For example, men are more mobile than women since they are able to make decisions on where, when, and how to relocate to a new residence (Jerneck, 2018). Men are therefore more likely to migrate to areas unaffected by climate events in search of employment, while women are less mobile, and more likely to stay in the affected areas to care for the family and household. The increasing rates of male out-migration because of climate signals may

result in negative consequences for households. In Nigeria, (Agwu & Okhimamhe, 2009) found that during flood periods and the dry season, the temporary migration of men to urban areas results in women being left alone to take care of the household. Under such conditions some women engage in petty trading to supplement the non- reliable remittances from their husbands in urban. In most cases, young girls and boys also join their mothers in small scale trade through street hawking the commonly required household items, like tomatoes, pepper, and drinking water. In two other communities examined in the same study, temporary male migration was found to increase the workload of women and expose them to physical and sexual abuse as they scrambled for depleted commodities or entered into early marriages.

During droughts in northern Mali, men temporarily migrate to urban settings in search of employment. The temporary out-migration of mostly male labourers has meant that women must undertake the tasks once reserved for men, on top of their own tasks. This increases their work burden and vulnerability, and decreases their wellbeing (Goh, 2012). Similarly, (Nelson & T. Stathers, 2009) found that unpredictable rainfall, declining soil fertility, and increased incidence of crop pests and diseases were leading to more frequent crop failure and increased yield variability in Tanzania, prompting an increase in seasonal migration by men. Men were reported to engage in unprotected sex outside the marriage, while away from their wives, and this contributed to the spread of HIV/AIDS in the village. A survey by (Babugura, 2011) reported similar findings in South Africa, where men who migrated were said to return with HIV/AIDS and pass on the disease to their wives. As a result of the death of men and women from HIV/AIDS, there were many orphans in the community surveyed. Such trend of events left behind orphaned children who are not in apposition to cater for their basic needs. In addition, remittances expected from male emigrants in urban in most cases were never received since skill less rural men from the village found it difficult to secure job opportunities within the urban setting. Such men found themselves ill-prepared to deal with the challenges posed by migration and instead of sending remittances to their rural families back home asked for support from their already hardly affected families. As such their families were further deprived. In addition, Babugura, (2011) also found that most men move to urban settings as an adaptation strategy to climate shocks in order to send remittances back home. however Babugura, (2011) provides anecdotal evidence of reverse remittance, where migrants who have moved to urban areas needed financial support from their households in rural areas. As such the movement of men to urban areas which was meant to help them get money to remit to their rural families did not work and instead their rural families had to send them money for upkeep.

Such circumstances further derailed the women's ability to cope with climate change due to the resulting increase in labour requirements at home and the need to remit funds to the urban-dwelling husband. It is therefore worth noting that due to men's role as decision-maker and women's role of household care, men are more likely to out-migrate to urban areas in search of jobs. The movement of men to urban settings may overburden women as they have to provide for children as well.

Stephenson *et al.*, (2010) also found that in cases where both men and women migrated to urban areas, the social impacts experienced by women differed from those experienced by men. While men often managed to find work under a government-sponsored food for work programme, women reported losing access to whatever limited livelihood options they had previously enjoyed. Women migrants reported that their situation was made worse by a lack of privacy and poor access to proper sanitation facilities in the few overcrowded shelters. Many households also reported tension between migrants and receiving communities over resources, including water and employment.

Climate-related disasters may disrupt local security safety nets, leaving men and women separated, and children unaccompanied or orphaned due to the erosion and breakdown of normal social controls and protections. Under such situations, women become more vulnerable to human trafficking than men, and economically-impoverished families become particularly vulnerable to being deceived with false offers of remunerated work and education for girls, trapping them into a system of forced labour and sex work (Goh, 2012).

During extreme events such as drought, floods and other climate-related disasters, women and girls face additional risks of intimidation, gender-based violence, sexual harassment, trafficking, and rape. The Annual disaster statistical review 2016 in Debarati *et al.*, (2016) states that women and girls are at higher risk of sexual violence, exploitation, abuse, trafficking and domestic violence during and after disasters (Debarati et al., 2016).

In summary, climate change affects men and women differently, given their distinct roles and responsibilities and inequitable power dynamics at the household and community levels. Yet women are disproportionately vulnerable to the effects of climate change (Nellemann, Verma, & Hislop, 2011). As the effects of climate change are not uniformly felt, climate change adaptation produces different and distinct gendered vulnerabilities (Edward R. Carr, 2008); (Swai *et al.*, 2012).

2.4.2 Gender and climate change adaptation

This study adopts the IPCC definition of adaptation, according to IPCC, adaptation is defined as:

> *"…adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. This term refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change" (IPCC, 2001:98).*

There have been several studies on gender-differentiated impacts of climate change (Alston, 2013; Geraldine T, 2009; Hannan, 2011) but there appears to be limited literature on gender and climate change adaptation (Arora-Jonsson, 2011). The literature that exists highlights women as more adversely affected by climate change and tend to be excluded from decision-making processes and bodies, especially in the African context (Arora-Jonsson, 2011; Denton, 2002). In fact, studies on gender and climate change, portray women as victims who are more vulnerable than men (Arora-Jonsson, 2011). The literature about women from the South, (Arora-Jonsson, 2011; Babugura, 2011; Ongoro & Ogara, 2011)indicate that more attention need to be paid to highly vulnerable and have a high mortality rate in times of natural shocks driven by climate change.

This notion of the "feminisation of poverty" has been problematized by several scholars, since it tends to label female-headed households in any context as poorer than other households (Chant, 2010). Others have called this argument an instrumental tool used to garner resources for women while lacking rigorous and convincing gender-disaggregated data (Chant, 2010;) While recent research indicates gender discrimination and inequities in an adaptive capacity, many have emphasised the importance of context and embeddedness in gender analyses (Carr, 2008; Denton, 2002; Arora-Jonsson, 2011). Arora-Jonsson, (2011) especially tends to challenge the universality of the discourse in which all women are portrayed in the same way, arguing that the emphasis on vulnerability, and the portrayal of women as victims, denies women agency and can result in policies that are focused on meeting short-term needs with no potential to substantially improve women's capacity to adapt to change.

The new emphasis on climate change adaptation links closely with environmental feminism and ecofeminism. Ecofeminism suggests a responsibility to challenge a patriarchal system that

is deepening the impoverishment of the earth and its people (Harcourt, 2017). The normative thinking on gender and climate change indicates that women are more vulnerable to climatic shocks than men (Denton, 2002) and tends to conflate "gender" with "women", seeing rural women as victims, vulnerable, and poor (Kristjanson, Waters-bayer, et al., 2010) although they play important roles in food security and nutrition for their households (Goh, 2012; Jerneck, 2018; Olivier, 2015). This past literature has generally portrayed the rural African woman as docile, resourceful, and utterly dependent on her male counterpart. Since 1970, sex differences in economic and domestic roles have been repeatedly described, but they have also been confounded with individual interests, and therefore presented as fixed and unchanging, yet there is data that shows an evolution of these roles. (Fajarwati *et al.*, 2016; Ongoro & Ogara, 2011) emphasises how women exhibit embedded approaches and responses to shocks and highlights that women's agendas are determined by their circumstances.

Despite the past gender and climate adaptation discourses that predominantly portrayed women as victims of climate change and subjects more vulnerable than men, recent studies tend to challenge this generalisation (Arora-Jonsson, 2011; Gonda, 2017). In most cases, women are portrayed as endeavouring to protect their households through the adoption of strategies and mechanisms in the face of shocks and stresses that affect their livelihood and food security (Fajarwati *et al*., 2016; Hoddinott & Kinsey, 2000; Nellemann *et al*., 2011). In fact, women are an untapped human resource, who, if given the same access to education, experience, and farm inputs available to male farmers, can increase yields by 20 – 30% (Johnson, Kovarik, Meinzen-Dick, Njuki, & Quisumbing, 2016; Nellemann *et al*., 2011). For example, Nigerian women are known to adopt coping strategies in the face of food shortages by allowing their offspring to eat first, eating once a day, taking home leftover foods from social functions, eating less expensive food, borrowing food or money to buy food, and backyard crop and livestock farming (Idrisa, Gwary & Shehu, 2008; Orewa & Iyangbe, 2009).

2.5 Conclusion

Gender-based inequalities and social exclusion are key factors undermining people's and communities' capacities to cope with and recover from disaster risks and climate events. Socially-constructed status, roles, and norms are gendered and intersect with other social identities, such as age or ethnicity, to create unequal levels of marginalisation and access to

assets between women and men, and girls and boys (Dankelman, 2010). The combination of power structures, intra-household dynamics, decision-making processes in and out of the home, as well as inequalities in terms of workloads, employment, and income, restrict many women across the world from accessing and securing livelihoods and achieving control over their lives. This undermines their ability to anticipate and prepare for major disasters and shapes their susceptibility and exposure to climate extremes (Borquez, 2017; Onwutuebe, 2019; Vogel *et al*., 2007).

Evidence indicates that disparities exist between men's and women's access to and control over key assets. Rural women in developing countries generally have fewer assets and rights than men; they are more vulnerable to losing their assets and rights due to separation, divorce, or widowhood; and they have less access to capital, extension services, inputs, and other resources related to agricultural production. Nevertheless, women's asset holdings often have positive effects on important development outcomes, including household food security and human capital formation. Consequently, helping women gain greater access to and control over key assets can increase the resilience to climate change of households and communities.

Climate change and climate variability inevitably has a tremendous impact on the livelihood of societies and pose challenges to national and regional security. As argued above, climate change/variability can have a catalysing effect on social unrest and armed conflict. However, climate change/variability does not do so on its own, but in interaction with the socio-economic and political system. Socio-economic impacts emerge from the effects climate change on basic resources such as on food and water that are critical for livelihoods.

CHAPTER THREE

CLIMATE CHANGE AND WOMEN'S LIVELIHOODS IN KAKAMEGA COUNTY, KENYA

3.1 Introduction

African countries are among the most vulnerable to climate change and its impacts due to lack of resilience and low ability to adapt, as well high dependency on rain-fed agriculture (Niang *et al.*, 2014). Kenya is no exception and continues to face a number of challenges that increase its exposure to climate-related risks, such as poverty and political instability (J. Parry *et al*., 2012). Over time, the country has experienced extreme climatic events that pose significant risks including floods, droughts and landslide. Major droughts occur about every 10 years, and moderate droughts or floods every three to four years (Huho & Mugalavai, 2010). Other climate-related hazards in Kenya, such as forest fires and landslides, are mild and mostly affect the highlands (J. Parry *et al.*, 2012). These climate-related extreme events affect the livelihoods of Kenyan men and women differently, and the aim of this chapter is to discuss the extent to which climate change in Kenya affects the livelihoods of women and how women cope with such climate-related challenges. The chapter begins by discussing the nature and extent of climate change in Kenya, before moving on to the causes of climate change, its effects and gender consequences, as well as gender adaptation to climate change.

3.2 Nature and context of climate change in Kenya

Kenya has a total area of 582,646 km^2, consisting of 11,230 km^2 water surface and 571,416 km^2 land area (GOK, 2009). About 85% of the land area is classified as arid and semi-arid lands (ASALs), with a fragile ecosystem. These arid lands mainly support pastoralism due to their harsh climatic conditions and vast area (Nyanjom, 2014). As a livelihood, pastoralism is mainly dependent on domestic livestock for social, economic and cultural purposes, and is predominantly grazing of domestic livestock at low densities in large unenclosed areas dominated by natural or semi-natural vegetation. The country is situated between 5^{o}N and 5^{o}S latitude and 38^{o}E and 40^{o}E longitude, with varied landforms types that are divided into plains, escarpments, hills, and low and high mountains. It is bordered by Ethiopia to the North, South Sudan to the North West, Uganda to the West, Tanzania to the South West, Somalia to the East,

and the Indian Ocean to the South East. In the year 2014, Kenya's economy was the ninth largest in Africa and the fifth largest in SSA (after Nigeria, South Africa, Angola, and Sudan). The economy was estimated to grow at 5.4% in 2014 and was among the fastest-growing economies in the region (Muraguri & Soler, 2018). However, despite the fast growth, external shocks have affected economic growth, mainly as a result of climate change, given that agriculture forms the backbone of the Kenyan economy (Le *et al*., 2019; J. Ochieng *et al*., 2016a).

Agriculture is the back bone of Kenyan economy as it contributes to approximately one third of Kenya's Gross Domestic Product (GDP) annually, and indirectly adds a further 27% through linkages with agro-based and associated industries. The country has about 75% her rural population relying predominantly on agriculture for their livelihoods (Muraguri & Soler, 2018). This exacerbates the effects of climate change on the livelihoods of Kenyans and especially on women, who constitute the majority of smallholder farmers, making up about 76% of the total number employed in the sector (Muraguri & Soler, 2018).

Like the other parts of SSA, Kenya is not exempt from climate change and its effects (Omolo, 2011; SEI, 2009). In fact, as the National Climate Change Response Strategy (NCCRS) puts it, "the evidence of climate change in Kenya is unmistakable" (GoK, 2010:2). This is because the country has experienced varied aspects of climate change, such as increasing weather variability, extreme temperatures (extreme hot or cold days) resulting in drought, and variability in precipitation leading to floods (GoK, 2010). In many areas, rainfall patterns have become erratic and unpredictable, with areas that were previously cool becoming extremely hot. This development has meant that some regions have experienced frequent droughts during the rainy season, while others have been subject to floods during normally drier periods (GoK, 2017).

As a result, temperature changes have been recorded, with Thornto, (2010:3) stating that the mean annual temperatures in Kenya have increased by 1.0°C since 1960, with an average increment rate of 0.21°C per decade. The increased warming has led to the decline of the Lewis Glacier on Mount Kenya, which has lost 40% of its mass since 1963 (Prinz, 2018). Furthermore, Ayugi and Tan (2018) observe varying trends of temperature change during different seasons and in different parts of Kenya. They observe that regions in western Kenya and the highlands areas have significant increasing trends in both seasons, i.e. March–May (MAM) season and October–December (OND) season. However, the eastern and northern

parts of the country display insignificant changes in mean annual and seasonal temperature. Generally, increased trends in warming are observed in locations that are considered cool temperate, as compared to hot regions that are mostly arid lands (Ayugi & Tan, 2018). The trends are as shown in the table below.

Table 2: Surface air temperature trends in Kenya from 1971 to 2010

Year	**MAM (^{0}C)**		**OND (^{0}C)**	
	Max	**Min**	**Max**	**Min**
1970-1979	**-0.01**	**-0.03**	**0.06**	**0.02**
1980-1989	**-0.01**	**0.04**	**-0.02**	**0.02**
1990-1999	**0.05**	**0.05**	**0.03**	**0.02**
2001-2010	**-0.01**	**-0.01**	**0.01**	**0.02**

Source: (Ayugi & Tan, 2018:9) Recent trends of surface air temperatures over Kenya from 1971 – 2010

Similarly, (Ayugi & Tan, 2018) studied the Greater Horn of Africa (GHA) in which increasing temperature trends were observed from 1973 to 2013 for mean minimum (at + 0.20 to + 0.25 °C/decade, depending on seasons) and mean maximum (at + 0.17 to + 022 °C/decade).

Apart from temperatures, changes in precipitation patterns have been observed, although these have not reached a statistically significant level/trend at the national level toward wetter or drier conditions (Kotir, 2014). At the sub-national level, heavy downpour have occurred during the short rains of October to December, particularly in northern Kenya, where the rains have begun to extend into the hot and dry months of January and February (J. Parry *et al.*, 2012). In addition, observations at sub-national level suggest that the long rains (March and April) have become increasingly unreliable along the eastern region, such as the formerly Eastern Province of Kenya (Parry, Zamudio, & Echeverria, 2013). Positive changes in rainfall intensity have also been observed along the coast where the long rains have been more intense than before (Ayugi & Tan, 2018)

3.3 Causes of climate change in Kenya

While there are natural causes of climate change such as water and energy cycles, the current warming trend is largely attributed to anthropogenic factors (IPCC, 2007a). Typical of this is human activities, mainly the burning of fossil fuels, industrial pollution, deforestation, and land use practices which lead to encroachment (Ochieng *et al.*, 2016; Ochieng & Koske, 2013) Such anthropogenic activities increase the concentration of GHGs in the atmosphere, as in the case of combustion of fossil fuel and industrial pollution (Perera, 2018). This also interferes with the absorption of carbon by terrestrial sinks, such as through deforestation and land use changes, leading to global warming (IPCC, 2007a). In Kenya, activities such as increasing construction, industrialisation, transportation, and consumption culture have contributed to the rise in GHGs in the atmosphere. For example, increased construction leads to the clearing of forests and interference with riparian lands, which reduces the areas under forest cover, which interferes with carbon sink. In addition, transportation and industrialisation involves combustion and the release of hydrocarbons into the air, which leads to further warming. By the year 2010, the total GHG emissions in Kenya were 73 MtCO2eq (million tons of CO_2 eq). Approximately 75% of the total GHG is generated through land use changes and agriculture sectors (Watch, 2017). By the year 2015, the total GHG emissions were 83 MtCO2eq, showing a gradual increase in the emissions of GHG, as shown in the table 3.2 below.

Table 3: GHG emissions by sector

	Sector	GHG emissions in million tons of CO_2 eq
1	Energy demand	6.9
2	Transportation	10.6
3	Electricity generation	1.1
4	Industrial process	3.5
5	Agriculture	32.6
6	Waste	2.4
7	Land-Use, Land-Use-Change and Forestry (LULUCF)	26.0
	Total	83.0

Source: GOK, (2015) Kenya Second National Communication to the United Nations Framework Convention On Climate Change

Natural factors such as movement of the Inter-tropical Convergence Zone (ITCZ) [7]and the ENSO are also key causes of climate change in Kenya (Fer *et a*l., 2017), due to its geographic location along the equator. The ITCZ creates a dividing line between the southeast and northeast trade winds and oscillates with the sun from season to season. Its influence causes short rains to occur around the time of year when the ITCZ migrates southwards, and long rains between April and June occur when the ITCZ moves northwards again. The problem with this is that the ITCZ is usually characterised by heavy rains and thunderstorms, resulting in Kenya experiencing two rainy seasons along the equator (Fer *et al.*, 2017).

Kenya also does not escape the influence of El Niño and La Niña episodes. Studies show that coastal Kenya and parts of Tanzania experience a strong change in the amount of rainfall they receive during the El Niño periods. Coastal Kenya receives up to 200 mm yr−1, more rain than they would receive otherwise, while during La Niña years, they receive ≈100 mm yr−1 less. In fact, during El Niño and La Niña episodes, the normal patterns of tropical precipitation and atmospheric circulation are disrupted, triggering extreme climate events such as droughts and floods around the globe. As a result, Kenya has become susceptible to cyclical prolonged droughts and serious floods. In most cases, the droughts are experienced on the northern sides, with high rains in central Kenya (Fer *et al.*, 2017).

3.4. Effects of climate change on Kenyan livelihoods

The effects of climate change on livelihoods in Kenya are widespread, and every area of society and human endeavour has been affected, including the agricultural sector, economy, health, biodiversity, ecosystems, social systems, and even the political system.

3.4.1 Effects of climate change on agriculture in Kenya

Agriculture is the mainstay of the Kenyan economy, as 75% % of the population earns a livelihood through subsistence farming, and it is therefore the main provider of employment, food security, livelihoods, and economic development (Republic of Kenya, 2010a). In terms of

[7]The ITCZ is a belt of low pressure which circles the earth, generally near the equator where the trade winds of the Northern and Southern Hemispheres come together. It is characterised by convective activity which generates often vigorous thunderstorms over large areas.

the economy, agriculture provides for 26% of the annual GDP, and indirectly generates 25% of GDP through other agro-based activities, such as manufacturing, transport, and wholesale and retail trade (GoK, 2017; Huho & Mugalavai, 2010). In addition, the sector constitutes 65% of total exports and provides employment to 18% of the workforce in Kenya's formal sector (GoK, 2010)

Climate change and weather variability affect agriculture in various ways in Kenya. High temperatures associated with droughts affect crop yields as most plants reduce yields when subjected to mild heat stress ranging between 1°C to 4°C above optimal growth temperature (Foster, Brozovi, & Butler, 2015) . Along with this, intense heat stress, more than 4°C above optimum, could lead to crop failure (Knox et al., 2012). In Kenya, the 1981 high temperatures related to drought led to reduced yield and/or failures causing famine in the eastern, central and western regions of Kenya. Similar high temperatures have been recorded from 1999-2000, 2004-06, 2008-2009, 2010-2011 and 2016-2017 (Schmidt *et al.*, 2017).

Heat stress can also lead to plant failure in flowering plants such as tomatoes and maize, when plants fail to produce viable pollen or flowers due to heat stress. In the case of non-viable pollen, the flowers fail to pollinate, thereby resulting in a failure of the fruit set (Zinn, Tunc-ozdemir, & Harper, 2010). This is the reason exposure of plants to high temperatures during the initial reproductive stage has an effect on fruit or grain production across all species (Knox *et al*., 2012) Studies in Kenya show that increased temperatures heavily impact grain yield and vegetative growth because increased minimum temperatures interfere with pollination of flowers, especially in beans and maize (Foster *et a*l., 2015). An analysis of yield gains between 1980 and 2013 indicated that Kenya's average yield has shown a slight decline of about 1kg/ha/year due to high temperatures. This affects food security since maize is a staple food in Kenya. In fact, (J. Ochieng *et al.*, 2016a) found that extreme temperatures had more of an impact on crop yields than rainfall, and could lead to a complete loss of crop yield.

However, changes in precipitation associated with droughts and floods have a massive effect on both livestock and crops. For example, the lack of 2004 long rains (March–May) caused a severe drought which led to massive crop failure in Kenya. Along with droughts that lead to general loss of crops, reduced rainfall has been specifically associated with reduced maize and sweet potato yields (Huho & Mugalavai, 2010).

According to Opiyo, Wasonga, Nyangito, & Schilling, (2015)droughts in northern Kenya have increased in frequency from once every 10 years in the 1970s, to once every five years in the 1980s, to once every 2-3 years in the 1990s, and have become an annual norm since the year 2000 (Schmidt *et al.*, 2017). Frequent droughts adversely affect agricultural production, and have resulted in regular famine-related relief food distribution in some parts of the ASALs, such as Machakos, Laikipia, Turkana, and Isiolo Districts (Huho & Mugalavai, 2010). Extreme temperatures also lead to wilting of crops, stunted growth, crop failures, and consequent lack of planting seeds. During such seasons, small-scale farmers consume all their surplus stored produce, including seeds for planting. During the next planting season, the farmers have to find planting seed for crops such as beans and potatoes, leading to late planting, which is also associated with crop failure. In fact, years of drought have seen annual crop yields drop by between 9.6% and 84% in maize yields, and between 2.8% and 72.2% in bean yields, depending on drought severity. The problem is exacerbated because the rapid recurrence of drought-related shocks leaves little or no recovery time before the next shock occurs. The farmers therefore dispose of all their assets, including goats, chickens, and even household belongings for women. Due to this, most crop farmers lose their capacity to participate economically and to be self-food-sufficient through the practice of rain-fed agriculture (Huho & Mugalavai, 2010).

Droughts also affect the livelihoods of more than three million pastoralists in northern Kenya. From 1990 to date, the government of Kenya has declared several national disasters due to droughts: in 1992-93, 1995-96, 1999-2001, 2004-2006 and 2008-09 (Huho & Mugalavai, 2010). During the dry seasons, water sources such as streams, rivers, springs, and even dams dry up, meaning that pastoralists have to travel long distances to get water for their livestock. During the 1984 drought, the Ngaboli and Ildupata springs dried up and never rejuvenated, while the waters of Ilpuduk spring reduced during the 1999-2000 prolonged droughts and was on the verge of drying up(Bizimana et al., 2016). This led to challenges in accessing drinking water for livestock, and the Maasai community which lived in these region lost a large number of livestock.

For pastoralists, droughts can instigate conflict over scarce resources, create food aid dependency, and compel migration, some of which occurs across national borders (Burke *et al.*, 2015; Omolo, 2011) Reduced herd size weakens communities' adaptive capacity, since increasing or reducing the number of specific species such as goats or cattle is a key strategy

to adapt to drought (Bizimana *et al*., 2016; Kristjanson, Waters-bayer, *et al*., 2010). Thus, reducing the number of livestock limits the pastoralist communities' adaptive capacity to the effects of climate change.

The impacts of climate change in Kenya are not always negative. In the cooler highlands, especially in central Kenya, temperature increases have created an environment more conducive to growth of crops (Ochieng *et al*., 2016), potentially leading to a 20% increase in certain food crops such as maize (Gornall *et al*., 2010) This benefit is experienced mainly in the highlands of Kenya Central and Kisii regions. However, most parts (80%) of Kenya suffer reduced or no production, leading to a net decrease in crop production (Gornall *et al*., 2010)

Thus, the effect of climate change on agriculture in Kenya is high. It is estimated that crop yields have declined due to excessive or insufficient availability of water, meaning more losses to pests and diseases, and more competition with weeds. In the livestock sector, production might decline due to lack of adequate pasture, restricted access to water, and heat stress(P K Thornton, Kruska, Henninger, & Kristjanson, 2003). Changes in the prevalence of livestock diseases (such as Rift Valley fever) are also possible, although how climate change will affect the spread of livestock diseases is basically unknown and will only truly be known in the next 20 – 30 years (Thornton, 2010).

3.4.2 Effects of climate change on energy

The energy sector is one of the most vital in every state (J. Parry *et al.*, 2012), because energy is required daily for production and consumption, as well as for other development processes. While energy is key to livelihoods, 85% of Kenyans rely on traditional energy sources such as forest woods, charcoal, dung, and agricultural residues (Kenya Private Sector Alliance, 2017). These fuels are primarily used for cooking and heating, with firewood being used for cooking in an estimated 68.3% of households (80 % of rural households and 10 % of urban households), and charcoal used by 13.3% of households. Other households, up to 44.6% in urban areas, rely on kerosene (GoK, 2017). Forests, which are a major source of firewood and charcoal, are frequently affected by climate change and fires, which are more common during droughts, thereby affecting the availability of firewood and charcoal. In addition, during harsh climatic events such as drought, people increasingly encroach into forests for agricultural lands and forest-related food such as fruits, while pastoralists use forested lands for grazing, and others

encroach on the forests to obtain charcoal for their energy and economic needs (Huho & Mugalavai, 2010). In the process, trees are often cut down, leading to a reduction in the future energy supply and at the same time increasing household gas into the atmosphere. Consequently, the felling of trees for fuel leads to reduced carbon sink, increased GHG, and heightened climate change.

Prolonged drought and decline in rainfall also directly affect the amount of electricity generated, as lower reservoir levels reduce hydropower production, resulting in load shedding. During the 1999–2000 drought, for example, reduced industrial productivity caused in part by less access to electricity resulted in Kenya's GDP declining by 0.6 % in 2000 compared with the previous year. The Kenya Power and Lighting Company's (KPLC's) revenue dropped by KES4.1 billion or US$20 million (GOK, 2010:40; Kandji, 2006:18; Mogaka *et al*., 2006). Power cuts have since become an annual occurrence (Mutimba *et al*., 2010). As hydropower generation has become increasingly unreliable, the proportion of Kenya's electricity produced via expensive thermal power plants has increased, leading to higher prices for consumers. Drought also influences the traditional energy sector, as people's reduced capacity to purchase kerosene and electricity leads to greater demand for charcoal and firewood (Mogaka *et al*., 2006). The loss of industrial production and higher energy prices caused by drought has historically resulted in greater economic costs than has resource degradation (Dyszynski *et al*., 2009).

The availability of domestically produced energy in Kenya is directly influenced by environmental and climatic factors. Loss of forest covers due to demand for fuel wood and charcoal has contributed to significant reductions in the amount of water flowing through rivers during the dry seasons (Mogaka *et al*., 2006). It affects the siltation of reservoirs, also caused by heavy floods (GOK, 2010), leading to a reduced capacity for electricity generation (GOK, 2010; MENR, 2005). Siltation alone has led to a reduction in the storage capacity of the Kindaruma Dam from 16 million cubic meters to 11 million cubic meters (GOK, 2010:40).

3.4.3 Effects of climate change on health

Climatic factors such as temperature and precipitation patterns directly and indirectly affect the health and well-being of Kenyans today (Campbell, 2016). Changes in climate directly affect health through the direct impacts of weather changes on human biology. These include: injury,

morbidity and mortality caused by climate-induced changes such as cyclones, floods, and droughts; thermal stress caused by heat waves and cold periods; the effects of ultra-violet rays on the skin and eyes, as well as respiratory diseases caused by air pollution. Indirectly, climate change influence health through creating conducive environment for breeding of certain disease-causing micro-organisms. The direct effects of climate change on health include death toll cause by floods, thunderstorm, landslides or droughts. For instance, five deaths were reported during the 2004 Landslides in Nyeri, Othaya & Murang'a (Huho, Ngaira, & Ogindo, 2011). The 1997/98 El Niño floods directly affected over 1.5 million people in different parts of the country. The heavy rains triggered floods and landslides.

Indirectly, climate change influences health by creating conducive environments for certain disease-causing micro-organisms to breed, as well as having an influence on the prevalence of vector-borne diseases. Studies found that vector and waterborne diseases in particular are directly influenced by climatic patterns, including ENSO events and surface temperatures in the Indian Ocean (Caminade *et al*., 2019). Of these diseases, malaria and cholera are of most concern. An estimated 25 million people are at risk of malaria every year in Kenya, and 40,000 die annually from the disease (Julie Parry *et al*., 2013). Studies have ascertained that malaria outbreaks generally occur between July and September and are influenced by temporal variations in maximum temperature and rainfall (Bhunu *et al*., 2016). This is because outbreaks occur when high temperature anomalies are followed by substantial rainfall a month later (Schmidt *et al.*, 2017) For example, high precipitation and temperature levels associated with El Niño events (1982–1983 and 1997–1998) were followed by malaria outbreaks (International Research Institute for Climate and Society, 2015). In fact, the El Nino event in Kenya in the year 1997 was specifically associated with tremendous increase malaria incidences compared with the year 1996. The increase in malaria incidences was up to over six times more than the previous year (Bhunu *et al*., 2016). Apart from Kenya, other studies conducted in Venezuela, Peru, Columbia and Guyana also established that there is a statistically significant relationship between malaria epidemics and El Niño events (International Research Institute for Climate and Society, 2015).

In addition, although malaria cases were historically more prevalent in the lowland areas of Kenya , research conducted in Kenya and the Lake Victoria basin has found that malaria has become more widespread in the highlands in recent decades, due to greater climatic variability coupled with environmental changes (such as deforestation) and changes in cropping patterns,

and their influence on mosquito breeding and survival (C. J. Omondi *et al*., 2017). For instance, the highland districts of Bomet, UasinGishu, Kisii, Gucha, Nyeri, Kiambu and Nyandarua were malaria-free in the 1960s, but by the 1980s malaria cases were being reported in all seven districts. As such Kenya faces a heavy disease burden due to the influence of climate change, 30% of which is due to malaria (Le *et al.*, 2019). In fact, Malaria is ranked as the number one cause of disease and mortality in both adults and children in Kenya, with an annual death rate of 5% (Caminade *et al.*, 2014). Despite the attribution of climate incidences to changes in climate, dispute exists among malaria scholars and scientist on the degree of influence that climate change has on malaria trends (Omondi *et al*., 2017). Some scholars are of the idea that climate change only has but minor influence on malaria patterns, and is a greater risk factor for dengue fever and other viruses such as *arbo* and *Hanta* (Morin, Comrie, & Ernst, 2013).

Another disease that is influenced by climate change in Kenya is meningitis. Studies show that meningitis belt is rapidly expanding with climate change. In fact the width of the disease prone area (belt) is reported to be expanding towards the South due to changes in land use patterns as well as regional changes in weather patterns (IPCC, 2007b). East African countries such as Kenya, Tanzania and Uganda together with central African countries including Togo, Cote d'Ivoire, Cameroon and Benin, which experienced less severe meningitis epidemics and were never considered to belong to the meningitis belt, have are today experiencing widespread meningitis epidemics. The spread of the disease belt southwards into other countries is associated with the extension of hot and dry conditions into such areas (Bhunu *et al.*, 2016). Apart from meningitis, cholera also poses a heavy health burden in Kenya. Along the Lake Victoria basin, cholera outbreaks have arisen due to consumption of contaminated water and food, and through poor hygiene practices (Cowman *et al.*, 2017). In addition, high rainfall and seasonality of sea-surface temperatures are correlated with cholera and malaria outbreaks. As such they have been marked as sensitive to ENSO patterns during the short rains of October to December (C. J. Omondi *et al*., 2017).

Climatic variability also influences socioeconomic factors indirectly, increasing the vulnerability of poor households who are often unable to buy medicine (Huho & Mugalavai, 2010). Added to poverty is an inadequate healthcare system which diminishes poor households' capacity to cope with health-related risks. For example, although district and provincial hospitals are equipped with inpatient capacity to treat persons affected by malaria, many of those affected live far from these facilities, and their first level of contact is with local health

centres. These centres lack qualified personnel and have an inadequate diagnostic facility, which limit their capacity to deal with malaria cases and increases the likelihood of misdiagnosis (Julie Parry *et al*., 2013). Other health problems such as Rift Valley fever, malnutrition, water-borne diseases (such as cholera and typhoid), scabies, chiggers and lice infestations are likely to grow due to climate change (Campbell, 2016).

3.4.4 Effects of climate change on the Kenyan economy

Climate change and variability have significant influence on the Kenyan economy. This is because the country experiences periodic floods and droughts that come with major socio-economic impacts, affecting economic growth. Kenya experienced major droughts in 1998-2000, 2004/05 and 2009, with major economic costs. The 1998-2000 climatic events were estimated to have cost $2.8 billion from the loss of crops and livestock, forest fires, damage to fisheries, reduced hydro-power generation, and reduced industrial production and water supply (Huho & Mugalavai, 2010). The 2004 and 2005 droughts affected millions of people, and the 2009 drought led to major economic costs from restrictions on the supply of water and energy.

The 1999 – 2000 La Niña drought specifically led to power rationing in Kenya, leading to a loss of approximately US$20 million to KPLC, and serious disruption of economic activities (Huho, Mashara, & Musyimi, 2016). The national GDP contracted by about 0.3% in the aftermath of the drought. By June 1999, an estimated 1.7 million people were in dire need of food assistance, with the figure rising to four million by December 2000 (Huho *et al.*, 2016). Another severe drought in 2008 – 2011 had an overall impact of about Ksh968.6 billion (Ksh64.4 billion for the destruction of physical and durable assets, and Ksh904.1 billion for losses in the flows of the economy across all sectors) (Huho *et al*., 2016). The impact of the drought has been documented, with livestock experiencing the largest damages and losses as shown in Table 4.3 below. The effects of climate change may be directly due to harsh climatic events and subsequent loss of biodiversity, experienced in sectors such as agriculture, energy, livestock, and water. Other sectors feel indirect impacts, including tourism, health and education, among others.

Table 4: Sectorial economic impact of 2008-2011 droughts

Sector affected	Impact in USD	% Impact
Agriculture	1,453.8	12.5
Livestock	8395.3	72.2
Fisheries	49.9	0.43
Agro-industry	85.9	0.74
Health and nutrition	137.3	1.2
Education	47.8	0.41
Energy	388.8	3.3
Water and Sanitation	1058.8	9.1
Environment and Tourism	9.1	0.007
Total	11,627.2	100

Adopted from: Waiyaki, Owiti, & Angwenyi, (2012)

In another more recent study, (Ochieng, Kirimi, & Mathenge, 2016b) estimated the effects of climate variability and change in crop revenue of maize and tea. They observed that increased temperature affected crop revenues negatively in maize but positively in tea production, while reduction in rainfall had a negative effect on income from tea. An analysis by Lekapana, (2013) further showed that exposure to extreme weather in Kenya economically affected the wellbeing of smallholder households, based on longitudinal and spatial analysis of income and household welfare. The authors found that extreme weather affects household welfare due to its impact on crop production. Extreme temperatures reduce crop produce, leading to food shortages and high food prices, reducing food accessibility, especially for low income rural farmers, of which the majority are women (Ochieng *et al.*, 2016b).

In Kenya, 70% of farmers practice smallholder rain-fed agriculture, and therefore directly rely on the environment for production (Schmidt *et al.*, 2017). Smallholders primarily grow maize, wheat, rice, sorghum, millet, cassava, Irish and sweet potatoes, bananas, and other fruits and vegetables (Ochieng et al., 2016b). Some farmers also rear livestock and/or practice fishing and aquaculture (Deb & Haque, 2016). Climatic events affect this production and are associated with huge losses from damaged crops or lost livestock. For instance, the frequent droughts from 1998 to 2000 caused US$370 million in agricultural losses (Steinbach *et al.*, 2017), including the death of an estimated two million sheep and goats, over 900,000 cattle and 14,000 camels (Bizimana *et al.*, 2016). Smallholders were even harder hit by the impacts of climate

change due to their high dependence on rain-fed production (Lekapana, 2013). The cumulative loss of crops, livestock and infrastructure had a negative effect on the livelihood of farmers, and in most cases made them vulnerable to subsequent climate-related shocks. Women are even more heavily affected as in most cases they lack assets to cushion them from climate-related shocks (Hoddinott & Kinsey, 2000).

Flooding has also caused significant threats to the Kenyan economy (Guha-sapir *et al*., 2011). For instance, the 1997/98 floods in Kenya affected almost one million people, the majority of whom were from the coastal and ASAL parts of the country. The economic cost of the event was estimated at $0.8 to $1.2 billion arising from damages to infrastructure (roads, buildings, and communications), public health effects (including fatalities), and loss of crops (Guha-sapir *et al*., 2011). The more recent 2006 event affected over 723,000 people in Kenya. The almost-annual burden of these events leads to large economic costs (as much as $0.5 billion per year, equivalent to around 2% of GDP) and reduces long-term growth (Guha-sapir *et al*., 2011). There is evidence of an intensification of these extreme events over recent decades and these may reflect an already-changing climate. Despite increasing climate-related shocks and risks, studies still show that Kenya is not adequately prepared to deal with the challenges (NCCRS, 2010; (Parry *et al*., 2012).

According to Awuor, Orindi and Adwera, (2008), Mombasa, Kenya's second largest city with a population of 700,000 inhabitants, has a history of disasters related to climate extremes, including floods causing serious damage nearly every year and often loss of life. The floods in October 2006 were particularly serious, since they affected the livelihoods of 60,000 people in the city and the wider province (Waiyaki *et al*., 2012). In addition, around 17% of Mombasa has always been submerged by a sea-level rise of 0.3 meters, with a larger area rendered uninhabitable or unusable for agriculture because of water-logging and salt stress (Awuor *et al*., 2008). Another study by Waiyaki *et al*., (2012) the estimated that 190,000 people and $470 million worth of assets in the city are currently at risk of an extreme storm surge. This indicates that climate change events are an existing threat in Kenya, and the economic costs of this can have a serious impact on the economy of both individuals and the country. Apart from direct economic costs, the indirect economic costs of climate change are also overwhelming. For instance, the economic burden of malaria, which is a climate-change induced disease in Kenya, is estimated at US$45 million to US$99 million annually (Campbell, 2016).

As outlined above, it is evident that Kenya incurs huge costs from even a small deviation in climate, due to poor adaptive capacity, a lack of necessary technology, and a lack of resources to deal with climate change (Niang *et al.*, 2014). Park, (2017) noted that developing countries especially those located at low latitudes are expected to suffer more from the agricultural effects of global warming, reflecting their disadvantaged geographic location. Higher evaporation and reduced soil moisture can damage crops in these areas. Similarly, Guha-sapir *et al.*, (2011) suggested that low-latitude economies with large shares of rain-fed and subsistence agriculture are especially vulnerable and may see reductions in agricultural income of 60% or more by 2100.

3.4.5 Effects of climate change on social systems in Kenya

Climate change events have several social effects that can undermine livelihood security. Drought can force rural pastoralists to migrate in search of new pastures, which is common in the Northern parts of Kenya (Thornton, 2010). Such drought-initiated migration leads to family breakdown, significantly impacting women since they are most often left behind to take care of children. In addition, climate-related shocks including droughts and floods affect production in most ASALs. During such times, most men move to urban centres in search of waged employment as farming becomes less profitable (Stephenson *et al*., 2010), resulting in families ties being broken. In addition, the communal social support systems are lost as people move far apart. This leaves the community more vulnerable to the effects of climate change (Parry *et al*., 2012). Furthermore, the migrations of men to urban centres often leaves women and children behind with little or no fatherly care and protection, conferring more responsibilities onto women as they have to supply household food, water, and security. Since women often have limited access to resources, the extra responsibilities and strains have negative impacts and have even led to decreased school attendance, as well as increased child labour (Ongoro & Ogara, 2011).

In rural areas, it is the responsibility of women and children to collect firewood and water, yet decreasing supplies are resulting in more work and less time for other tasks, as they now often have to go further distances to find supplies (Goh, 2012). In many developing counties like Kenya, women have limited access to land, capital, and other resources. This makes it difficult

for them to access the climate-resilient technology or crops necessary for climate change adaptation (Arora-Jonsson, 2011).

In agro-pastoralist environments, numerous aspects have led to shrinking plot size, such as higher population, and land sales to non-pastoralist communities resulting in fencing of pastoralist corridors and access to water, which exacerbates the challenges arising from climate change (Filho, Nzengya, Muasya, & Chemuliti, 2017). During dry seasons, due to highly fenced pastures and land areas, the livestock keepers are often pushed into unsuitable areas where they lose communal ties. This is especially the case with the Maasai community who initially inhabited Nairobi but have since been pushed outside the city. This results in increased incidence of diseases, and conflicts with other communities. Most Maasai in Kenya for example migrate to Tanzania and men (heads of families) move with the livestock in search of water and pasture (Filho *et al.*, 2017). This is likely increase pressure on families, including higher vulnerability to famine.

The migration of populations due to climate change also leads to other challenges, including conflict over property rights as herdsmen encroach on land belonging to farmers (Serdeczny *et al.*, 2016). In the north of Kenya, pastoralists from West Pokot and Turkana counties often move their herds towards and even into neighbouring Uganda when drought intensifies, as in the years 2011 and 2016 (Opiyo *et al*., 2015). This movement led to conflicts in some parts of the country, such as in Laikipia, with pastoralists from the neighbouring counties forcibly relocating their herds to privately owned ranches to graze (Opiyo *et al*., 2015). Climate-induced conflicts in other countries have in turn led to migration of many refugees into Kenya: approximately 566,500 as of January 2012. Most of these refugees are from Somalia, Ethiopia, and Sudan who left as a result of the effects of climate change on their livelihoods (Torres & Casey, 2017). A majority of these are women and children, who require attention and support. This growing refugee burden hampers the country's ability to properly attend to domestic demand for improved social services.

Another example of climate induced conflict in Kenya is in Isiolo County in Northern Kenya region. In the region, prolonged drought and water scarcity contributed to inter-ethnic conflicts as a result of competition for scarce resources such as water and pasture (Sharamo, 2014). State-recognition of drought resulted in the community being provided with fodder for their livestock in a few pastoral settlements. However, agro-pastoral communities in neighbouring regions, who had similar water scarcity problems, got no support. This enhanced tensions

between the two groups, leading to violent incidents involving livestock theft and loss of lives (Sharamo, 2014). Conflict increases as pastoralists from different ethnic communities migrate from their traditional homelands to other parts of the country where they are not always welcome, and competition for grazing land raises tensions and sometimes turns violent as the situation becomes more desperate (Salome, 2011). This is exacerbated when accompanied by livestock theft.

In Turkana, for instance, most conflicts are caused by violent theft of livestock. According to Opiyo *et al*., (2015), these raids not only lead to the loss of livelihoods (livestock), but create a feeling of insecurity that further exacerbates vulnerability to climate change among communities as women's movements become limited (Ongoro & Ogara, 2011). During such period's women find it difficult to provide for their families through outdoor activities. In fact, an NGO working in conflict and peace building initiatives (TUPADO) indicated that 592 people were shot dead during raids in Turkana between 2006 and 2009, with a further reported two people losing their lives during a raid (Debarati *et al*., 2016). In addition, CEWARN reported 640 conflict-related deaths in Turkana and Pokot County for 2009 alone (2010) in the annual disaster statistical review 2016 (Debarati *et al*., 2016)

Raids weaken communities and rob them of critical workforce that could look after livestock, because it is mainly the young that care for the livestock that are killed or injured during raids (Opiyo *et al.*, 2015).The loss of critical work force is especially felt during droughts when young men are required to move far away to distant areas in search of pastures. Other negative effects include a reduction in the food security and economic stability of the raided community, by decreasing their main livelihood assets. For instance, the livestock lost between 2006 and 2009 due to raids in Turkana and West Pokot county numbered more than 90,000 (Schilling, Opiyo, & Scheffran, 2012). These conflicts lead to unstable food production globally and subsequent loss of livelihoods and suffering. Women are especially affected since they have limited access to assets that could cushion them from the impacts of climate-initiated conflicts (Codjoe *et al*., 2012).

3.4.6 Effects of climate change on Kenyan biodiversity

Kenya is rich in biodiversity and hosts over 35,000 species of flora and fauna (Keppel *et al*., 2012), particularly insects. This rich diversity is anchored on diverse ecosystems ranging from

mountains, large water bodies, tropical savannah grassland, dry lands, forests and arid lands, as well as 467 inland lakes and wetlands that cover approximately 2.5% of the total area. The forests in Kenya have a rich variety of plants and animals, some which are rarely found elsewhere in the world. The richness of species in a region is often correlated with high annual rainfall, and as such wetter forests are richer in species. Consequently, Kakamega Forest has the richest plant diversity in Kenya. In addition, coastal forests have more value as centres of endemism with many plant and animal species found nowhere else in the world (Engelbrecht & Engelbrecht, 2015). The diversity of plant and animal species supports a variety of livelihoods including tourism, building and construction, trade, and farming, among other natural resource-based activities (Keppel *et al*., 2012). However, climate change has significantly altered Kenyan biodiversity, as species struggle to adapt to changing conditions (Vu *et al.*, 2011).

According to (Djoudi & Brockhaus, 2011), deciduous and semi-deciduous closed-canopy forests are sensitive to even slight changes in precipitation, especially during the growing season. Similarly, deciduous forests are more sensitive to reduced precipitation than grasslands or savannahs (Case, 2006). This has other effects besides the reduction in biodiversity. As the plant life changes, so do the migratory routes used by different animal species in Kenya. Changes in migration routes further affect synchrony, fecundity, genetic structures, and phenology of animal species (Case, 2006). This has been observed in both seasonal wetlands migratory birds, as well as larger animal species such as gazelles, elephants, wildebeest, zebra, and rhinos. Changes in migratory patterns also bring about other forms of conflict between people and animals, especially where water resources are limited and dwindling. This has been observed in areas such as Taita Taveta and Turkana, where water resources are limited and people, livestock, and wildlife depend on those limited sources (Opiyo *et al*., 2015)The rising tensions between communities as a result of climate-related impacts are often politicised, hence the need to discuss how political issues relate to climate change.

3.4.7 Effects of climate change on political systems

In Kenya, there are not many studies on the effects of climate politics (Sharamo, 2014). However, it is clear that where climate change leads to migration, affects livelihoods, or creates inter-ethnic conflict over the use of land and resources, these issues not only affect but can

destabilise political systems. Sharamo, (2014) points out how conflicts among pastoral communities are causing deep political divisions at clan and ethnic levels, leading to further breakdown of social cohesion and political structures within these communities. The state needs to deal with the insecurity and poverty that climate change evokes and respond to the communities' needs in a fair and just manner. During the Kibaki regime, a special Ministry for the Development was created to address the livelihood issues in Northern Kenya that was hard hit by impacts of climate change. Due to stronger governance in Northern Kenya, this intervention managed to create peace and spur development among the Turkana and the Pokot.

In this case, the government of Kenya made political adjustments and created structures and institutions to address climate-related impacts. A good example is the National Drought Management Authority (NDMA) that operates in ASALs where the effects of droughts are pronounced. However, in cases where the political response is insufficient, citizens may become more vulnerable and lose their livelihoods due to the impacts of climate change.

3.5 Gendered consequences of climate change in Kenya

As discussed in Chapter 2, climate change affects men and women differently in Kenya, as in the rest of the world. This is due to the different roles and responsibilities ascribed to them at the household and community levels (Goh, 2012). Women have been shown to disproportionately suffer in terms of food intake in times of extreme climate events, since they have to share the little, they have with children. However, this does not mean that men do not suffer. Men also face negative consequences due to food shortages. In examining the impact of droughts in agro-pastoralist communities in northeast Kenya, for example, (Ngigi, Mueller, & Birner, 2017) found that during drought-initiated food shortages, a common practice, especially among women, was to reduce meal intakes. This increased women's health problems, as well as those of children and lactating mothers. This hampers growth and development of children, which is a critical form of human capital. During such periods, men turn to other means of earning income by collecting and selling bush products like gum and resin, or by cutting trees for firewood and charcoal, but also report weakness because of low quantities of food intake whilst doing hard manual labour.

The other gendered effect of climate change relates to conflict, particularly in the form of armed livestock raiding. More men die during raids, which has led to an increase in female-headed

households. Added to this, Omolo, (2011) points out that not only does it increase the burden on women, but they become more vulnerable to insecurity and conflict after raids because they are left alone to take care of the children and often do not have the resources or capacity to flee from the raids. This also means that they can be pushed off the land, as women often have limited customary rights to land, wells, and livestock, especially in Northern Kenya.

As previously indicated, a majority of Kenyan women work in agriculture (Njobe, 2015). Their potential to be employed in off the farm activities is limited compared to men, who are more mobile and can take up other forms jobs in urban settings when rural livelihoods fail. This has been documented in Kenya by Coulibaly *et al.*, (2015), in Uganda by Case, (2006) and Tanzania by Coulibaly *et al.*, 2015). These studies suggest that women are less flexible than men in working off-farm as a response strategy to the effects of drought. Typically, in patriarchal societies like Kenya, women's productive and reproductive labour is embedded in the household and the duties associated with this (Diiro *et al.*, 2018). Hence, the gendered division of labour within the household has meant that more opportunities exist for men to work off the farm in response to climate stress than women (Coulibaly *et al*., 2015). However, some studies indicate that when it comes to female-headed households, they are often compelled to work off the farm in menial jobs to earn income (Ongoro & Ogara, 2011). As such, working off-farm is an adaptation that at the same time robs women of the time to take care of the children and to conduct other household chores (Stokes *et al.*, 2015). In Kenya for instance, one major diversification option reported by women in Narok is charcoal burning and sale. When extreme climate events affect farm-based activities, women often resort to charcoal burning, or buy charcoal from charcoal burners, for sale in Narok town. Women shift to charcoal-based enterprise, since they believe that this livelihood strategy is less strongly affected by climatic variables. While this coping strategy may provide a short-term solution, charcoal production often weakens long-term resilience by destroying vegetation and exposing agricultural land to erosion. This further reduces farm productivity and leads to loss of biodiversity. This is common in other parts of Northern Kenya in ASALs (Atela *et al*., 2018).

Access to resources is another factor that affects women more than men. Culturally, women have had limited access to productive resources (Atela, Gannon & Crick, 2018:19). In Kenyan communities, the major productive assets such as land, livestock, ploughs, fishing nets, and cash crops are owned and controlled by the male household head (Stokes *et al.*, 2015). Women traditionally control household assets, food crops, and smaller animals (goats, chickens).

Ownership of and control over land and cattle is culturally decided by men. The commercial exchange and inheritance practices in Kenya ensure that men primarily hold these major assets, although some women do own cattle. Although cattle ownership by women only applies to female household heads. Furthermore, changes in market conditions, especially in the 21st century, along with the effects of climate change have seen men venture into women's traditional role in livestock product production, such as sale of milk, robbing many women of their livelihoods. In Uasin Gishu County, men have become major players in the sale of milk, a role that was predominantly left for women (Ongoro & Ogara, 2011).

Even though most studies show that women are often more negatively affected by climate change than men, a few studies indicate otherwise. In some cases men may be more negatively affected, since they own land (Kimeu & Maneno, 2017), or due to the fact that women are able to invoke cultural norms that make men responsible for household food security during scarcity (Kristjanson, Mango, Krishna, Radeny, & Johnson, 2010) As such, it is important to note that differential climate impacts may also affect people differently depending on their marital status, relationship to the head of household, or family situation. Gender-differentiated impacts of climate change are also not always rigid, straightforward, or predictable (Goh, 2012). Due to such differentiated impacts, Demetriades & Esplen, (2008) caution that women cannot be treated as a monolithic group when looking at their vulnerability to climate change and the various coping strategies they adopt to mitigate the various effects on their livelihoods.

3.6 Gendered adaptation and coping mechanism

Adaptation is defined as alterations in ecological, economic as well as social systems in response to anticipated or definite climatic spurs and impacts. The term includes changes in systems, , practices, and processes to reduce anticipated damages and maximize benefit from opportunities that come with changes in climate (IPCC, 2001b). In this regard, Kenyan men and women have employed gender-differentiated strategies to adapt to climate change, dependent on access to different forms of capital (Johnson *et al.*, 2016). Given their extensive involvement in agriculture and various gendered household tasks, Kenyan women have a good local knowledge base of the environment since they interact with the natural environment daily. Not only are they involved in farming, but they perform household duties such as fetching water, gathering firewood and fruits, all of which are dependent on the environment (Goh,

2012). Given this, they often have extensive knowledge of seasonal timings, as well as the best crops to grow, best times, and what seeds to plant to realise a good harvest.

In rural communities, knowledge sharing among women is common since they come together in groups to mitigate the effects of climate change and to share critical information on adaptation and coping mechanisms (Ongoro & Ogara, 2011). These groups serve to empower women, beyond the immediate purposes of resource conservation and management especially where they link up in associations and use this social capital as a form of agency. For example, women have linked up with the Greenbelt movement that supports women to plant trees, paying them for their work, in order to counter the effects of climate change. By linking up with such organizations, it contributes to building a sense of belonging and social support that can be used as a tool to counter repressive gender biased gender relations.

In Kenya, found (Ongoro & Ogara, 2011) that a group of widows and divorced women affected by HIV and AIDS acted as an agent of livelihood sustainability among members during periods of scarcity. The group through the provision of financial services such as loans, and savings to members and pooling together of assets in form of labour, information and knowledge made them to more effectively confront the numerous climate initiated challenges including water scarcity, soil degradation, and disease burdens among women, The group also enabled members to do rain water harvesting and agroforestry (Mubaya, Mafongoya, & Obert, 2017). These examples show that groups do not only provide material gains, but also strengthen personal and relational benefits by developing the skills, knowledge and the dignity of women. A further benefit is that these groups provide women with voice and platform for social networking.

In addition to community-based groups, farmer's groups, community networks, credit groups, savings and credit societies, cooperatives and village councils have been noted as providing a positive influence on adaptation through resilience-building (Nelson & T. Stathers, 2009). Access to diverse networks and organisations improves the access of women to economic, social, and political institutions. At the institutional level, the government of Kenya provides a number of social safety programmes, including the Hunger Safety Net Programme (HSNP), targeting the four northern counties often affected by drought. The government also provides emergency food relief, food subsidies, and other farm input support during or after climate crises. This is because food access and production is usually a challenge that leads to food scarcity and famine.

Food insecurity due to climate change is a major problem because extreme climatic events in Kenya reduce crop yield or can even lead to complete crop loss. According to Johnson *et al*. (2016), the main strategies that women adopt are to purchase food if they have the means, to reduce consumption, or to consume different foods that are easily accessible. In a study in Kenya by (Ngigi *et al*., 2017) on the effects of climate change on food security, he found that 63% of respondents tended to resort to purchasing food in response to climate-related shocks. Although this is a common coping mechanism, it comes with challenges since droughts are linked to food shortages and price increases that heighten food insecurity. Again, this tends to affect women more than men given their limited access to financial. The lack of access to financial capital also means that women are less likely to adapt to climate change in ways that need more financial investment.

It is also important to note that the financial burden on women increases not only in terms of food security, but also water for consumption, cleaning and sanitation. Research done in Kibera, Nairobi showed that during water scarcity, women were often compelled to purchase water from vendors, which consumed up to 1/3 of a household's monthly income. They also had to travel long distances of up to one hour daily to collect the water (Kapwata *et al.*, 2018). As a result, women bear financial and time costs when water supplies are limited. A coping strategy adopted by these women was to restrict their water use to drinking and occasional bathing to reduce consumption (Ibnouf, 2014). The shortage of water affects the ability to keep and maintain livestock, forcing the few women who own livestock to dispose of them.

Furthermore, drought affects livestock prices since it leads to decline in forage and water availability, which in return deteriorates the overall livestock health conditions. This most often leads to a decline in livestock price and revenues (Lekapana, 2013). At this point, the few women who own goats and cattle, especially those in female-headed households, sell their livestock for survival. These sales usually fetch little cash as prices are tremendously reduced. Furthermore, the population of women who own livestock is relatively limited. Those without livestock suffer in the process and become even more vulnerable. In such areas, (Ngigi *et al.*, 2018) research shows that domestic arrangements are affected as female-headed households have limited access to other means of survival. Reports show that under these conditions, women tend to engage in a range of transient relationships for survival, which can be economic or sexual (Ongoro & Ogara, 2011). While such adaptation and coping strategies are meant for survival, they are also associated with other dangers such as STIs, and HIV and AIDS (Goh,

2012). Where women engage in other economic activities, such as petty trade, they can be drawn into insecure or illegal activities to diversify their options to cope with the effects of climate change on their livelihoods (Ngigi *et al.*, 2018). However, the options open to women may be limited due to their age and marital status. For instance, in Kenya and Tanzania, a study done by (Ochieng *et al.*, 2016) among smallholder farmers revealed that most often married women are still to a large extent excepted from profit making ventures because of gender roles, cultural norms shaped by patriarchal structures.

3.7 Vulnerability of Kenyan women to climate change

The main reasons why women are more vulnerable to the effects of climate change is because they have limited access to a range of resources and assets (Julie Parry *et al.*, 2013). These include inadequate access to natural capital, social capital, financial capital, physical capital, and human capital. These assets are the basis of livelihoods and resilience and are a prerequisite for sustainable community livelihood development (Nel, 2015). Diversification of livelihood and access to various forms of assets is therefore important for the livelihoods of rural households, especially during climate-related shocks (Albore, 2018).

In Kenya, most women have limited access to or control over natural capital, especially land. The land they farm in most cases belong to men, with women owning only 1 – 5% of land titles in Kenya (GoK, 2017). This is because the majority of ethnic groups in Kenya share a patriarchal culture in which men own the key productive assets such as land, livestock, and medium- to large businesses (Kimeu & Maneno, 2017). Despite women having limited access to natural capital, the limited access of lack of rights to land affects access to a range of other resources, such as financial security, food, water and shelter, especially for those who depend on land for their survival (Ongoro & Ogara, 2011). According to (Kimeu & Maneno, 2017), lack of land ownership status negatively affects agricultural productivity, and women's access to and control of land has been concomitant to the reduction of absolute poverty in households and communities (Gerber *et al.*, 2014). Apart from access to land and ownership, the decision-making processes to determine the acreage for food crops or cash crops, crop variety to plant, and selection of seeds for each planting season are dominated by men. This renders women vulnerable to the effects of climate change since their limited access to natural capital leads to

inadequate access to other capital, and ability to adopt and adapt to other crops or cultivation methods.

In addition, water rights are often linked to land rights, meaning that the management of this resource is also controlled by men (Kristjanson, Waters-bayer, *et al*., 2010). Yet, studies show that when women are involved in water governance, the outcomes are often better for both women and men (Ongoro & Ogara, 2011). Despite proven advantages of involving women in water governance, gendered power relations in Kenya still prevent women from taking part in water management activities. For example, in rural Kenya, governance of water excludes women from community water management groups, mainly due to the fact that women do not own land. As such, they are excluded from decision-making forums, which directly affect them as the main users (Kimeu & Maneno, 2017).

Apart from their lack of access to natural capital, women also have less access to credit than men (Demirguc-kunt, 2013). Because women rarely have land deeds, they typically lack collateral for a formal loan. Access to banking has improved markedly in recent years, and all the major commercial banks in Kenya now have at least one financial credit or mortgage product targeting women, and the government has initiated several programs to provide women with credit. However, the traditional method is still for women to pool resources and to borrow against this. Even though up to 50% of women now have access to credit, these sources are still informal, mainly accessed through micro-finance institutions (Fletschner & Kenney, 2011). This is particularly the case for women living in the rural areas. In urban areas, women have greater access to credit through institutions such as the Kenya Women Finance Trust, Kenya Rural Entrepreneurship Programme, United Women's Savings and Credit Co-operatives Society, and the National Association of Self-Employed Women of Kenya (Demirguc-kunt, 2013). This hampers women's ability to cope with prolonged effects of climate change.

Besides their limited financial capital, women have limited access to human capital. Human capital is an embodied form of capital and includes human labour, skills, education and health. Women in Kenya have low access to skills and knowledge on climate change and related adaptation mechanisms, because most extension officers in Kenya have the tendency to reach out to male farmers rather than female. This practice is fuelled by cultural sensitivities that prohibit male extension officers from talking to women farmers in parts of Kenya (Hannan, 2011). Furthermore, the National Gender and Development Policy indicate that agricultural

extension agents in most cases tend to focus on male heads of households as landowners, and hence give them preferential information (Diiro *et al*., 2018). This is because traditionally women are believed to do household chores, while men farm. It is also culturally prohibited for men to visit the homesteads of other men, even if to provide professional information. Additionally, the hours during which extension services are provided sometimes conflict with the times when women are expected to be engaged in their reproductive roles. Consequently, extension staff target male heads of household, and not women. Harcourt, (2017) did a study and found that women who contribute the bulk of agricultural labour received only 7% of the extension information, showing that women have often not been the target for extension work, and as such they lack information. This approach denies women farmers access to modern and appropriate agricultural research information and technology, which could lead to an increase in the productivity of the agricultural sector as a whole.

Apart from limited access to extension services, women in Kenya have limited human capital in terms of their ability to make decisions (Ongoro & Ogara, 2011). At the household level, decision-making on a number of issues is done by the man. For instance, in pastoralist societies, women may milk the family cow and sell the milk products but cannot sell the cow itself because it is "owned" by her husband. For conservation, this means that activities which include the use of productive resources like land or livestock should include men and women in decision-making (Kristjanson, Waters-bayer, *et al.,* 2010).

Studies show that allowing women access to the same productive resources, technologies and services (livelihood assets) as men, has the potential to improve agricultural productivity and subsequent household food security, as well as general welfare (Onwutuebe, 2019). The World Bank (2005) showed that allowing women farmers access to the farm inputs and education as men could increase yields by more than 20%. Similarly, (Johnson et al., 2016)noted that giving women farmers access to the same farm inputs, education, and experience as men would increase their yields for maize, beans, and cowpeas by as much as 22%.

3.8 Conclusion

Kenya as a country is highly dependent on rain-fed agriculture and natural resources for livelihoods. This makes the country more susceptible and vulnerable to the effects of climate change. Climate change affects all forms of assets, but women are more affected due to their

limited access to resources to cope with climate-related shocks. Women in Kenya have limited access to information, natural capital, financial capital, and human capital in terms of education. Despite these limitations women, as the main farm labour providers and majority of small-scale rural farmers, have unique ways of coping with climate change. These include intercropping, faster adoption of climate-smart agriculture, sale of the little assets they own, and the use of social capital such as groups to borrow goods and funds during scarcity. However, few studies have been conducted on how women mitigate the effect of climate on their livelihoods. This is the focus of the current study. The following chapter will outline the research methodology adopted to investigate how women adapt to and cope with climate change, in order to situate the study and to describe the limitations in terms of the research and findings.

CHAPTER FOUR

DIFFERENT THEORETICAL APPROACHS TO UNDERSTANDING CLIMATE CHANGE AND WOMEN'S LIVELIHOODS

4.1 INTRODUCTION

Theories advanced to understand the different effects of climate change on livelihoods and how people respond to these changes are varied, including the theory of change (Bours & Pringle, 2014), sustainable resource management (Failler, 2018), gender and feminists theories (Djoudi & Brockhaus, 2011; Elmhirst, 2016), political economy approaches (Elmhirst, 2016; Hanson, Hanson, & Buechler, 2015; Sundberg, 2015), social capital theory (Adger, 2014b; Delta & Green, 2014; Whiteley, 2015), Sustainable Livelihoods Approach (SLA) (Hodson, Ting & Goldman, 2009; Oliver, 2017), and resilience theory (Holling, 2013), among others.

Though important for helping to analyse the effects of climate change on the livelihoods of people, especially those involved in rural agriculture, these theories are not all suitable for understanding how women respond, adapt, and mitigate the effects of climate changes on their lives. To realise the objectives of the study, appropriate theories were selected to both explain and interpret the effects of climate change on women involved in urban agriculture. Accordingly, this study is anchored in SLA and the focus is on how women sustain their livelihoods through adopting various strategies when faced with the impact of climate change. This approach is complemented by other theories and approaches discussed in the previous chapter, such as the Asset Based Community Development (ABCD) approach, feminist theory, resilience theory, and intersectionality. The aim of this chapter is to expand on the different theories that can help to understand the effect of climate change on women, as well as the different assets they typically can draw on to mitigate and build resilience to these effects.

4:2 SUSTAINABLE LIVELIHOODS APPROACH (SLA)

4.2.1 Background of SLA

SLA is an analytical framework that highlights the dynamic dimensions of poverty and wellbeing through analysis of the assets which poor individuals, households, and communities deploy to sustain their livelihoods when placed under stress (Norton & Foster, 2001). Its origin

is traced to different fields, including social science, and agro-ecosystems or farming systems analysis, and participatory approaches to rural development. The approach's main strength is the analysis of livelihoods within a framework that encompasses assets, policies and institutional processes that affects livelihood outcomes at various levels. The SLA has been widely applied to analyse various rural development projects.

According to (Solesbury, 2003) SLA emerged from different rural development projects since the 1960s, such as Agro-Ecosystem Analysis, which sought to bring together concepts in ecology with social and economic aspects of agriculture. The approach resonates with older approaches, such as Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA), which emphasised the need to learn from rural farmers, given their knowledge of their environment and how they used various assets to survive. In the evolution towards SLA, PRA stemmed from The Brundtland Report on Environment and Development in 1987, which underscored that sustainable development requires a secure political system, a stable economic system, technical knowledge, a strong and robust social system, sustainable production systems, a dependable technological system, an international system that is networked, and a flexible administrative system, all of which are echoed in the SLA (Bermejo, Arto & Hoyos, 2010:12).

Another approach that led to the birth of SLA was the human development approach in the 1980s, considered a precursor to SLA. In fact some scholars to date regard SLA as the operational vehicle of human development (Bermejo *et al.*, 2010). The main proponent of this approach is the Indian economist Amartya Sen, who studied the components of human development and placed an emphasis on livelihood sustainability and resilience (Meadowcroft, 2016). Sen recognised recognized that resilient livelihoods need to be diversified, in that the activities of individuals or communities to secure their livelihoods need to be varied (Sen 2008). These activities involve both on- and off-farm activities done to secure either earn income or secure a livelihood.

The concepts of sustainability, resilience and livelihood diversification as proposed by Sen are key components of SLA (Albore, 2018). Other proponents of the human development approach include Chambers (1991), Davies (1996), and Moser (1998), who emphasised vulnerability to shocks as the pre-curser to poverty and loss of livelihoods, while Berry, (1989) stressed the importance of access to resources as a way to cushion the effects of shocks like climate change

on vulnerable communities (Solesbury, 2003). Hence, the human development approach can be classified as one of the major precursor to SLA.

In the first Human Development Report by the United Nations Development Programme (UNDP, 1990), there was a shift of focus from the macroeconomic bias of earlier development thinking to a more nuanced approach that looked at individuals and household health, education, and human wellbeing (UNDP, 1990). From the report, studies on sustainable development and livelihoods emerged and became common in the developing world, especially in agrarian societies in Africa. A good example is the writing of Jane Guyer on Nigeria (1981, 1992, 1996, and 1997). However, the concept of sustainable livelihoods finally came out clearly in the works of Chambers and Conway (1992), who aimed to promote the effectiveness of development cooperation (Robert Chambers and Gordon R. Conway, 1992). Their work reacted against the earlier theories and approaches, such as human development approach and PRA. Years later, donor institutions such as the UK Department of International Development (DFID), Oxfam, the UNDP, and Care adopted SLA for analysis and evaluation of their development programmes and practices (Solesbury, 2003).

In progressive developments, the SLA replaced the "basic needs approach", which had been used to understand development and poverty. The basic needs approach was developed during the world employment Conference in 1976 organized by international Labour Organization and was strongly supported by Abraham Maslow in his work, *Motivation and Personality,* before being further improved by Sears' speech in 1971 commonly referred to as "The cruel choice: a new concept in the theory of development" (Goulet, 1973:397). The approach contends that taking care of human needs at different levels would help to achieve development and eradicate poverty. It assumes that development is achieved through the provision or satisfaction of human needs, such that when people have a guaranteed subsistence, then they can make a good living (Shing, 2012). However, based on SLA, the needs-based approach proved limiting due to its strong focus on the community's limiting factors (needs) rather than strengths (capabilities). At this point, SLA, with its emphasis on freedom of choice and the use of capital as capabilities, established a correlation with the human development approach, which looked at the diversity of assets within a community or household that foster resilience (Morse & McNamara, 2013). The emphasis on assets diversity and resilience makes SLA suitable for analysis of livelihoods in different contexts (Olivier, 2015:71).

In essence, aspects of SLA arguments relate to human development approach, which emphasizes the people, centred approach. The people-centred approach stresses that poverty elimination requires respect for human freedom and choices rather than the resources, facilities, and services they use (Solesbury, 2003). This approach is shared by the Rapid Rural Appraisal approaches developed in the 1960s and recognises the role that poor rural farmers play in poverty eradication as a necessary step towards human development. This approach believes that development and poverty eradication only occur when there is investment in the subjects, and when subjects have the freedom to make decisions and choices about their own development. The human development approach also infuses SLA, and emphasises the importance of both sustainability and access to resources to sustain a livelihood (Scoones, 2009). Key to the approach is the availability of resources, facilities and services, and their sustainability. The resources include the five forms of capital in SLA, which are essential to ensure livelihood sustainability. Facilities and services include institutions that interact with the rural poor to influence their livelihoods, while livelihoods are defined by Scoones (2009) as the capabilities, assets, and activities that individuals draw on in order to earn a living. The above two approaches make SLA a suitable tool for analysis of both poverty and rural livelihoods, and how they adapt during climate-related shocks.

4.2.2 Definition and Context of Sustainable Livelihoods Approach

SLA emanated from the works of early development theorists, who had a narrow and simplistic conceptualisation of the approach (Scoones, 2009). For instance, the definition of livelihoods as, “adequate stocks and flows of food and cash to meet basic needs” (Chambers & Conway, 1991:5) limited livelihoods to only cash and food. The definition is incomprehensive as livelihoods comprise much more, incorporating both material and social capitals and capabilities, such as livestock, land, information, and institutions (Olivier, 2015:73). From this understanding, Robert and Conway (1992) developed a comprehensive definition of livelihood as a combination of the capabilities, assets and activities required to make a living. This study uses this definition.

In this framework, capabilities refer to the reactive potential to challenges and crises or shocks, such as climate predicaments, like floods and droughts, and their consequences, such as the impact on food insecurity (Nel, 2015). Capabilities constitute the beings and doings that enable

a valuable life (Nel, 2015). For example, capabilities can be the ability to be mobile during disaster, which in turn depends on a number of factors such as infrastructure, financial resources, and ability to drive, among others. The capabilities of individuals or a community in most cases depend on access to assets, resources, or the forms of capital to cushion one from shocks. These could be natural, social, financial, physical, or human effort (Olivier, 2015:74). In the poverty context, SLA gives a comprehensive approach that considers poverty a result of inadequate access to resources. The approach holds that the poor need adequate access to resources to make them resilient in the event of shocks in order to sustain their livelihoods.

One aspect of SLA is resilience in the face of external shocks and stresses. In the poverty alleviation approach, (Chambers, 1995:191) considers a sustainable livelihood as one that is able to increase resilience over time. Thus, sustainable livelihoods can be viewed in two forms: the negative dimension that considers the ability to cope with and recover from stresses and shocks (Scoones, 2009); and the positive dimension which encompasses enhancing capabilities in adapting to shocks , exploiting the environment, creating change, and assuring stability (Robert Chambers and. Conway, 1992; Olivier, 2015). To accommodate these two perspectives, Chambers and Conway explain that a livelihood become sustainable when it has the ability to cope with and successfully recuperate from shocks while continuing enhance its capabilities both in the present time and in future while maintaining its resource base (Chambers & Conway, 1991).

4.3 Tenets of sustainable livelihoods approach

The sustainable livelihoods approach rests on five forms of assets, known as capitals. These are the building blocks of livelihoods, which play a key role in ensuring the sustainability of living. As defined above, capitals constitute physical resources, finances, the natural environment, and the social and human attributes that individuals, a household or a community uses to cope with or adapt to livelihood stresses. They are the building blocks of a livelihood that mutually enhances livelihood resilience (Morse & McNamara, 2013). The capitals intertwine and overlap in practice. For instance, a sick person can pay money for treatment in a facility to become well. In such cases, financial capital reduces, while human capital increases. On the other hand, when the person gets well and is able to work for a pay, he/she can use human capital to acquire financial capital. Within a rural setting, an individual with

access to land can sell the land to gain money (financial capital), while losing the ownership of the natural capital (Albore, 2018). Another example is that someone with more human capital, one can draw on assets such as education, can access more employment opportunities, which can increase financial capital through work opportunities (Morse & McNamara, 2013). As such, a low level of formal education limits access to financial capital and other forms of capital that can be traded for financial capital. Such capital trade-offs help individuals accumulate capital that can help them cope with livelihood threats.

Given this, capitals are key in determining sustainability and resilience to livelihood shocks. The capitals are the resources from which individuals, households and communities draw to adapt to or cope with the impacts of climate change on their livelihoods (Goh, 2012). Therefore, households with limited access to forms of capital such as education, finances, and private land tend to have limited adaptive capacity and resilience. A key reason for this is because the resilience of livelihoods relates directly to the variety and amount of capitals they possess or have access to (Chambers &Conway, 1992:10;Olivier, 2015). This calls for diversification of livelihood sources, especially during extreme climate events such as droughts or floods. According to (Hossain, 2005), low-income households may not be able to sustain their livelihoods from a single source of capital, and need to embrace multiple sources to sustain their livelihoods. In rural/poor villages, in addition to subsistence farming, households or individuals may offer temporary labour, sell part of their farm produce, or even lease part of their farm to bridge the need for financial capital. Some rural dwellers, especially women, join social groups where they can lend and borrow money, or save money during surplus years to use during shocks. As such, the different forms of capital are important in different ways. At this point, it is necessary to define, describe and evaluate these various forms of capital in order to understand how they relate to the effect of climate change on the livelihoods of women involved in rural agriculture.

4.3.1 Natural capital

Natural capital describe the natural environment from which the goods that sustain life, such as water, land, air, living organisms, and all ecosystems on the earth that promote/support human survival and wellbeing are produced (Cleveland *et al*., 2014;Gerber, Nkonya & Braun, 2014). SLA places particular emphasis on the preservation of the natural environment because

it is of special importance to those who derive their livelihoods from natural resource-based activities (Tabulatur & Musik, 2014). Accordingly, natural assets such as water, fuel, wood, cultivation land, crops, and forests are important for livelihood development and are highly subject to climate change. Natural capital is critical for sustainable livelihood because it is key in the production process, especially for the rural poor who dependent on the land for their livelihoods (Kameri-mbote, 2005). As such, the negative effects of climate change on natural capital affect rural farmers in many ways, not just in terms of their food security, but in terms of pasture and water, energy, movement, economy, and governance.

Historically, the importance of natural capital is overshadowed by a focus on financial and other forms of capital (Cleveland *et al*., 2014). However, more consideration and emphasis on sustainability and conservation within the last few decades has re-emphasised the importance of natural capital for human survival. In addition, there is now a better appreciation of the fact that natural capital underpins the ability of other forms of capital to produce benefits for people, and its importance should not be undervalued or underestimated.

In fact, natural capital plays a critical role in achieving the international development targets. For instance, in the Sustainable Development Goals (SDGs), goals 14 and 15 have a direct focus on the sustainable use and preservation of natural capital. The SDGs are closely linked to natural resources and their achievement is highly dependent on the conservation of natural capital. For instance, improving resilience to extreme events and disasters; sustainable water management and sanitation; ending hunger and promoting sustainable agriculture; sustainable and clean energy; growing and diversifying the economy; developing resilient infrastructure; developing sustainable cities; ensuring sustainable consumption and production; and tackling climate change all directly depend on the proper care of natural capital.

Natural capital in SLA is closely connected to the vulnerability context, as most of the shocks that shatter the livelihoods of the poor affect them through natural capital. The essential goods and services that are directly rendered through natural processes, such as water and food, are often negatively affected by natural calamities, including forest fires, floods and related erosion, earthquakes that destroy agricultural land, changes in temperature and precipitation that destroy crops, and changes in the value and productivity of land over the year. These events degrade the quality and quantity of natural capital, constituting threats to the livelihoods of rural dwellers that depend on natural resources for their livelihood.

Due to the critical role of natural capital in rural livelihoods, ownership and access is key. However, ownership of and access to natural capital such as land has remains a challenge for rural women. Due to cultural beliefs and customs, women in most African countries lack the rights to own, inherit, rent, or lease land (Giovarelli, 2016). Women can only be *de facto* land-users, rather than *de jure* land-owners, as land is inherited and titled to men. Due to this, women throughout SSA have limited access to this essential form of capital and even those who have access through their husbands lose them when husbands die, or when they divorce (Agwu & Okhimamhe, 2009). Studies show that women's limited or non-existent access to natural capital makes them less able to cope with, adapt to, and mitigate the effects of climate-related shocks on their livelihoods (Onwutuebe, 2019). As land is a key factor of production, lack of access contributes significantly to poverty among rural women (Jafry, 2000).

Human beings often exploit natural resources to survive and gain other forms of capital, including through clearing forests for farming, industrial activities, and exploitation of forest resources. In unregulated, these anthropogenic factors are a major factor that affects natural capital (Gerber *et al.*, 2014). In the industrial age, i.e. since 1750, anthropogenic Green House Gas (GHG) emission is rapidly rising due to growing populations, industrial economic activities, lifestyle, energy use, land use patterns, technology, and climate policy (Stern & Kaufmann, 2014). The burning of fossil fuels, which releases carbon dioxide gas into the atmosphere, has been recorded as the highest contributor to natural capital destruction. GHGs and aerosols alter incoming solar radiation and outgoing infrared (thermal) radiation, which are part of Earth's energy balance, and as such create changes in climate. Since the beginning of the year 1750, the global effect of anthropogenic factors on climate has been a warming influence. These changes in temperature are associated with droughts and floods that devastate natural capital.

Apart from human capital, policies, legislation, protocols, and strategies by states and international organisations also play key roles in either protecting the natural capital or exposing it to climate-related hazards. State agencies have a role to play in protecting natural resources and regulating its exploitation to both serve the economic needs of the state, and ensure sustainability for future generations (Nyumba, 2018). Along with this, natural capital can be depleted through climate-related events such as floods that cause erosion, the leaching of soil nutrients, and the destruction of vegetation, among others (Annecke, 2002). Where crops are destroyed, people often turn to the natural environment for their survival, leading to the

degradation of the natural ecosystem. Loss of natural capital owing to both climate change and human activity is critical in states where natural capital is the main source of livelihood, as is often the case in developing countries.

The erosion of natural capital has a direct impact on other capitals. For example, flooding can wash away plants, thereby threatening farms that produce physical capital, affecting financial capital through income, and health through spread of disease, and so forth.

4.3.2 Physical capital

Physical capital includes public or private infrastructure, tools, technology, and the infrastructure used for effective production of goods and services. Examples include roads, vehicles, shelter, water and sanitation, energy and communications networks, production equipment, seed, fertiliser, and pesticides. Physical capital is important as it helps turn raw materials into finished products and/or services (McLaughlin, 2008; Oliver, 2017). For instance, maize requires a milling machine to make grain into flour, while wheat requires several machines and equipment, ranging from farm operations to milling, and even the baking of bread. Therefore, communities or individual persons with limited or no access to physical capital are at risk of non-productivity, which is likely to affect their livelihood. For any farmer group to develop a livelihood strategy, they need physical capital to help them tap into the resources from the natural environment and turn these into consumable products.

Studies have found that lack of or inadequate access to some types of infrastructure, such as water infrastructure, stable energy sources, and adequate shelter, is considered a core dimension of vulnerability and poverty. Such deprivation results in depreciation of human health, reduction of human capital, and more time spent in non-productive labour including searching for household energy, water, and health services. The opportunity costs linked to lack of or inadequate access to infrastructural facilities can impede essential services such as transport, education, and access to market, health services, and food during scarcity. In addition, income-generation activities and livelihoods are affected. Poor infrastructure, obsolete technology, and low access to resources exacerbate vulnerability in the rural setting, while access to advanced technology and established infrastructure, including electricity, good roads, and communication networks, reduces the vulnerability of poor rural farmers by

increasing their adaptive capacity to climate-related disasters (Becker, Paton, & Johnston, 2015).

In essence, poor infrastructure heavily affects rural farmers. Since transportation of farm inputs to the village becomes a challenge. For example, poor rural access roads make it a challenge to transport farm products to the village, which then negatively affects crop yields as production remains low. It therefore becomes a challenge to find a market and transport limited produce over long distances on bad roads. In the case of perishable products such as tomatoes and vegetables, the farmers are likely to experience losses as a result of spoilage. The higher costs of attaining farm inputs and transporting farm produce to the market increases production costs for rural farmers and thus place them in a comparatively disadvantaged position in the market.

In fact, physical capital, such as good rural access roads and established communication channels, are requirements for enhancing the livelihoods of rural poor farmers, as these enable them to easily link with the market (Petersen & Pedersen, 2010). Such networks enhance smoother movement of both farmers and farm products to and from the market, and good communication networks make it easier for rural farmers to link with urban settings to diversify their livelihoods with off-farm livelihood activities. As such, physical capital enhances the development of multiple livelihood strategies and contributes to livelihood sustainability and resilience-building (Hodson *et al*., 2009).

While proper communication networks also help disseminate climate information in time and enable farmers to adequately prepare for anticipated adverse climatic events, rural areas rarely have adequate information networks, and may lack both radio and television waves, thereby effectively preventing these farmers from receiving timely climate information. Even when the information is disseminated in time, rural dwellers may find it difficult to act since they have poor roads that prevent their mobility, as well as inadequate physical assets that they can turn into cash to enable their adaptation.

Changes in climate often rob men and women of physical infrastructure, due to destruction of shelters (building), roads, telecommunication lines, bridges and physical facilities that rural dwellers survive on. Under such instances both men and women are bound to suffer. However, because women have inadequate access to natural, physical and financial capital, as well as limited decision-making power, they are likely to feel the impacts of climate change on physical capital more strongly. The limited access that women have to different forms of capital

means reduced adaptive ability. In fact, physical household assets that belong to women are often swept away by floods or sold to help mitigate the effects of climate change (Goh, 2012). Women often sell jewellery and utensils to attain cash to help mitigate the effects of climate on their livelihoods, leaving them even more exposed to further effects of climate change (Arora-Jonsson, 2011).

Most physical capital that aid in the production process is often too expensive for individual farmers or poor rural communities to afford. Road networks, telecommunications, electricity, and certain basic infrastructures require huge financial capital investment to both construct and maintain. These require government or state intervention to ensure rural communities have access to basic amenities. Hence, the focus of SLA on institutional framework becomes instrumental in the provision of physical infrastructural facilities as a way of enhancing livelihoods and boosting communities' capacity to cope with the effects of climate change on their livelihoods. Institutions as external agencies with strong financial muscle can help build basic infrastructure and boost rural livelihood activities. The close connection between rural communities and external institutions and organisations in terms of linking social capital (described below) proves to be essential in linking rural communities to assets outside their reach.

4.3.5 Social capital

Social capital refers to the network of relationships that an individual has within a social system. Robert Putman defines social capital as, "connections among individuals in the form of social networks and the norms of reciprocity and trustworthiness that arise from them. According to Putman social capital is based on social organizations such as trust, norms and networks that can improve the efficiency of society by facilitating coordinated actions (Claridge, 2018). It also involves membership of organisations, groups, and social and professional networks that provide support. There are several understandings of social capital. For example, Bourdieu, (1983) emphasised the relationship between the individual and formal institutions, while Coleman, (1988) focused on the link between family support and school performance. However, another understanding from Putnam, based on the work of Coleman, emphasised that social capital is based on trust, norms and civic participation (Paper & Siisi, 2014). Putnam sees social capital as a combination of norms, obligations, trust, and social

networks that are voluntary in nature (Paper & Siisi, 2014:27). He argues that with trust, social capital increases social cohesion in a community and contributes to increasing individual wellbeing and communal prosperity. All these definitions emphasise social networks as the core of social capital (Whiteley, 2015).

Social capital is an important component of sustainable livelihoods, since the social networks (bonds and trust) of the poor are one of the primary resources to manage risk and vulnerability (Woolcock & Narayan, 2000:242). For example, Olivier (2015) states that individuals with a greater share of social capital have increased capabilities and access to other forms of capital. Unlike financial, natural, and physical capital, social capital increases with use, and does not become spent or worn out. Thus, social capital can increase exponentially when connected with other forms of capital. For instance, (Adger, 2014a) found that increased social capital increases human capital as it promotes safe, supportive spaces for the development of children (Christopher Paul, Erika Weinthal, Marc Bellemare, 2016). Social capital also engenders interpersonal trust and cohesion, as the more people depend on each other, the greater the bonds of trust and sense of belonging. For instance, Gallaher *et al.,* (2013) compared cultivator households with those that do not, and found that cultivators have a higher frequency of positive interactions with their neighbours, such as exchanging goods, food, cash, and even services such as child-minding. Cultivators indicated that social interactions strengthened friendship bonds, increased networking among women in the area, and created a general sense of community identity.

The literature recognises three types of social capital: bonding, bridging, and linking social capital (Birendra *et al*., 2018). Putman holds that bonding capital is composed of strong ties of a group and community, between people who need each other for -getting by, while bridging capital is made up by the weak ties (Claridge, 2018). In fact, bonding and bridging ties apply between actors of the same level of power, such as between community members, while linking capital operates across power hierarchies, such as between a community member and a local official (Babaei *et al*., 2012). Bonding capital applies to friends and family, while bridging capital refers to membership of informal groups, community savings or credit schemes, and membership of local formal organisations such as NGOs and religious organisations such as churches (Whiteley, 2015). For example, in a rural setting, linking capital can describe connections between a government official or institution that has an influence in the daily life of cultivators (Bhandari & Yasunobu, 2017). Bonding, bridging and linking capital are core

aspects of social capital for rural development, and are particularly important for this study to understand how women respond to and mitigate the effects of climate change on their livelihoods.

In most cases, bonding capital involves individual farmers who already know each other (Claridge, 2018). They may be close friends, family members, neighbours, or members of primary groups (Birendra *et al*., 2018). It connects individuals who are similar socio-economically and demographically; hence, those that subscribe to this type of social capital exhibit a high level of homogeneity (Birendra *et al*., 2018). Bonding capital helps to enhance shared identities and personal reputation, contributes to local reciprocity and trust, and helps boost emotional closeness and social support during climate-related livelihood shocks (Birendra *et al*., 2018). As such, bonding capital can engender a high level of solidarity within a group and effectively mobilise individuals and resources for a common purpose, as well as help create bridging and linking ties.

Bridging social capital connotes loose ties between individuals or groups who lack demographic homogeneity but possess similar financial status and power. This form of social capital has a horizontal connection that links different social groups and communities. The strength of bridging capital is that ties are inclusive, cutting across gender, ethnicity, caste, race, culture, and other social cleavages. Bridging capital can include friends, different levels of farmers, and work colleagues who have overcome social cleavages and are supportive to each other. This form of social capital is built together through a generalised trust among the group members (Birendra *et al*., 2018). The main utility and advantage of this form of social capital is access to a larger pool of resources, information, and opportunities that are not available in a homogeneous group. Bridging capital is therefore associated with positive outcomes and low potential for negative externalities, unlike bonding capital. As such, Putman, (2002) in Claridge, (2018) describes bonding social capital as useful for getting by, and bridging social capital as useful for getting ahead. According to Putman, communities get ahead when they are able to leverage their more extensive social relations to achieve collective objectives, such as financial development (Birendra *et al*., 2018). This form of capital works well where there is a lack of linking capital.

The third type of social capital is linking capital, which is found between groups and people in positions of authority or influence (Birendra *et al*., 2018). This form of social capital represents the vertical dimension that links individuals with organisations such as civil society (CBOs,

NGOs, and voluntary groups); government agencies such as extension workers; representatives of public interests such as political party leaders and elected politicians; and private sector and development partners such as the African Development Bank. It involves the capacity to engage power structures such as chiefs, officials, and social workers (Claridge, 2018). This form of capital is important for community development as it provides an avenue for a community to voice its needs (Babaei *et al*., 2012), and helps to increase access to resources from formal institutions outside the community, such as capacity-building, financial, and technical support. As such, the community is able to gain different forms of capital from external agencies and institutions that help them build resilience to the adverse effects of climate change.

As with bridging capital, linking capital including networks between communities and government organizations is often low within low-income rural communities. The loosely bound linkage between communities and organizations/ institutions is due to lack of grass-root offices for government and non-governmental organizations. Such limit the interaction and access of resources from institutions by individuals in low-income rural. This is illustrated by a case study on low-income households in South Africa, where the poorest households were isolated and lacked opportunities to participate in community-level institutions (Olivier, 2015). Communities that interact closely with NGOs are often able to broaden their networks and gain access to other forms of capital such as financial capital through project funding, human capital through extension and agricultural trainings, and technical support (Næss, Bang, Eriksen, & Vevatne, 2003). This can help communities cope with climate change challenges and build resilience. The work of NGOs and government agencies is therefore crucial in building and cushioning communal livelihoods of rural farmers.

4.3.4 Human capital

Human capital is an embodied form of capital that includes human's economic inputs, such as physical labour, but also extends to a range of abilities such as good health, energy, knowledge, skills, experiences, leadership capacity, and charisma possessed by individuals or members of a community (Tapati *et al*., 2015). This form of capital is acquired and developed through training, apprenticeships, and development/learning activities that empower people to engage with the effects of climate change on their livelihoods (Birendra *et al*., 2018). According to

(Scoones, 2009), human capital combine two dimensions, one emphasising the amount and the other the quality of labour. This is what literature refers to as the qualitative and quantitative dimensions of human capital (Coleman, 1988; Tapati *et al*., 2015). While the quantitative dimension is measured in terms of the number of people as well as the time taken in income-generating activities, the qualitative aspect concerns the capacities and skills that enable individual members to secure livelihood opportunities.

Human resources are often required to coordinate natural, physical and social capital into productive labour and sustainable livelihoods systems (Park, 2017). Such human resources include skills and physical strength. Skills, or the qualitative dimension of human capital, is acquired through education and apprenticeship that helps sharpen livelihood or employability skills and enables individuals to access sustainable livelihood sources. In areas where households or communities invest in education, community members can easily diversify their livelihoods to off-farm activities that can earn them income even in urban settings.

In rural areas, adequate skills in crop and animal production, knowledge and skills on climate change adaptation, and improved crop and livestock technology are a necessity to help farmers cope with the effects of climate change on their livelihoods. Despite such needs, most rural poor farmers have low levels of education and inadequate skills. Their rural setting makes it difficult to access education and climate information due to less-developed physical infrastructure that lessens their access to the physical capital discussed in Section 3.3.2 above. Women are even more disadvantaged in terms of education and skill acquisition, as their reproductive roles leave them with little residual time and energy for other activities (Cleveland *et al*., 2014). Consequently, women become poorer and more vulnerable, as most studies associate poverty and vulnerability with low education levels and inadequate skills acquisition (Albore, 2018). The patriarchal nature of most African communities discriminates against girl child education, hence rural women rarely have the human assets (skills, knowledge, level of education, information, command over labour and technology, or credit) to boost their livelihoods and help them adapt to climate changes (Jafry, 2000). In addition, decision-making is undertaken by men, meaning that patriarchal societies and structures ensure that women remain in the domestic space where they can rarely access public information, skills, and education.

Despite the emphasis on education, human capital is also acquired through apprenticeship, which in most cases has been the mode of transmitting indigenous knowledge (Ibnouf, 2014).

Men and women traditionally learnt the knowledge of food production and prediction of weather patterns from their ancestors. In fact, despite their limited access to formal education, women still thrive in agriculture due to their traditional role in ensuring household food security and proper nutrition. They therefore possess substantial knowledge and skills on the agricultural practices used in the past. Such an asset gives them an advantage in sustaining their livelihoods amidst climate-related challenges. Indigenous knowledge is a rich source of information for rural women farmers, anchored in their own life-long experiences, as well as the experiences of their communities built through generations. Combined with modern scientific knowledge, this can provide an incredible base for climate change adaptation (Ibnouf, 2014).

Physical strength or quantitative human capital is also essential in rural labour-intensive agricultural work but is heavily dependent on good health. Health is therefore considered a vital component of human capital (Few *et al.*, 2004), since most rural dwellers depend on physical labour for income and livelihood. According to (Chambers & Conway, 1991), most poor rural dwellers use their bodies as their main asset. Through the body, rural farmers can access aspects such as good health, energy or strength, time availability, as well as the capacity to make decisions over their labour. Therefore, ill-health or premature death negatively affect the quantity of workforce, economic stability of communities or households, and the livelihoods of rural dwellers (Woolcock & Narayan, 2000). Another factor that affects human capital development is malnutrition, which impacts child human development and human immunity in general and can consequently undermine the ability of individuals to perform physically. Thus, both the quality and quantity of work is compromised, making communities more vulnerable (Albore, 2018). Malnutrition can be felt as a result of the effects of climate change due to decreased yields and limited availability of a variety of food for consumption (Kotir, 2014). At such times, individuals would need to spend more energy looking water and energy resources but would likely have to limit their food intake as an adaptive strategy.

Women are further disadvantaged in terms of access to quantity of human capital due to comparatively lesser endowment in muscle strength and aerobic work capacity. This implies that heavy physical work, such as lifting and carrying, long working hours, poor working postures, and engaging in physical activities over extended periods (like carrying water over long distances) can result in musculoskeletal problems. Furthermore, women are known to be more likely to be affected by farm chemicals including pesticides, herbicides and fertilisers

which are absorbed via the skin, through inhalation and ingestion. In addition, strenuous physical work, fatigue, and overexertion can affect women's reproductive health, causing uterus prolapse and spontaneous abortions (Hoddinott & Kinsey, 2000; Olivier, 2015).

4.3.5 Financial capital

Financial capital refers to resources, cash or commodities, exchanged for services or goods, that are used to achieve livelihood objectives (Jacobs, 2009). Hodson, Ting and Goldman (2009) classify financial capital into two main categories: stocks and inflows of money. Stocks include savings, as well as assets such as livestock, furniture or jewellery, grains, and many other things sold for money or exchanged for services, while inflows include salaries, state grants, pensions, and cash transfer stipends.

Financial capital is a critical component of the sustainable livelihoods framework since it helps provide the cash used for general livelihood development/investment, as well as being a source of expenditure during climate-related shocks. Financial capital can be used for the direct achievement of livelihood outcomes since it is the most flexible of the five forms of capital, and can help purchase food and clothes, and pay for health and many other human or household needs. The versatility of this form of capital is its ease of exchange for other forms of capital. Financial capital can help build houses (physical capital), purchase land (natural capital), pay for education or health services (human capital), and attract friends or social groups (social capital) (Christopher Paul, Erika Weinthal, Marc Bellemare, 2016). In can also be transformed into political influence to influence policy-formulation and legislation and govern access to resources.

The versatility of financial capital also makes it easy to dispose of. As such, stability of financial capital requires regular income or stable investment, which the rural poor can often only access through loans. However, the main challenge that the rural farmers face is inadequate access to financial services such as loans and savings. In fact, rural farmers in Africa are in dire need of financial resources, yet such services are hard to come by in rural areas. According to (Demirguc-kunt, 2013), lack of access to credit facilities, as well as other financial services such as savings, limit farmers from investing heavily in farming or in other off-farm activities. Studies (Christopher Paul, Erika Weinthal, Marc Bellemare, 2016; Fletschner & Kenney, 2011; Wilke, 2006) show that access to financial services by rural

farmers are key to increasing productivity since farmers can borrow money to purchase farm inputs which they can easily pay back after harvest. In addition, access to stable financial services has been proven to increase rural farmers' capacity to enhance their livelihoods and wellbeing by helping them to acquire and accumulate assets (Fletschner & Kenney, 2011; Jacobs, 2009; Torres & Casey, 2017). Financial capital can also help rural women farmers invest in human, physical, natural and social capital and manage climate-related shocks and disasters.

In terms of gender dimensions, women and men access financial capital to different degrees; women have been shown to have limited access to financial services since they lack the collateral which is traditionally required by financial institutions to access loans. Since women lack or have inadequate access to land, their access to collateral for loans is limited. Furthermore, the low levels of education reflected among women in most African countries bars them from accessing decently paid jobs to ensure access to a regular income. As such, most women in Africa remain dependent on men in terms of financial support, as well as in decisions concerning savings and borrowing. Women farmers are even more affected by the comparatively less-developed financial structures in rural settings. However, financial institutions are slowly developing policies that are sensitive and meet their struggle to access financial capital. In addition, community-based groups especially women groups have been formed through which they borrow money from the financial institutions such as banks and micro-financial institutions. The vulnerable women farmers also access safety net programmes, such as regular cash transfers implemented by the state, which helped improve the financial status of women. In addition, women also run small-scale businesses and own livestock which provide them with financial capital and buffer them from the devastating effects of climate change.

In conclusion, the five forms of capital appear at the centre of the sustainable livelihoods framework, and are the building blocks of a sustainable livelihood, as individuals or communities draw their livelihoods from the five forms of capital discussed above. Access to these are negatively influenced by the vulnerability context, which presents a situation that limits the poor from accessing, accumulating or using their assets, or that subjects the assets to shocks. Along with this, access to and use of assets exist under the influence of policies, organisations and relationships between individuals, organisations and authority, which is also

part of social capital. The strategies adopted by communities or individuals determine their livelihood outcomes in terms of wellbeing and ability to overcome subsequent shocks.

Apart from the five forms of capital, some scholars have tried to introduce a sixth form of capital – "political capital" to the framework. This was mainly to address the recurrent criticisms of livelihood approaches which claimed that the framework is deficient in explaining politics and power structures. Such scholars' argued that in the SLA, power plays a role everywhere. Within the different contexts power is eveident; in terms of access to capitals, power is inevitable, within mediating institutions and social relations power structures control relations and resource allocation. In fact, they argued that power guides the underlying choices of strategies, which influences the options and outcomes. Hence, critics of SLA recommended the consideration of political capital as a new form of asset. Scoones, (2009) however notes that the claim of lack of political angle in SLA as argued by proponents of political capital is not essentially true. He argues that the SLA encompasses transforming structures, processes and policies, through the institutional frameworks that mediate institutions and organisations (Scoones, 2009). In addition, such additions do not really deal with the complex intersections of the structural bases of power ‑ in political interests, competing discourses and embedded practices. Such reflections address the criticism of deficient socio-political structures and process that influence livelihood choices (Solesbury, 2003). To further tackle power, politics and social difference, this study introduces a feminist theory that together complements the SLA.

To illustrate the SL framework and interaction of capitals within different contexts, Figure 1 below shows a conceptual framework for SLA, which has the five forms of capital discussed above at its core. The framework depicts the poor rural farmers, of which the majority are women, as operating in the vulnerability context. The vulnerability context is the external setting in which poor rural farmers dwell and gain position through direct impacts upon people's asset status. The context is composed of livelihood shocks, trends and seasonality that have both positive and negative impacts on the livelihoods of the poor, as discussed below. However, the rural poor use their assets accumulated within an institutional setting, such as policies, cultures and institutional structures, as shown in Figure 4.1 below.

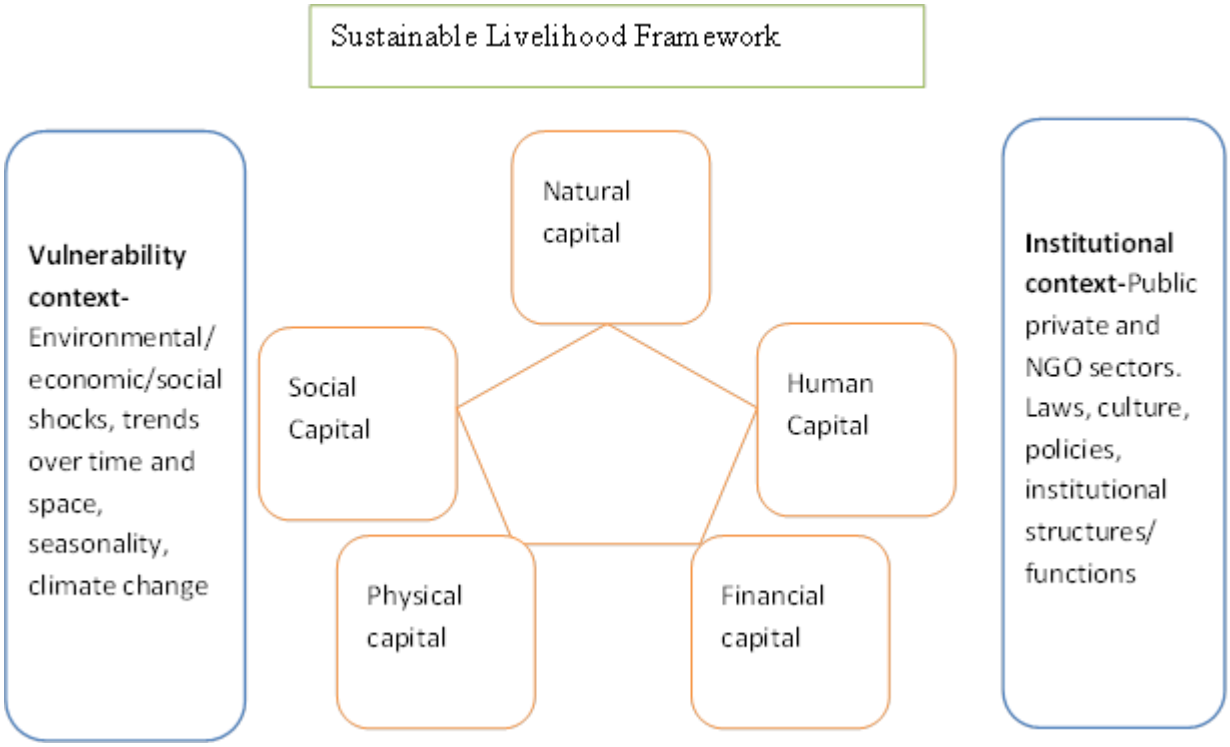

Figure 1: Sustainable livelihoods framework (Adapted from Olivier, 2015; Scoones, 2009)

The sustainable livelihoods framework as argued by Scoones, (2009) places emphasis on the economic attributes of livelihoods as intermediated by social-institutional processes. The framework instrumentally links inputs- (capitals or assets) with outputs- (livelihood strategies), to produce livelihood outcomes through different trajectories. Such outcomes can reflect a vulnerability context or a sustainability context, that affects resilience (Shimeles, Verdier-chouchane, & Boly, 2018).

4.3 THE SUSTAINABLE LIVELIHOODS APPROACH CONTEXTS

Contexts describe the different environments in which livelihoods and livelihoods assets operate. The literature focuses on two broad levels of contexts: vulnerability, and institutional context. These contexts help to explain the situation of a community's livelihood, especially during climate change or weather-related shocks. The contexts affect livelihood capabilities, which is the ability of livelihoods to withstand stresses and recover from shocks (Nel, 2015). Thus, sustainable livelihoods are affected by both the vulnerability context, which affects the quality and availability of capitals, as well as the institutional context, which affects access to capitals (Morse & McNamara, 2013:36)

4.3.1 Vulnerability context

This context describes the external uncontrollable factors that influence people's assets and livelihood opportunities (Petersen & Pedersen, 2010). It is characterised by insecurities such as shocks, seasonality and trends that threaten the wellbeing of individuals, households, and communities in the face of changes in their external environment. The vulnerability context has two facets: The first describes the influences outside of an individual's or community's control that can undermine and pose a threat to livelihood capitals, which include shocks, seasonality and critical trends (Albore, 2018). The second deals with the internal dimension, or the ability of the individual or community to withstand these influences based on their asset accumulation (Chambers & Conway, 1991; Morse & McNamara, 2013). This second facet is mainly concerned with defencelessness as a result of limited or lack of ability and means to cope with the challenges (Oliver, 2017). Vulnerability context is the result of strong external effects of shocks, trends, stress and seasonality on the rural poor, coupled with weak internal capacity to overcome such effects. As such, the effects become a threat to people's livelihoods.

The vulnerability context depicts the livelihoods of most rural farmers, especially poor women, who experience shocks that threaten their capabilities and livelihoods. When prolonged, droughts and floods may be fatal to the livelihoods of rural farmers who fall in the vulnerability context due to their weak capacity to adapt. During prolonged shocks, negative trends and stresses, the poor become more vulnerable since they are less capable of coping with the negative impacts of such conditions due to their lack of, or limited access to different forms of capitals (Albore, 2018). The vulnerability context is therefore concerned with the resilience of livelihoods, or the ability of people to withstand or create change. The context is focused on shocks, seasonality and trends and how they affect an individual's ability to cope with and recover from such (Oliver, 2017).

According to (Nel, 2015), shocks are sudden events that negatively affect the livelihood security of individuals or communities, and reduce individual wellbeing and ability to overcome livelihood challenges. In most cases, shocks destroy or ensure the disposal of farmer's assets, leaving them more vulnerable to subsequent or continued shocks (Nel, 2015). For example, climate-related shocks such as floods destroy the natural environment upon which

peoples' livelihoods depend, which can erode their financial, physical, human, and social capital in various ways. In response, people often resort to selling off their assets to survive, making them more vulnerable to prolonged or subsequent occurrences of such shocks. Recent droughts and floods in Kenya, for instance, have seen people reduce food intake and sell property such as livestock (Ongoro & Ogara, 2011). Such shocks increased insecurity related to cattle-rustling, and droughts led to loss of both human and livestock lives. The residents remained vulnerable as they lost their main source of livelihood and had to rely on government support (Huho & Mugalavai, 2010).

Another component that defines the vulnerability context is trend. Trends include national and international economic forces, such as economic slumps or recessions. An economic slump or recession is a negative trend characterised by increased market prices and low supply of goods. This has greater impacts on poor rural farmers since their low purchasing power limit their access to food during periods of scarcity. The impacts are widely felt on children's and poor women's health. This is because women and children often have to skip meals and reduce their food intake, thereby becoming weaker and malnourished (Fletschner & Kenney, 2011). Apart from economic trends, social trends in terms of population growth or changes in the demographic profile of communities also affect vulnerability.

Population growth may cause positive or negative impacts on the livelihoods of a community or a household. Burgeoning population can negatively affect livelihoods since it is associated with increased deforestation, industrialisation and emission of GHG. These often accelerate climate change and its effects on livelihoods (IPCC, 2007a). Furthermore, population increase comes with high unemployment rates, mushrooming of slums, increased crime especially in developing countries, and extra expenditure which has a negative impact during lean periods (Stephenson *et al*., 2010). However, such increases in population trends can be positive, where it increases the availability of human resources, the labour force, and income of people. Hence, changing trends may promote or threaten livelihoods, depending on whether the trends are positive or negative.

Changes in socio-economic trends are often affected by seasonal shifts in weather patterns (Park, 2017). For instance, prolonged droughts and floods lead to reduced food production, increased food scarcity, and subsequent reduced food supplies in the market (Guha-sapir *et al*., 2011). These reduce a country's GDP and can easily lead to inflation, loss of employment opportunities, and the inability to support essential services such as health, education, and

agricultural subsidies. While negative economic trends often result from climate changes, the causes vary from political instability, to post-election violence, attempted coups, and disease outbreaks, among many others. All these act as shocks and hit the vulnerable groups with weaker bargaining power, making them lose their livelihoods and become desperate dependents vulnerable to any further shocks (Shuaibu, Akpoko, & Umar, 2014)

Vulnerability context is also depicted through stress. Stress refers to long-term negative trends and shocks that undermine livelihood potential (Osbahr *et al*., 2010), and can be induced through continued shocks or negative trends or both. Stresses mainly emerge due to a decline in the quantity and quality of assets. For instance, during prolonged periods of drought, accumulated assets are often used, and continued dry spells deplete these assets. Climate change stresses are in most cases experienced when frequency of droughts and floods increase, or when any of them is prolonged (Dutra *et al*., 2013). The prolonged periods of droughts and floods negatively affect production of food; lead to food insecurity; affect economy as food prices rise; and lead to climate-related illnesses and fuel conflicts as people scramble over scarce resources. Under such circumstances, the people lose all their accumulated assets and seek support from organisations and government. Under situations of insecurity and poor governance, citizens are subjected to more stress that affects their livelihoods.

Stress can occur at the individual, household or communal level. At the individual or household level, stress may include frequent illness, alcoholism, and violent or disruptive behaviour of a household member. At the communal level, stressors can include poor transport, inadequate public and extension services, poor communication, inferior education and inadequate health systems, and harsh and prolonged climatic events. Stresses take place over either a long or short time and are either predictable or non-predictable (Oliver, 2017). As such, it becomes distressing if nothing or little is done to mitigate the stressors making their effects felt on livelihoods. Stress is part of what makes the vulnerability context insecure and is a major threat to poor rural farmers with limited external support. In these situations, external agencies such as institutions, organisations and governments are best suited to rescue livelihoods, and hence the need to discuss the institutional context.

4.3.2 Institutional context

This context refers to the policy and institutional environment within which capitals exist (Morse & McNamara, 2013). Under stress and shocks, there are the structures and processes in terms of institutions and policies that either facilitate or limit the resilience to livelihoods shocks (Olivier, 2015). The structures, institutions, and policies are essential to vulnerable communities when the capital they possess becomes insufficient in the face of shocks and stresses, and where external assistance is needed (Nel *et al*., 2001:5). Under such circumstances, external agents such as governments or NGOs have a valuable role to play by introducing new capitals into a community through service delivery, infrastructure improvement, technical support and insurance, or forms of social protection (Morse & McNamara, 2013).

According to (Morse & McNamara, 2013), in terms of climate change, some capitals are vulnerable to certain shocks and require authorities to act and limit damage. For instance, assets may be damaged by flooding, but the existence of publicly owned structures to limit or address that impact may reduce the effect on people's livelihoods. Similarly, government-funded agricultural extension, education, and communication services can supplement the knowledge base of farmers to mitigate the effects of shocks. The institutional context also includes the intervention or support received from private agencies, development partners, and NGOs that can provide support for livelihoods. Such institutions have an influence on access to many forms of capitals and enhance people's livelihood opportunities and choices (Oliver, 2017). NGOs provide trainings on smart agriculture, farm input to farmers, and female farmers with grants that help them purchase land and other assets. As such, through NGOs women farmers are able to acquire or access human, physical, financial, and natural capital. The institutional arrangements therefore often support rural poor women farmers to cope with livelihood challenges.

Another aspect of institutional context is policy framework. Existing policies influence livelihoods either positively or negatively, and when livelihoods are based on negative undesirable policies, communities may not be able to overcome shocks. For instance, according to Albore (2018), the Ethiopian government prohibited the growing of *Khat*, a crop used to produce an amphetamine, an addictive and illegal drug. However, the crop yields high income, and criminalising *Khat* production and trade negatively impacted on the livelihood of growers. Despite this, the government did not provide alternatives, and *Khat*f farmers lost their

livelihoods. A similar situation occurred in Kenya, where the export of *Khat* (*Miraa*) to Britain was banned and farmers lost their livelihoods, as the Kenyan government failed to provide an alternative. Policies are therefore important in either promoting or undermining livelihoods, and the institutional context is instrumental in analysing the context in which livelihood capitals exist.

Nevertheless, there are risks involved with outside intervention, such as "top-down" assistance, which creates dependency (Nel, 2015), or restrictions placed on livelihood activities, such as restrictions on livestock keeping in urban areas (Scoones, 2009). A key part of the institutional context are the organisations that make and implement policies or legislation, deliver services, trade and perform other functions, all of which influence livelihoods (Scoones, 2009). These are called institutional structures and may be formal or informal, public or private. Formal organisations range from those at the local level, such as cooperatives, NGOs, small business and the local municipality, to large multinational companies and international donor organisations (Christopher Paul, Erika Weinthal, Marc Bellemare, 2016). Informal organisations include things such as labour exchange groups and rotating credit schemes (Christopher Paul, Erika Weinthal, Marc Bellemare, 2016). While levels of authority may vary from one organisation to another, both small and large-scale organisations are relevant to livelihoods.

However, weaker institutional frameworks and structures become exposed during periods of climate stress. For instance, in some cases, shocks destroy physical public infrastructures, lives are lost, and people displaced. Where institutional frameworks and structures are weak, they become overwhelmed and public service delivery to the community is hampered. As a result, the communities fail to access essential public services such as clean water and energy. This is common in developing countries, especially in SSA, where institutional and legal frameworks are unable to deal with environmental degradation and disaster risks during shocks (Osbahr *et al*., 2010). Various actors, structures, and networks are therefore required to reconfigure innovative processes that can improve responses to climate variability and change in both rural and urban contexts (Næss *et al*., 2003).

In addition to institutional structures, institutional processes are also part of the institutional context and include the laws, policies and cultural norms that dictate how institutional structures function (Scoones, 2009). These institutional processes mediate change in society by controlling how actors relate to each other (Morse & McNamara, 2013:36). The formal

institutional processes, such as policies and legislation, dictate the way the public sector interacts with society, while the informal processes, such as norms, conventions and customs that develop out of cultures, inform how individuals interact with each other (Solesbury, 2003). The power relations inherent in norms and culture may constrain people according to factors out of their control, such as their age, gender, or race. Whether formal or informal, these institutional processes are crucial in determining who gains access to which capitals, and thus affect livelihood resilience during shocks. The SLA is therefore a very useful approach to analyse the types of capitals/ assets people draw to and the institutions that people link with to be able to cope with the effects of climate change.

4.4. WEAKNESSES OF SLA

Although SLA is instrumental in analysing different contexts of livelihoods, it is not without critiques. The main shortcomings include: 1) overemphasis on external agencies (institutional framework) rather than local communal efforts to sustain shocks; 2) over-concentration on the micro level not enough attention to the macro level (Oliver, 2017:22); 3) inability to explain power inequalities and dynamics that determine access to different forms of capital; and 4) inadequate attention to gender and social hierarchies. In fact according to Scoones, (2009), the framework needs to address issues of knowledge politics, power relations, scale and dynamics in order to have continued relevance and help solve both macro and micro livelihood challenges.

In terms of knowledge, Scoones, (2009) argues that the SLA framework being fluid in definition and complex in nature offering diversified methods of analysis and definition, the framework become subject to knowledge politics. He points out that the institutional power behind ideas creates a particular politics of knowledge in the field. For instance, framings by powerful institutions such as the World bank and other international donor agencies are key (Scoones, 2009). Such dominant framings are he argues are reinforced by academia as scientific knowledge that informs policy and development practice. Therefore the politics of knowledge of SLA requires a standardization of the process through which livelihoods knowledge is applied.

Apart from knowledge politics, politics and power are part and parcel of livelihoods. While the framework attempts to address power dynamics and institutional politics at local level, critics have emphasized the need to move beyond the local level to examine wider structures of

inequality. To solve global political economy and governance issues that are key to livelihoods, the approach according to Scoones should delve simultaneously into both structure and agency and the diverse micro- and macro-political processes that define opportunities and constraints. As such the SLA ought to consider structural conditions as well as human action in order to be able to address both governance and power dynamics globally and locally. In addition, the structural forces defining power relations within various livelihood settings including class, gender, religion, caste, cultural identity and ethnicity are central to understanding livelihood trajectories and outcomes. The framework therefore requires an explicit theorisation of politics, power and social difference to best analyse livelihoods. Such a gap is bridged in the study through the use of feminist theories.

The issue of scale as espoused by Scoones revolves around the analysis of macro and micro influences of climate change (Scoones, 2009). While Sustainable livelihoods focus on small scale local livelihood interventions (micro level), the need to look at issues globally has become inevitable. The major issues affecting livelihoods such as poverty, climate change, and large scale environmental issues are global. Hence there is a need to come up with global redresses mechanisms that examine international and global networks, linkages, connections, flows and chains that affect livelihoods at the local level. As such Scoones, (2009) argues that an appropriate approach to livelihood analysis should consider large scale globalized processes that affect rural livelihoods (Scoones, 2009).

In addition to the issue of scale, Scoones, (2009) also observes that the SLA possess an inherent single time-frame analyses of livelihoods and as such, the approach misses out on long- term dynamics and the possibilities for future far-reaching transformations. The focus of SLA on coping and short-term adaptation, which draws on a rich heritage of vulnerability analysis, is never sufficient (Scoones, 2009) . Instead it ought to comprehensively consider systemic transformation due to long-run secular changes in livelihoods that may be occasioned by gradual changes in trends and stress. In fact, Scoones, (2009) argues that since livelihood changes and resilience building process are often dynamic and occurring through dynamic drivers operating over decades, there is need for an analytical process that is able to consider the drivers. Such drivers include regional economic shifts, urbanisation, long term demographic changes, migration, land-use as well as climatic changes (Adger et al., 2003).

These weaknesses are addressed using different theories and approaches complementing the SLA, as illustrated below.

4.4.1 The Asset-Based approach to Community Development (ABCD)

As noted above, the first weakness of SLA is that it puts more emphasis on external influence, such as government policies, structures and NGOs, instead of focusing on how the community participates in building their own livelihoods. The over-emphasis on external institutions undermines the ability of the locals to participate in their own development. The Asset-Based Community Development Approach (ABCD) is therefore applied in this study to bridge the gap, since it emphasises awareness and mobilisation of the assets and strengths from within the communities, a component not emphasised in SLA (Nel, 2015).

ABCD is a community-based development model, practice and theory that originated from an evaluation of community development case-studies (Nel, 2015).The theory was originally put forward by Kretzmann and McKnight (1993) and focused on enhancing the abilities, self-worth, and relationships within the community (Wilke, 2006). The ABCD approach is based on the communitarian philosophy and emphasises the individual ties, norms, and values that tie communities together (Collver, 2014). The approach holds that communities have abilities within themselves to spearhead their development through mobilising existing but rarely recognised assets. Unrealised assets include not only personal attributes and skills, but also the interpersonal relationships between individuals or community members that enhance local associations and informal networks (Nel, 2015). In this way, community-based development initiatives are sustained and scaled up by local associations as the driving force, and a means through which the community's assets can be identified and then connected to one another in ways that multiply their power and effectiveness (Mengesha & Meshelemiah, 2015).

ABCD takes as its starting point the existing assets and strengths of a community, particularly the strengths inherent in community-based associations and other social networks. These community ties, as with social capital, are an asset that helps different people come together. In fact, the approach views communities as a group of people who have untapped resources and assets. Hence, the approach holds that increasing social ties through common norms based in community associations generates a structure that enables a community to engage in their own development (Paper & Siisi, 2014), because social assets often activate formal institutional

resources, including community-based groups, organisations, local government, and private enterprise.

The approach has been applied in Chicago's Grand Boulevard neighbourhood to bring poor community members together to work on projects that bring varied new forms of livelihoods to the community (Nel, 2015). The approach has also been applied to help a church-based community group, Bethel New Life Inc., to convert vacant lots into homes and day-care centres (Wilke, 2006). Finally, the approach has been used to conduct asset mapping among rural poor communities. Such an application is important as it helps communities to understand the wealth of resources in their community and build within them the mind-set to utilise their assets in order to create change.

ABCD as an approach that focuses attention on the capacities, skills and assets of lower-income communities and believes that linking community action and knowledge can help to produce solutions based on the existing community assets (Mengesha & Meshelemiah, 2015). Its emphasis is on enabling the community to identify their own assets and use the self-accumulated assets to meet their needs as a community (Nel, 2015).Because the approach emphases the strengths and assets of the community, it discourages the complete involvement of the state as a primary actor in community development (Collver, 2014). ABCD, like social capital theory, assumes that relationships and partnerships are built in the community based on networks of trust and shared norms, and that these relationships and partnerships are beneficial for all members. It also assumes that all communities, including the poor, possess sufficient resources to tackle their social issues (Collver, 2014).

Along with this, ABCD is based on the assumption that when people become aware of their strengths and resources (assets), the likelihood of them attaining their goals and utilizing their full potential increases. The changes are enhanced through interactions with both local and professionals. Such interactions help to uncover, reaffirm and enhance the hidden embodied abilities, such as aspirations, skills, knowledge and other forms of social assets including networks, families and groups in communities (Nel, 2015). The awareness of strengths increases people's confidence, and as such they become energised and start taking responsibility for their own development. This approach expands on SLA, because it elaborates on the process of asset discovery within the community, which SLA lacks. In essence, the ABCD approach focuses on capacity-building for community members and associations (internal-looking) without reporting on structural changes (external-looking) brought about by

the approach (Nel, 2015). By being internally focused, the approach places more emphasis on the community and individuals within it, and as such can be used to analyse the role of the community in mitigating the effects of climate change.

The approach also complements SLA since it strengthens the role of social capital in overcoming livelihood challenges. The approach, however, is more focused on building bonding capital than bridging capital (Dulal, Brodnig, Onoriose, & Thakur, 2010; Nel, 2015; Wilke, 2006). Bonding capital becomes useful in the ABCD approach because it creates shared identities, helps to develop local reciprocity, builds personal reputation, and enhances trust. In so doing, it strengthens emotional closeness which helps to provide social support in times of crises (Birendra *et al*., 2018). Bonding capital is therefore instrumental in creating a high level of solidarity in a community and is used to effectively mobilise individuals towards a common goal. This approach helps the study to analyse the use of local resources and asset to mitigate the effects of climate change and the participation of women farmers in their own development. It also underscores the agency of women in climate change adaptation and resilience building.

Despite ABCD being instrumental in identifying and mobilising resources among the poor, the main challenge in using the approach is that in low-income communities, there is often an inability to use or mobilise certain assets due to limited technical expertise, or non-recognition of certain assets as important for livelihood development. This calls for an external agency to bridge the gap in technical skills through capacity-building. For this reason, SLA emphasises institutional context that recognises the role of external agencies (institutions and policies) in enhancing capabilities and asset-accumulation within the community. SLA and complementing approaches are however concentrated at the communal-micro level and fail to explain international and global trends affecting livelihoods, as well as how livelihoods can cope with such effects.

4.4.2 Resilience theory

The second weakness of SLA is that, in the livelihoods discourse, sustainability tends to speak about how to cope with immediate shocks and stresses (Scoones, 2009), and is therefore too focused on the short-term. Resilience theory is used both to bridge the gap and explain the long-term strategies used by communities to adapt and cope with livelihood shocks and stresses over a long period of time. The theory is traced back to the field of ecology in the 1970s through

the works of C.S. Holling (Holling, 2013). He defined resilience as, "a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables" (Holling, 2013:17). Apart from Hollings, other scholars in various fields, including economics, environmental psychology, anthropology, human geography, and engineering have used the theory to frame their work (Chillrud, 2017).

Accordingly, resilience theory has facets and definitions from numerous scholarly disciplines, and particularly in relation to resilience and climate change and the different pathways of resilience building (Atela *et al.*, 2018). While other scholars consider this diversity a weakness, Folke, Carpenter, Walker, Scheffer, & Chapin, (2010) believe it can also be seen as positive since it provides for flexibility and contextual application, which is important in dealing with climate change in the real world. Furthermore, the diversity allows for a multi-disciplinary approach that accommodates the complex nature of resilience, since resilience can never be bridged to a single perspective. As such, the common application and definitions of resilience are borrowed from various fields, including ecology, social science, engineering, and psychology, among others. Social science perspectives of resilience and climate change include those on community resilience (Becker *et al*., 2015); psychological aspects of personal resilience to disaster (Hofler, 2014); institutional resilience (Aguirre, 2017); urban resilience (Newell *et al.*, 2016); social and community resilience (Tobin, 1999); economic resilience (Bernier & Meinzen-dick, 2014); resilience in policy (Folke *et al.*, 2010; Tanner, Bahadur, & Moench, 2017); and social–ecological resilience (Adger *et al.*, 2003).

Socio-ecological resilience defines resilience as the ability of a system to persist and adapt despite shocks (Adger *et al.*, 2003), or the ability of a system to absorb disturbances and still retain its basic function and structure (Atela *et al*., 2018).The socio-ecological approach therefore considers resilience in terms of the recovery of a system from shocks, persistence amid shocks, and the adaptive capacity of a system. In other words, it looks at a system in terms of its capacity to self-organise, learn and adapt, and also the ability to change into an improved state (Chillrud, 2017).

The theory complements SLA since understanding of community resilience to disasters springs from SLA, where social, economic, human, physical, and natural capitals are seen as the determinants of resilience (Folke *et al*., 2010). Each of these five capitals corresponds to characteristics of resilient systems. For example, a strong base of social capital in the form of

trust, norms, and networks would lead to a high degree of coordination and cooperation in the community. Similarly, human capital in the form of education, health, skills, knowledge, and information provides a high capacity to develop and implement an elective risk reduction strategy and be able to cope with the effects of climate change on livelihoods.

Given the risk and impacts of climate change on rural livelihoods, adaptation and resilience-building is inevitable (Borquez, 2017), and rural small-scale farmers adopt different pathways to build resilience and adapt to climate change (Bours & Pringle, 2014). Three different pathways can be adopted in building resilience: absorptive coping capacity; adaptive capacity or incremental adjustment; and transformative capacity which involves transformational responses (Tanner *et al*., 2017). The absorptive resilience is the ability of social, economic and ecological systems to retain their original structure by absorbing infrequent and low magnitude risks (Steinbach et al., 2017). The absorptive capacity involves the first-line response to shocks and how the affected population respond by improving their capacity to absorb the impacts of shocks on their livelihoods. This can include safety net programmes, such as distribution of food rations or cash transfer programmes, which have the capacity to boost the living conditions, sustain livelihoods, and increase the capacity of households and individuals to overcome the effects of climate change. At this level, there are also community-initiated wage or livelihood activities, including diversification of livelihood activities that boost household stipends.

However, coping/absorptive resilience may be short-lived and as a result of external supports, which in most cases are unsustainable (Steinbach *et al*., 2017). In the case of prolonged shocks, communities create adaptive responses involving systematic strengthening of communal institutions, infrastructure, and skills to overcome climate-related shocks. Adaptive resilience is mainly concerned with the ability of social, economic, and ecological systems to improve their original structure to manage future risks and bounce back better when shocks occur (Steinbach *et al*., 2017).This increases the community's capacity to deal with the effects of climate, and at the same time reduces sensitivity to climate hazards (Nellemann *et al*., 2011). As such, the adaptive responses are created by the community and government institutions to increase societal wellbeing and reduce sensitivity to climate change. This could be through well-structured social systems that cushion members from climate-related shocks; climate responsive infrastructure including roads, bridges, and shelter that help increase the wellbeing

of the community and lessen climate-related shocks; and government institutions with financial muscle to pre-emptively respond to anticipated climatic shocks.

In cases of prolonged shocks, transformative resilience may be necessary in enhancing adaptation. According to Steinbach *et al*., (2017), transformative resilience is the changes in social, economic, and ecological systems that enable communities or households affected by climate-related shocks to move beyond the vulnerability threshold. Discussions on transformative resilience are burgeoning due to the fact that most resilience-building strategies promoted the maintenance of the status quo (Weichselgartner, 2014; Folke, Carpenter, Walker, Scheffer & Chapin, 2010). However, current debates on climate change have often highlighted the status quo as contributing to climate change effects, and propose that adaptation should not necessarily lead individuals or communities back to the status quo, but rather to an adjusted or transformed system that is less sensitive to climate change (Folke *et al*., 2010). Under such circumstances, the community would have the ability to function and thrive even during commonly experienced livelihoods shocks.

Transformative changes are often undertaken by individuals, communities and organisations, such as NGOs and governments (Holling, 2013). One of the transformative resilience measures taken by individuals includes migration to non-shock prone areas, which has been used through history as a means of coping with climate-related shocks. During climate-related disasters, families or individuals migrate to non-affected areas or to urban centres in search of formal employment. However, this can be counter-productive as it often leads to loss of bonding capital between family members, which can have a negative effect on livelihood strategies (Serdeczny *et al*., 2016). As men often leave for urban areas in search of formal employment, most women are left with the responsibility of taking care of the children and assuming men's roles in the community. In addition, though migration appears to be an appropriate climate adaptation strategy, the decision to migrate is made by men, meaning that the right to migrate may be limited to men, and women may be constrained in resorting to this as a mechanism that supports resilience.

In conclusion, resilience and adaptation can be built from both within and without. While communities themselves initiate adaptation and build resilience, it can also be initiated by external institutions such as governments, NGOs, and the private sector. Adaptation and resilience-building can be done through local networks, since such networks can provide access to resources, new information, and opportunities in other networks, which are important for

informing livelihood trajectories and hence building resilience to climate change. In fact, the better connected an institution, the greater its adaptive capacity. The theory is instrumental in explaining how women farmers overcome climate change challenges on their livelihoods. It takes care of the long term global strategies and issues which are key weaknesses of the SLA. In essence it makes it easier to analyse complex livelihood issues, including how policies and external agencies influence resilience.

4.4.3 Feminist Theory

To address the inability of SLA to explain power dynamics and brokerage, as well as gender and social relations that control allocation and access to assets, this study complements SLA with feminist theories, given the gendered nature of climate change effects in Kakamega. I engage with various feminists approaches in order to provide a gender lens on climate change and be able to articulately present how rural women adapt to and mitigate the effects of climate change. These perspectives include feminist political ecology, Marxist feminism, radical feminism, and of patriarchy.

Feminist Political Ecology (FPE)can be traced back to a branch of Political Ecology in the 1990s, as well as to gender and development studies, which underscore the dynamics of gender in relation to the natural environment and natural resource-based livelihoods (Elmhirst, 2016). The theory developed along feminist and women-centred scholarship, as well as lively debate and theorising in the field of gender ecology and politics (Sundberg, 2015). The scholarship promoted activism in and debates on environmental and sustainable livelihoods issues, and is linked to three areas of study: feminist science studies, ecofeminism, and feminist critiques of development (Sundberg, 2015).

In feminist science studies, FPE is traced back to feminist critiques on science and epistemology (Elmhirst, 2016). The critics, including Donna, (1991) and Sandra, (1986), argued that patriarchal gender norms contribute to conceptions of who is perceived as a knowledge producer, what counts as knowledge, and how knowledge is produced (Sundberg, 2015). These scholars demonstrated how women and marginalised segments of communities are often systematically excluded and disadvantaged by conventional scientific practices that fail to recognise them as knowers. They posit that scientific knowledge often renders women's experiences invisible and characterises them as being inferior to males. FPE is therefore built

on the critiques to highlight how research and practices often exacerbate the production and reproduction of contested power relations.

In ecofeminism, FPE arose from the emphasis placed on the connection between women and nature, and the explanation of the background of women's oppression through patriarchal institutions. Both FPE and ecofeminism emphasise the relationship women have with nature, and the roles they play in maintaining it, based on their socially constructed roles (Elmhirst, 2016). Feminist critiques of development also contributed to the emergence of FPE as they demonstrated how women were often excluded from, and or exploited by conservation projects in the name of sustainable development (Sundberg, 2015). This notion as noted by Hanson *et al*., (2015) was reiterated by Chandra Mohanty, a postcolonial scholar who highlighted how Western feminists spearheading development projects perceived women from developing countries as victims in dire need of Western help. She argued that such homogenising depictions denied the rich diversity of abilities that women possess based on their locations, knowledge base, and experiences (Harcourt, 2017).

Building from the works of feminists' science studies, ecofeminism, and feminist critiques of development, Dianne Rocheleau, Barbara Thomas-Slayter, and Esther Wangari in 1996 developed FPE as an integrative conceptual framework in the book, *Feminist Political Ecology* (Rocheleau, 1996; Lykke, 2010). The theory stresses politics and power at various levels and highlights gendered power relations, as well as making a commitment towards tackling gender inequality. FPE is anchored in the reasoning that poverty is strengthened and feminised when women, who are key players in agriculture and natural resource use, are neglected as agents who play crucial roles in environmental transformation (Sundberg, 2015).

FPE theory therefore seeks to understand how gender is played out in power and knowledge relations (Elmhirst, 2016). It helps to analyse gender as a central social category that informs and shapes societal relations with nature and determines the allocation of different responsibilities and resources between men and women, as well as their different knowledge regarding nature and cultural relations. The theory also goes beyond gender to explain other social constructs that dictate power dynamics and allocation of resources, through the lens of intersectionality (Harcourt, 2017).

The concept of resilience and climate change also relate to Marxist feminism, which believes that women's position in society primarily benefits capitalism and capitalists, rather than men

(Haralambos, Holborn, Chapman, & Moore, 2013). Margret Beston, in (Haralambos *et al*., 2013) argues that capitalism exploits women and benefits from a large reserve of labour from women to keep wages down and profits up. The proponents of Marxist feminism view women as secondary breadwinners who provide cheap and easily exploitable labour. Since women are socialised to form a docile and easy to manipulate labour force, they are ready to submit and comply. However, Marxist feminists have been criticized for being sex blind and failing to explain gender inequalities. Some scholars have also argued that Marxist feminists ignore many questions raised by feminists, and view women's struggles as insignificant. This approach views women as people who sit on the side-lines of the struggle between capital and labour and are only used as subjects in the struggle. The failure to consider patriarchy has been considered its greatest weakness (Haralambos *et al*., 2013). In order to bridge these weaknesses, it is necessary to engage with the debates raised by radical and Marxist feminists who highlight the effects of patriarchy on women.

The Marxist feminist especially believes that patriarchy is maintained through men's control of women's labour, which denies them access to certain resources or jobs. However the radical and socialist feminist believes that patriarchy is one of the instruments separately used to uphold women oppression. Sylvia Walby, in her book *Theorizing Patriarchy* (1990) (Walby, 1990), attempted to address the weaknesses of other feminist approaches and developed an approach to understanding gender and power inequalities in contemporary society. Walby believes that patriarchy is indispensable in the analysis of gender inequalities and, unlike other feminists, she argued that patriarchy has six structures that restrict women and sustain male domination, namely: paid work, patriarchal relationships within the households, patriarchal cultures, sexuality, male violence towards women, and the state. She argued that these structures work independently but can also affect one another, strengthening or weakening patriarchy in different structures, and that the existence of these structures restricts the choices of men and women (Walby, 1990).

According to Walby, (1990), paid employment is the first and key structure for creating and maintaining inequality for women. She argues that paid employment continues to have men dominate the best paying jobs, while women are paid considerably less than men, and do most of the part-time work. Economically, work is any activity or application of energy that produces services or products of value to other people (Fajarwati *et al*., 2016). Although work can be performed without wages, salaries, or income, in the economic realm, work is strictly efforts

or energy expended for a wage. However, work is classified into productive and reproductive facets. Productive work is work that produces profits (Fajarwati *et al.*, 2016). It involves roles played by men and women to get paid or to produce goods that are not consumed by them. Reproductive work involves labour required to maintain reproduction of labour and continuity of the family, including giving birth, cooking, nurturing and caring for children, caring for the sick, fetching water, washing, and provisioning basic household needs. These are all mainly classified as women's roles. Such work is usually unpaid and conducted within the domestic sphere. Feminists see this as a result of the capitalist system that regards women as convenient sources of cheap labour, and that helps maintain patriarchy. In line with patriarchal structures, women in Africa are socialised to be traditional household producers and the traditional subsistence farmers, but receive no pay for this work (Wahaga, 2018).

Walby also argued that most women therefore choose not to work or to work part-time, due to the poor job opportunities they have (Walby, 1990). Along with this, in terms of household production, households sometimes involve distinctive patriarchal relations of production: individual men directly exploit women by gaining benefits from women's unpaid labour, particularly in the home. This is because women do most of the household work, as well as childcare, which is unpaid. Women also suffer violence and abuse in marriage (Haralambos *et al.*, 2013).

Culture is also part of the structures that dictate what men and women should do, how they should do whatever they do and what is appropriate for maintaining masculinity and femininity. This applies to division of labour, appropriate and attractive behaviour, power, and decision-making. Culture and patriarchy give men power to make decisions and dictate women's lives. Walby also noted that sexuality is a structure used to perpetuate patriarchy, observing that men in the 19th century controlled women's sexuality through monogamy, and by insisting that the husband's pleasure was far much important than the wife's. She posits that this sexual double standard still exists, and men still control women's sexuality. For example, young men who are sexually active are praised for their virility, while women who are sexually active are condemned as slags or whores (Walby, 1990). She also observed that patriarchy had put heterosexual marriages in place to satisfy men's sexual desires. Apart from sexuality, Walby viewed violence as another structure that perpetuates patriarchy, arguing that violence is an expression of power over women, and that violence and threats of violence against women

sustain patriarchy by keeping women in their constructed role, deter them from challenging patriarchy (Walby, 1990).

Finally, she observed that the state perpetuates patriarchy through its role in formulating policies on gender. Though such policies may favour women, Walby noticed that the state is still patriarchal, racist, and capitalist, and that although women are not necessarily confined to private spheres, little is done to open their space in the public sphere. Walby also recognised that patriarchy changed from being privately enforced in the 19th century, to being publicly maintained in the 20thcentury. Private patriarchy is characterised by a patriarch who controls women individually and directly within the private environment of the home. The man as the husband and father is the individual oppressor and the beneficiary. In the public domain, patriarchy is exercised by confining women to lower-status jobs. As such, capitalists employ women in lower-status jobs and restrict their upward mobility at work. In public patriarchy, the state and employment are now the dominant structures and agents of patriarchy, and while women may no longer be exploited by individual patriarchs, the whole of society may be set up to exploit them (Haralambos *et al.*, 2013).

However, power dynamics is not just a problem between men and women, but also between women themselves in terms of ethnicity and class. As such, the need to go beyond feminism and respond to other intersecting issues such as class, racism, ethnicity among other was inevitable. In this way, Crenshaw, (1991) developed the term ‘intersectionality’ respond to the simplistic binary gender analysis (women/men).

4.4.4 Intersectional approach

Intersectionality as an approach is a feminist related theory developed in the attempts by feminists to understand power dynamics in society. The intersectional approach or lens helps to conceptualize intersecting systems of oppression and power dynamics among women (Lykke, 2010). The approach is traced back to a Black feminist legal scholar Kimberlé Williams Crenshaw who developed and came up with the term as a metaphor to help explain the interlocking multiple systems of oppression among women. Crenshaw discourages monistic views of discrimination as limiting as they fail to recognize different intersecting systems of oppression (Carastathis, 2018).

Crenshaw identified three main dimensions of intersectionality namely structural intersectionality, political intersectionality and representational intersectionality (Crenshaw, 1991). Structural intersectionality according to Crenshaw, (1991) involves structures and systems in society created specifically to help confer and maintain certain specific privileges for groups people or individuals and at the same time restrict rights and privileges other groups or individuals. Political intersectionality takes into account how laws and policies are used and manipulated by dominant groups in terms of gender, ethnicity, ability, age, class, sexuality and race to their favour and Representational intersectionality looks at how different age groups, race, gender, class, ethnic and ethnic groups are portrayed or depicted by the media. Crenshaw focused on these three dimensions of intersectionality as major structures used to perpetuate discrimination (Crenshaw, 1991). However other scholars have delved into other dimensions such as institutional intersectionality and economic intersectionality (Carastathis, 2018).

The approach has four main benefits that make it suitable in analysing the social world. Such include: simultaneity, complexity, irreducibility, and inclusivity. First, simultaneity deals with the simultaneous capture of oppression. It presents the opportunity to capture phenomenological experiences of individuals facing various forms of oppression multiple running simultaneously at a time and does not fragment the experiences through binary exclusive approach (Carastathis, 2018). As such the simultaneity of the approach has the advantage of considering the interlocking social structures and gives them equal attention. As such the approach becomes the best to unearth the interwoven nature of oppression.

Secondly, Carastathis, (2018) recognizes complexity of the intersectional approach as another theoretical benefit of the approach that enables it to capture the structural complexity of oppression. Unlike other analytical approaches that are monistic in nature, intersectionality focuses on complexity of relationships in a society and takes three major approaches to managing complexity. Such include inter-categorical approach which mainly focuses on multiple social groupings across and within the analytical categories; Intra-categorical approach which is mainly used to further analyse complexity of lived experience within an already homogeneous social group such as women and the anti-categorical approach which deconstructs the analytical categories as reductionist and view human life as too complex to be reduced to simple categories. Both the three approaches refute monistic approaches as simple; failing to capture subjective experiences of individuals and the complex social structure that perpetuate oppression. In addition, see the monistic approaches as reductive in that views the

complex individual experiences multi-facet simultaneous oppressions into simple unitary categories.

In the third place, intersectionality has a methodological benefit of irreducibility. Irreducibility emphasizes capturing multiple categories of oppression at any given moment. As such, the researcher avoids reducing human experiences into one single entity of oppression or into two or more axes of oppression which are mutually exclusive. The methodological benefit of irreducibility also applies in enhancing heuristic lens to interpreting results of both quantitative and qualitative research (Carastathis, 2018). Irreducibility exerts require a theoretical commitment by researchers, to consider a multi-facet analysis of data that may have been collected using a monistic view of oppression. Finally, the fourth benefit of intersectionality is inclusivity. This benefit involves the view of intersectionality as a theoretical paradigm that provides a corrective measure against forms of oppressive ideologies such as white solipsism and elitism. The intersectional in that way acts as a tool for enhancing inclusion and fostering political solidarity among groups (Gonda, 2017). These four methodological benefits of intersectionality make them relevant to the study as a theoretical underpinning, methodological approach and a heuristic lens to interpret results of this study (Carastathis, 2018).

This approach therefore complements the SLA through provision of complex dynamic ways of understanding oppression and power play among women. The approach is essential in analysis of the influence of climate change since it helps to tackle forms of deprivation and social differences that affect equitable distribution of resources. In fact studies already recognize the presence of complex social issues influencing the influence of climate change on individuals and their adaptive mechanisms (Osbahr, Twyman, Adger & Thomas, 2010; Agarwal, 2010; Ribot, 2011). It is therefore imperative to include social influencing climate and its effects on different populations into research initiatives.

In fact, studies on gender and climate (Carr & Thompson, 2013; Gonda, 2017; Kaijser & Kronsell, 2014) shows that gender analysis is slowly shifting from the previous suppositions that women are homogeneously vulnerable to shocks while and men are less vulnerable. Such assumptions are monistic in nature and fail to understand several intersectional factors that influence vulnerability (Kaijser & Kronsell, 2014). Therefore, intersectional approaches are instrumental in this study since it is necessary helps to unearth intersecting social dimensions that influence oppression both among women and between men and women.

The need note social categories such as race, age, level of education, ethnicity, marital status, gender, class, sexuality, and other socially constructed and dynamics influencing power distribution, resources allocation and ability to adapt to climate related shocks is inevitable in the attempt to unearth the effects of climate change on women (Davis, 2008; Kaijser & Kronsell, 2014). The intersectional approach becomes handy in explaining inter and intragroup difference as well axes of identity that may govern an individual's relationship to power. Thus, intersectionality provided a suitable lens for analysing gender power dynamics and women's ability to cope with the influence of climate change due to its ability to uncover inter- and intragroup differences, as well as social categories. The intersectional lens helps to provide a clearer view of how power dynamics intersects different parameters including age gender, class and ethnicity.

4.8 CONCLUSION

This chapter argued that sustainable livelihoods theory is a core theoretical approach that can help explain climate change and women's livelihoods. SLA is suitable because of its utility in analysing rural poverty and livelihoods, and in explaining assets and capabilities, and it gives special attention to different forms of capitals, such as physical, natural, financial, human, and social capital, and views them as key components of a sustainable livelihood. However, the theory exhibits certain weaknesses, which are complemented through the application of other theories, including ABCD, resilience theory, and feminist theories. While feminist theories help to explain gender relations and power dynamics in society in relation to capital access and distribution, ABCD underscores the participation of the rural poor in their development, and resilience theory links the micro (communal aspects of livelihoods) with the macro (national, international and global) aspects of climate change and women's livelihoods. The combination of the four theories and approaches provide a strong analytical framework for analysing climate change and women's livelihoods in rural Kenya.

CHAPTER FIVE:

METHODOLOGY

5.1 Introduction

This research sought to understand the influence of climate change on the livelihoods of women practicing rural agriculture in Kakamega County and how they adapt to such changes. Three main research objectives were identified. These include: 1) to examine the capitals and assets women draw upon to deal with the effects of climate change on their livelihoods, 2) to establish the factors that determine women's access to assets and capitals, as well the underlying power dynamics that affect women's ability to adapt and mitigate the effects of climate change on their livelihoods and 3) to examine how climate change is affecting women's asset bases and their survival/ adaptation strategies.

This chapter outlines the research process and procedure. The chapter contains discussions on research methods and approaches used for data collection and analysis, research techniques and underlying assumptions made during data collection and analysis as well as the rationale behind them. The chapter has five broad parts namely Chapter (1) philosophical assumptions of the study, (2) the research design, (3) sampling design (4), data collection methods(5)the ethical considerations, (4) the limitations of the study and (5) fieldwork reflexivity.

5.3. Philosophical assumptions

Normally, philosophical assumptions guide the empirical research process, including the design, data collection, interpretation and analysis. The assumptions determine the approach and are informed by several factors including the aim and objectives of the study, the geographical area of coverage, nature of the study subject, the sample size of the study, available time and funds to undertake the study. Since the success of this study is based on a clear understanding of human experiences and practices amidst climate related shocks in a rural setting, a social constructivist approach was adopted. The approach is a social science method that emphasizes context and culture as key aspects in constructing reality and constructing knowledge of a given society (Kim, 2014). The approach is based on certain basic assumptions about reality, knowledge and learning. First the approach assumes that reality is a social construction that occurs through human activity and that members of a society invent the

properties of their social world together. Secondly, the approach assumes that knowledge is socially and culturally constructed and that the members of the society often create meaning out of their environment through their interactions with each other as well as with the environment they live in (Creswell, 2009).Finally the approach assumes that learning is a social process that can only take place when individuals are involved in a social activity or process. in order to study participants as meaning makers who socially construct their reality on a daily basis (Braun and Clarke, 2006; Creswell, 2009). This approached enabled me to understand individual lived experiences of the study participants that inform their response to climate related challenges. In fact, the proponents believe that humans are rational beings who understand their environment and create reality by interacting with their social, cultural and historical environment. This study therefore, adopted social constructivist ontology, to bring out the lived reality of the participants through their experiences, perceptions and actions and these affects the livelihoods of women in Kakamega County.

To objectively fulfil the constructivists' philosophical approach, the study used interview guides with open ended questions instead of the common structured questionnaires. This approach presented me an opportunity to listen keenly to the detailed narrations of experience of every individual participant in the study and to make further inquiries to understand how each participant experienced climate change and how they dealt with the effects on their livelihoods.

Closely related to social constructivists' ontology is an interpretive epistemology. Since this study was based on the experiences of rural women farmers and how climate change influence such experiences, the study also adopted the interpretive epistemology as a perfect complement to social constructivists' ontology approach. This enhanced a deeper understanding of rural farming women and how climate change affects them since it provides an appropriate conversational space necessary to elicit discussions and to uncover the meanings participants attach to certain climatic events. The approach also enhanced a closer relationship between me and the study subjects in order to obtain rich data (Guba& Lincoln, 1994: 111). According to Bryman, (2012), the use of interpretive epistemology allows participants to create a rapport with the researcher, to recount and narrate their reality and experiences and to explain the meaning attached to certain events that affect the individual lives as local residents. Interpretivism as a philosophical assumption therefore underscores fact that individuals' experiences are important and attach diverse meanings to any phenomenon and experiences

within the locality. In fact, it emphasizes the prospect of attaining various views from every study participant and an understanding the meanings study participant attach to their reality (Bryman, 2012:30).

Methodologically, it is also important to consider one's underlying axiological assumptions that influence ones beliefs, values and know-hows of the participant and subject being studied (Creswell, 2009). In this regard, my study design was influenced by my own interpretations about communal values, believes, knowhow and living arrangement since I have lived in the same community since childhood and have first-hand experience of the effects of climate change on women. Such experience influenced my study design in terms of the best method to collect thick data on the effects of climate change on the livelihoods of rural women farmers in Kakamega County.

5.4 Research Design

5.4.1 Research strategy and approach

This study adopted a cross sectional exploratory study design with an aim to unearth the livelihood experiences of rural women farmers under the influence of climate change in Kakamega County. A qualitative research strategy was adopted to find out how individuals interpret how climate change influences their livelihoods. In trying to understand how individuals interpret their social world, a qualitative approach uses data collection methods that generates thick detailed descriptions of lived experiences through various ways including discussion, observation and interactions with the study subjects to understand the meaning they attach to their experiences.

Other studies on climate change and livelihoods have used quantitative indicators to measure or predict the effects of climate change on livelihoods. While a more positivist or quantitative approach can measure impact, it cannot capture that actual lived experiences and descriptions of the adaptation strategies of women. Accordingly, a qualitative approach was considered best suited in the case of this study which sought to capture the experiences of women and their responses to climate change (Braun and Clarke, 2006;). Coupled to this I adopted an inductive approach, where the research was first informed by observations and conversations, rather than being guided by theory or prior literature on the subject. The preliminary observations were

used to inform and design the study to fit within the appropriate context and to allow the field to inform the study.

5.4.2 Study site

The study was conducted in Kakamega County. Kakamega County is located in the Western region of Kenya and is 3,050.3 km2. The county boarders Vihiga County to the south, Busia and Siaya Counties to the west, Bungoma and Trans Nzoia Counties to the north, Uasin Gishu County to the north-east and Nandi County to the east. The county has 12 sub-counties and 60 wards consisting of 398,709 households. The sub counties are: Likuyani, Lugari, Malava, Navakholo, Lurambi, Ikolomani, Shinyalu, Mumias Esat, Mumias West, Matungu, Butere and Khwisero (CIAT-International Centre for Tropical Agriculture, 2018; County Government of Kakamega, 2018). Out of the twelve sub counties, four were purposively sampled for the study.

The area was purposively selected owing to its fragility and sensitivity to climate variability, dependence on rain-fed crops and the high number of women involved in agriculture (GoK, 2012). The economy in the area is predominantly based on crop farming, with a bit of livestock farming. In fact, sixty-one per cent of households rely on crop and livestock production for their daily living (CIAT-International Centre for Tropical Agriculture, 2018).Another factor for the choice of the study site is that I have lived in the area since birth and have an intimate understanding of the cultures, views, gender roles, climate related shocks as well as the terrain. Such 'insider' knowledge and understanding enabled me to interact with the participants with ease as I speak the local dialect (Luhya). Hence the study participants were able to express their experiences and views openly and comfortably without having to involve an interpreter.

5.5 Sampling design and procedures

The sampling design was multistage since there were two different sub counties and informants. This was done to ensure representation from different sub counties and ecological zones, bearing in mind that the county has two distinct ecological zones supporting different crops. The sub counties were first sampled and thereafter informants were sampled from the

selected sub counties. Both stages involved different qualitative sampling methods discussed below.

5.5.1 Sampling of sub counties for the study

During sampling, the sub counties were selected first, before the study participants were selected. The sampling of the sub counties was done purposively to ensure that there is representation of ecological zones and proximity to urban or rural settings. The county has two main ecological zones i.e. the Lower Medium (LM) and the Upper Medium (UM). The Lower medium includes the southern part of the county and has sub-counties such as Mumias East, Mumias West, Butere, Matungu and Khwisero. Here production of sugarcane as well as maize, tea, sweet potatoes, nut, and cassava are typical. Out of the lower medium Mumias West was selected based due to cash crop (sugarcane farming) and proximity to Mumias town. Matungu Sub County was also selected for being relatively rural, having medium sized pieces of farm land and practicing mainly food crop farming (maize and beans).

The Upper Medium ecological zones covers the central and northern parts of the county and includes sub counties such as Ikolomani, Lurambi, Malava, Navakholo, and Shinyalu, which practice intensive maize, tea, beans, and horticultural production mainly on small scale; and Lugari and Likuyani where medium scale farming of beans and maize is practiced. Out of these two other sub counties were selected purposively; Malava was selected for proximity to town and financial services, while Lugari was selected for being relatively rural, having larger pieces of land and practicing medium scale farming.

Table 5: Sub county sampling

Ecological Zone	No	Sub county	Access and proximity to services	Agricultural characteristics	Main crop
Lower Medium	1	Matungu	Rural, difficult to access and less access to financial services	Small scale food crop and livestock production	Food crop (maize beans)
	2	Mumias West	Partially urban and residents access services with ease	Medium scale sugarcane farming and small scale crop and livestock farming	cash crop Sugarcane
Upper medium	1	Lugari	Rural with medium land ownership, poor access to financial and government services	Medium scale Food crop and small scale livestock production	Food crop (Maize Beans)
	2	Malava	Partially urban and good access to services	Small scale mixed farming	Both food and cash crop (maize and sugarcane)
	3	Lurambi	Mostly urban and has the best access to services	Small scale mixed farming	Both cash and food crops-Tea, maize beans, horticulture

A fifth sub county, Lurambi was also selected for being the county headquarter and housing most of the key informants. Lurambi Sub County has more access to services due to its proximity to the county headquarter and has more small scale farmers who serve the urban areas (Kakamega town). The study was therefore conducted in five sub counties namely the

Lugari and Malava, Mumias west, Matungu and Lurambi Sub-Counties of the Kakamega County in Western Kenya.

5.5.2 Sampling and recruitment of study participants

The study was conducted over a period of four months between the months of September 2017 to January 2018. This was because after the pilot test in August 2018, there were disputed presidential elections and it became impossible to collect data due to political animosity and difficulty in movements. The study used open ended questions on climate change effects on livelihoods and assets, factors influencing asset access ownership and decision making, how women adapt to climate change and the effects of climate such adaptation on women's asset base. The study participants were both men and women practicing agriculture in the five sub counties sampled for the study. Stakeholders, including key government departments, NGOs, CBOs, self-help group and women group leaders were included as key informants. Stratified sampling was used for the sub counties and 3 FGDs, two KIIs and 2 Life history participants were sampled from every sub county. In every sub county the three FGDs conducted included: one of mixed gender FGD, one for male and another for female farmers FGD. However, in Lurambi only two FGDs were conducted because of the high number of KIIs. This is because almost all county staff work in Lurambi sub county Kakamega town.

Before the study started I visited the area during pre-test, to help me ensure samples are representative geographically. I then took the first week of the study visiting different offices within the county headquarters and sub county offices to make contact and book appointments for interviews. The key informants visited were sampled purposively; two per Sub County based on special/ key information they have about climate change and women farmers' livelihoods in the area. Their close interaction with women farmers was given priority. The key informants were identified from government line ministries, stake holders in agriculture and climate change, as well as women leaders. This was done in close collaboration with the County Commissioners' office and the ministry of agriculture. I visited their offices to book appointments for interviews, which after much rescheduling took place with the key informants

Two life history participants were sampled per Sub County. The sampling was purposive based on gender and duration of practice as a woman farmer. Since the participants were often old women, I had to consult widely during the study to get suitable participants. Through the area

chief, one old woman was identified to participate in the life history, who in turn identified other women that I could interview. Using this snowball sampling method I was able to identify sufficient participants from diverse backgrounds to interview.

To organize and make contact with the focus group participants proved a challenge since there was no register for farmers. However, after consultation with the Agricultural and Livestock officers at county level, I was advised to work with government extension workers and the government Department of Social Development and Agriculture to access farmers and farmer groups. Based on the information from the three departments a list of farmers was generated and which acted as a sampling frame. From this, participants were purposively selected based on the Sub County, ward, gender and age of the informants. After sampling the informants, in consultation with the village elders and women group leaders, I was able to get some telephone contacts of the sampled farmers from the Department of Social development group registers. These farmers were contacted and asked to participate in the study. Where information on the e participants was missing, I used the village administration and networks to trace them and introduce me. Once contact was made, the participants were all informed of the study, risks and benefits as well as their rights as participants and their willingness to participate in the study through focus group discussions was sought for.

Table 6: Study tools and samples

Sub county	**FGDs**	**KIIs**	**Life History**	**Total participants**
Matungu	3 (24 participants)	3	2	28
Mumias West	3 (24 participants)	2	2	28
Malava	3 (24 participants)	2	2	28
Lugari	3 (24 participants)	2	2	28
Lurambi (Lubao)	2 (16) participants)	11	2	28
Total	14 (112) participants)	16	10	138

A total of 138 participants participated in the study. The total number of participants was arrived upon with the view of reaching a saturation point and at the same time targeting more than15 participants since several scholars have argued that essentially any study using qualitative strategies must consider more than 15 participants (Greene, 2014)). The participants

were all black Africans residing within Kakamega County and practicing agriculture as a source of livelihood. Female participants were the majority (75) since the study focuses on how women farmers experience the effects of climate change on their livelihoods. The men who participated in the study were 63. Among the participants, 6 were single, 95 married and 37 widowed. Most participants were of age 35 years and above and youths (35 years and below) were only 25 in number. This is because the youth tend to shy away from agriculture due to the drudgery involved, and instead opt to search for white collar jobs in the urban settings. The table 5.3 below shows the demographic profile of the study participants.

Table 7: Demographic profile of study participants

Method of data collection	Age of participants	Gender of participants		Marital status		
		M	F	Single	Married	Widowed
FGD	25-34	12	10	4	16	2
	35-44	13	14	2	20	5
	45 -54	20	18	0	26	12
	54 and above	11	14	0	14	11
KII	25-34	1	2	0	3	0
	35-44	2	1	0	2	1
	45 -54	2	4	0	5	1
	54 and above	2	2	0	3	1
Life History	25-34	0	0	0	0	
	35-44	0	0	0	0	
	45 -54	0	4	0	2	2
	54 and above	0	6	0	4	2
Total		63	75	6	95	37

5.6 Data collection methods

The study aimed to investigate how climate change affects the livelihoods of women and therefore it was necessary to collect the lived experiences and views of individual residents of the area. To achieve this qualitative data collection methods were applied. The methods applied

include: life history, focus group discussions, key informant interviews and observations. These methods expanded on below.

5.6.2 Focus group discussions

Focus group discussions (FGDs) are widely used in qualitative research to gain in-depth understanding of social issues (Nyumba, 2018). The method of data collection is appropriate for stimulating arguments and discussions that lead to agreements and disagreement about social phenomenon, thus deepening the discussion beyond what may have come out in a face to face interview. This method also proved instrumental since it brought several people from same locality to discuss their views perceptions and experience and as such created a social environment where participants could freely express themselves. As such, the focused group discussions generated insights into people's shared understanding of everyday life. There were 14 focus group discussions conducted as follows: Malava sub county 3 FGDs; West Kabras Ward in Malava Sub-county 3FGDs, Lugari Sub county 3FGDs, Chimoi Ward Lugari Sub county 3FGDs and Lurambi 2 FGDs. The FGDs were three per Sub County; one being mixed men and women, another with male participants only and another with female participants alone. Women only Focus groups were meant to allow full participation of women in the discussions without letting men to dominate or shape their ideas. However mixed gender FGDs were expected to promote discussions between men and women which was not often the case since in most mixed FGDs, women kept quiet and let the men talk or agreed with the information men gave because such is what is culturally expected. The FGDs were conducted using semi structured questions covering the themes in both literature review and objectives. The questions were on: the effects of climate change on women's livelihoods; capitals and assets women draw upon to deal with the effects of climate change on their livelihoods; factors that influence women's access to the various capitals; how climate change affects women's asset bases and how women build resilience to cope with climate change effects. The participants in the FGDs were all farmers and were selected purposively based on age, gender and means of livelihood. The participants were recruited with the help of the agricultural extension officers, and village elders in the community of study. Once identified, the participants were invited to a central point for a focus group discussion.

5.6.3 Key informant interviews

Key informants were purposively sampled based on their expertise and knowledge on the influence of climate change and women's livelihoods. The Key informants included stakeholders in agriculture, climate change and women's issues at the village level and government officials dealing with the same. Such in Kakamega included Women Enterprise Development Fund (WEF) field officer, One Acre Fund field officer, women leaders, Social development officers, ward administrators, area chiefs, livestock development officers, cooperative development manager and crop protection officers, directors for climate change and chief executive officer for agriculture and livestock economy Kakamega County. To conduct these interviews, a key informant interview guide was used. The key informant interview guides had open ended questions on effects of climate change on women farmers and how the farmers mitigate the effects of climate change on their livelihoods. Before conducting the interviews, appointments were made with the key informants. The interviews were then scheduled on appropriate dates and venue, mostly at their offices for those with offices and homes for the communal leaders. The key informant interviews were conducted to a point at which new information or themes could not be any more observed in the data , also referred to by Guest, Bunce, & Johnson, (2006)as saturation point. At saturation point there were 16 key informant interviews conducted.

5.6.1 Life histories

Life histories were used to elicit the lived experiences of sampled women farmers in the study area. The method has over time been neglected in research, however feminist researchers writing women's histories found it important in exploring the experiences of women especially in areas where certain ways of life are threatened (Kouritzin, 2000). This method is appropriate because life history research aims to capture the lived experiences of people over time (Dhunpath, 2009). This method was especially useful in this study which aimed to establish how climate change over time has affected the lives of rural women involved in agriculture and how they have mitigated the effects. The participants were identified through the area chiefs and assistant chiefs. The participants were women who practiced agriculture in the area for more than 3 decades. A total of 10 women were (2 per sub county) sampled. The study participants narrated their life histories in the region over the last three decades, and how they

have coped with different climatic shocks and events over time. The aim was to establish the trends of shocks, their effects and adaptation/ coping mechanisms over time.

5.6.4 Participant observation

Observation as a method of data collection involves the systematic description of events, behaviours, and artefacts in the social setting chosen for study (Kawulich, 2005). Participant observation is a qualitative data collection method that involves the observer being a member of the setting in which she/he is collecting data (Kawulich, 2005). I chose this method to be appropriate and played the role of *participant as observer*, since being a researcher and at the same time a member of the community being studied, this would have been the most appropriate approach. In participant as observer approach, it was necessary that I make the subjects aware of the research activity I was undertaking and its purpose as I did. During the observation process I played several roles as a participant. I took part in farming activities at farm level; in women's group meetings and attended churches where the women farmers go to observe and talk to the women. I also participated in the market where I posed as a buyer to get to know who owns and sells what goods and at water collection points where we shared informal livelihood stories. While I would have wished to conceal my identity so as to cover a natural setting, this was not possible due to the ethical requirements of informed consent.

Apart from limiting depths of data this method was advantageous to me because it enabled me to appropriately understand and capture the context within which study participants interact. This method of data collection in addition gave me a chance to learn things that the study participants did not discuss in the interviews. As a participant observer, I observed four main sites including on-farm activities, activities at the market place, and activities at the water collection point. Observation of farm activities was conducted in Lugari and Malava sub counties. I posed as a farmer and most often joined women farmers in doing on farm activities. During such sessions informal conversations were struck with the women on how climate change affect their livelihoods especially farming, how they cope and adapt to such. This opportunity also helped me observe the gender roles that women engage in. Women are mostly in the farm in the morning weeding crops such as maize beans, bananas, vegetables and or planting different crops. Women also keep free range chicken. During observation I was able to note that women have relatively smaller farms and those who stay on large farms attribute

such to their husbands. I was not able to join men in farm activities since men tend to work separately from women.

On two other sites, I posed as a buyer in order to observe the transactions in the market and how gender issues and power dynamics affect the marketing of farm products. Such were done in both Malava and Mumias market. As a buyer in the market, I noted the assets that belong to women by observing what they sold in the market place. The third point of observation was at water points and while fetching firewood. I participated in fetching firewood and water from the common water pump in Lugari. While fetching water and firewood, I was able to engage in informal talks that provided rich data on how women are affected by climate change. At this point it came out that women look for water from far during dry seasons and face a number of risks.

The process was easier for me, since as a teenager I grew up in the village and understood the local language and ways to interact. I therefore shared many more common stories about the village experiences. This made the participants to feel comfortable and provide information in a friendly environment. The intension of participant observation was to avoid the influence of the researcher on the daily practices and behaviours of the subjects being observed. Though this was mostly achieved, little influence over the topic observed could not be evaded since at times the farmers at farm level viewed me as an expert who had come to teach them. This I dispelled by being too close and doing everything they did.

Having lived in the area since childhood, I have observed and seen the effect of climate change on the livelihoods of women. Such insider knowledge made it easier for me to probe the participants and expand on their stories. It also meant that I was more readily accepted when it came to joining in on different activities and events. I often dressed like a community member to suit the context in every observation event. I posed as a farmer during farm observations and as a buyer during market observation. I also carried a bucket to the water to observe women collecting water, the distance they go and also had informal conversations with them on how climate affects their access to water, as well as what they do when affected by droughts and floods. Observations were noted in field notes and possible photographs were taken to provide evidence. The observations were able to bring out concrete evidence and raise other issues for follow up during interviews. During observations, informal conversations were initiated to bring explanations for different phenomena. Field notes were also taken daily to help write observation reports. As part of ethical requirements, I informed the participants that I was

collecting data and this had a major disadvantage in that there some trade-off between the depth of the data revealed to the researcher and the level of confidentiality provided to the group for the information they provide. This I overcome by becoming as close as possible and by blending with the participants in all their undertakings

5.6.5 Non participant observation

This method was used to observe physical things that did not need participation. Through non-participant observation, I was able to document livelihood activities that both men and women are involved in. I was able to note the farm sizes and difference for both men and women, the kind of structures and assets that men and women owned and the assets that men and women have authority to sell. This method was used alongside other methods and helped to corroborate the data provided through interviews.

5.6.5 Data collection procedure

Fieldwork began with a short pilot study in the first week of August2017. The pilot study tested the interview schedule for key informants, the guides for the FGDs, life history guides and observation check lists. I found that the guides were long and some questions were missing which were added after the pre-test. The guides were therefore re-adjusted after the pilot; more questions were added to the key informant interview guides. The FGD timing was reduced from one and a half an hour to one hour since one and half an hour seemed longer and the beneficiary felt the monotony of sitting for long. And observations that initially had no checklist were accompanied by a checklist to help the observer to remain within the objectives of the study. Field work was started in the first week of September 2019 and was concluded in December 2017. Before the study commenced, relevant authorities were consulted and informed of the study. Such included the county commissioner, Assistant county commissioners, Sub County administrators and the area chiefs in locations selected for the study. Mobilization was then done using the chiefs, religious leaders and women representatives who provided community entry being the community gate keepers.

Once I had met the authorities at the county and sub county level, I made appointments with them for interviews and moved on to the village level where I contacted the chiefs and village elders who assisted me in finding participants.

Being a long-time resident of the area and behaving like the participants meant that they trusted me and I was able to build friendships and bond with the participants. Being an insider, I understood the cognitive, emotional, and/or psychological precepts of participants and also had knowledge of the historical and practical happenings of the field environment (Greene, 2014:3). In that way I was able to gain rich data in a natural environment and reduce social distance between myself and the study participant. This kind of researcher participant relationship also referred by Oliver, (2017) as "faking friendship" was very helpful and made my data collection process easier since the participants gained full confidence in me and felt no need of hiding anything. Though helpful, at some point it also became difficult to keep an appropriate social distance as the participants now wanted me absorbed in all their daily activities including those not related to the study. However, such a risk was addressed by being clear to the participants on the purpose of the study and delineating boundaries of socializing.

5.7 Data analysis

All the audible conversations were voice-recorded and transcribed. The FGDs and life histories were done in a language the participants were comfortable with (Luhya). However, key informant interviews were conducted mainly in English except two of them that were done in Kiswahili. The interviews and discussions were recorded, and field notes were also taken alongside the recordings. Notes were as well taken during observations of farms; water points and markets these notes were used to corroborate the findings from different methods to increase validity. Field notes as well captured the nonverbal interactions and group dynamics during interviews and discussions. Since non-verbal data can never be audio recorded, the researcher depended on the behaviour and actions of respondent's during pre-focus group discussion, during and post-focus group discussion. The non-verbal data provided a rich descriptions and interpretations of the study compared to the sole use of audio data alone.

All the data collected from Key informant interviews, focus group discussions and Life histories were voice recorded. The voice recordings were then transcribed. After transcriptions, the data which was in the local dialects were then translated into English. Some transcripts

were back translated to ensure the translation does not interfere with the original meaning. This I was able to do since I fluently understand and speak the local language. The transcriptions and field notes then helped to code the data into themes that emerged from the literature review chapters. Coding data was done in NVIVO 11 where a code frame was created and data was coded into parent nodes and child nodes taking care of themes emerging from existing themes; technique also referred to by Olivier as "code and retrieve" (Olivier, 2015: 117). This method of data processing is important and appropriate since it considers and brings together both existing themes and emerging themes. Thematic analysis was used in the study for its ability to analyse "experiences, meanings and the reality of the participants" and suitability in analysing complexities of meaning within a textual data. (Braun and Clarke, 2006:81). Themes captured important issues in the data in relation to the research question and objectives and brought out emerging patterns from the data set. The main themes arising from the data set included effects of climate change on women, copying strategies women to overcome climate change effects, assets women rely on to build resilience, effects of gender and power dynamics in copying and adapting to climate change and how women adapt and build resilience to the effects of climate change. In terms of climate change adaptation, social capital came out as a major theme that aids women to build resilience. Emerging themes were recorded as child nodes. The themes were strictly derived from the data in an inductive bottom up manner. As such the analysis was data driven and brought out the themes arising from the different methods of data collection.

5.8 Ethical issues

The study followed strict adherence to ethical guidelines as stipulated in the policy for responsible research conduct at Stellenbosch University. The aim and nature of the study was explained to all participants. Informed consent was read to those who could not read, and a verbal consent was obtained. The information sought was kept under password for confidentiality purposes. Informants were encouraged never to use names, however in cases where names were mentioned; report replaced the names with pseudonyms. Letters were sought from all authority from the county level up to the ward and village level. Institutional permissions were granted within the appropriate time. In cases where the participants travelled from far to attend focus group discussion, refreshments were provided, and fare reimbursed. The study did not experience any negative influence on the breach of ethical provisions

however ethical dilemma was presented during participant observation. In the process of participant observation, the decision to conceal my identity as a researcher would have provided thick natural and experiential data; however, covert observation would as well breach the participant's right to informed consent. As a researcher, I decided to make known to the participant my intention of collecting and recording information for study purposes. To ensure that I achieve in-depth data, I had to bond and identify freely with the participants to the level they gained full trust in me.

Another ethical issue was anonymity; having bonded with the informants, it was only natural that we call each other using the real names since participants felt comfortable being called by their names. It was however my work as a researcher to ensure that their identity is concealed in the field notes and the final write up. Where the description of a participant in the findings would lead to identification of a participant, I was forced to generalize so as to ensure anonymity. Despite asking the participants not to mention their names during FGDs, some still went ahead and mentioned names. These names were however changed into pseudonyms so as to ensure anonymity.

5.9 Reflexivity during field work

The field work for this study was conducted in the year 2017. While field work was meant to be in August, it was postponed to September due to elections, however the elections were disputed, and new preparations made for Kenya to elect her leaders. In the wake of these challenges data collection started in September going for three months. Given chance I would organize to do field work during a non-electioneering year to avoid interferences. Doing my field work during an electioneering year made it especially difficult to recruit the participants since most of them expected some kick back thinking that the study was part of the political events. The study was conducted during a period when most people are suspicious of being engaged in initiatives thinking that such can be used for political ends to rig elections or manipulate voters. It was therefore not easy to convince the participants that the study was meant for academic reasons and had no political attachments. This was overcome by the help of community leaders who helped to explain the purpose of the study. In fact, it was at times difficult to meet the participants at appointed times or places since political rallies attracted most people. As a researcher, given another opportunity I would organize to conduct field work during a non-electioneering year.

Another reflexive issue that came out during the study is the insider outsider debate (Hayfield & Huxley, 2015). Being an insider in the study I already had deep and broad understanding of the context and the participants. Insiders hold a privileged research position when conducting qualitative research, since one is familiar with the culture and social environment (Dwyer, 2009) and this made it easier for me to develop research questions, design interview schedules, access and recruit participants as well as to collect and analyse data with no difficulty. However, despite being more aware of the lives of my participants, the question of objectivity, reflexivity, and authenticity of a research needs to be taken into consideration. I therefore gathered information with the assumption that I know nothing about the phenomenon being studied as advised by Moore, (2015). This helped me to keep me objective

To maintain objectivity, I considered two elements of reflexivity, namely being prospective and retrospective. Prospective deals with the effects of the researcher on the process of research study (Attia & Edge, 2017; Braun and Clarke, 2006). For instance, at the beginning of the study especially during the pilot, the participants held the idea of researcher subject relationship and were less willing to open up to me. This was however overcome by creating a rapport between the participants and the researcher through close bonding and because I could speak the language. By bonding I was able to identify as an insider and have the opportunity to obtain in-depth information in a natural setting. My knowledge of the culture and practices was only useful in helping me to gain access, respect and trust of participants.

In the process of bonding and becoming an insider, I realized the risk of retrospective reflexivity, which is the effect of the research process on the researcher (Attia & Edge, 2017). Such was experienced when I at times became completely immersed in the field and made friends with the participants, which meant that I sometimes veered of the topic and started to discuss non-research related issues. To counter this, I returned to my interview guide to stay on track. In one instance, in the process of close bonding, being a female researcher, one of the male participants saw me as potential female suitor and asked for a relationship. I dealt with this by emphasising my role as a researcher. However, as this topic is close to home I could not help but sometimes becoming emotional, especially during the narration of the life histories by the elderly women. Some of the stories made me feel remorseful, and it was difficult to control my facial expressions.

The qualitative methods worked well to produce rich in-depth data, especially the use of participant observation. It however emerged during the study that this method would present

ethical dilemma of having to inform the participants of my intention to collect and record data, which made them a bit uncomfortable in the initial stages before they gained confidence in me. I however overcame this through bonding and creating rapport with the informants. Participant observation also presented situations where my gender and age would not allow me to participate in certain activities such as selling cows in the market, which is the task of men and attending certain communal meetings, only attended by elderly women and men.

The scope of the study though in Kenya, was limited to Kakamega County; in Kakamega County, the study focused on only five out of the twelve sub-counties. This is due to limited resources and time. Otherwise, with resources and time the study could have sampled at least 10 counties out of the 47 counties in Kenya and several sub counties. However, sampling was appropriately done to ensure that this study is representative of Kakamega County as one of the key food producing counties in Kenya. It therefore means that the study would not represent the arid and semi-arid regions of the country.

In addition the methodological use of several methods to collect data was important for triangulation and corroboration of information to strengthen the study. The varied methods of data collection provided different specialized information during the study. The life histories for instance were instrumental in providing information on the long term effects of climate change and adaptation measures across time. FGDs provided rich information on farmers' experiences, which they shared and expanded upon in discussions. Women only and men only focus groups proved to be more productive than the mixed FGDS. This is due to the patriarchal cultural norms that expect women to keep quiet and uphold men's opinions as true. In the mixed gender FGDs, women and men accused each other or women kept quiet as men dominated discussions. This gave insights into the patriarchal nature of society and power balance that affects decision making.

The life histories revealed that the negative effects of climate change have become intensive in the recent past as adverse climatic events intensified. As such, communal social networks have been weakened and are no longer as strong as they used to be three decades ago. Such strong networks enabled the community to take care of the socially deprived. With frequent and prolonged droughts as well as floods, the communal networks continue to weaken as NGOs and government institutions strengthen their capacity to provide for rural dwellers. Though social capital still plays an important role in building the resilience of rural women to the effects of climate, these shocks have become more rapid.

In terms of the research design, I used both gender segregated focus group and mixed gender FGDs. The gender segregated proved to be the best approach of collecting gender related information in a patriarchal community. This is because culturally, in Western Kenya, women never attend meetings with men and if they do so they are expected to listen and let men talk. Such was observed in some mixed FGDs when men dominated and women contributed very little to the discussions. In some mixed gender focus groups, the discussion turned into an emotive debate when men accused women and vice versa. However such gender mixed FGDs revealed the underlying power dynamics embedded in patriarchy. In future studies, it would be important to have only a few (one or two) mixed gender focused groups ,while for clarity of information, flow of thought among women only and men only FGDs should be considered in a patriarchal society like Kakamega.

CHAPTER SIX

RESEARCH FINDINGS

6.1 Introduction

Climate change is recognised as a serious problem globally. The effects of climate change on the livelihoods of poor rural farmers have been a concern in sub Saharan Africa, especially in Kenya. In Kakamega County where about 61% of the inhabitants rely on crop and livestock production, this is an existential problem (CIAT-International Centre for Tropical Agriculture, 2018). As women are primarily responsible for agricultural production, it is important to understand how they mitigate the effect of climate change on their livelihoods. Few studies have focused on this topic, specifically in relation to how women in Kakamega cope with the effects of climate change.

In this chapter, the findings of the research are presented in terms of the effects of climate change on women's livelihoods. The findings are presented thematically based on the objectives of the study and the themes that emerged during data collection. These include: (1) aspects of climate change experienced in Kakamega County; (2) the livelihoods of rural women in Kakamega; (3) effects of climate change on the livelihoods of women farmers; (4) assets women draw to in order to cope with the effects of climate change on their livelihoods; (5) how women farmers mitigate the effects of climate change on their livelihoods; and (6) the of role social capital in promoting resilience to climate change among women farmers in Kakamega.

6.2 Aspects of climate change experienced in Kakamega County

This section describes the aspects of climate change experienced in Kakamega County. The findings concur with those other studies which also indicates that three main aspects of climate change affect livelihoods of women farmers in Kakamega county (CIAT-International Centre for Tropical Agriculture, 2018). In tandem with the findings these aspects include changes in temperatures, precipitation and a lack of predictability of weather patterns.

Temperature changes are observed in Kakamega County across all the sub counties. The participants reported that the area has generally become hotter as compared to the previous ten year, especially in the months of April May and June. This is congruent with findings from (CIAT 2018) that reported an increase in temperatures in the last decade by 0.4^0c in the first season and 0.3°C in the second season. Based on the qualitative interviews, a participant reported:

> *I can say that the temperatures in this place have greatly changed over the last ten years. We initially experienced nearly normal temperatures throughout the year. These days we experience very hot temperatures from January up to March and very cold temperature between June to September. Like in February and March it becomes so hot that you may not dare work or walk outside on direct sunlight*[8].

These findings are congruent with similar reports indicating that the average temperature in western region where Kakamega is geographically situated has risen by 0.78^0C (NAR, 2008). Added to this, participants reported experiencing a change in precipitation and indicated that they observed that the rainy seasons had become shorter in the past ten years. Apart from being short, the rains when they did come were heavy meaning that they experience a high rainfall but over a short period. Prior to the current decade the rains for the first season usually started from the month of February up to the month of June, but this has changed significantly according to participants. They indicated that the onset of main rainfalls are now vary between late March and early April and this highly affect the livelihoods of farmers who entirely depend on rain fed agriculture. For example, a noted:

> *I can say that ten years before now, we used to enjoy enough rains and plenty of food here in Munami, these days the rains come late…as late as March or April and may just disappear within the same month leading to crop loss*[9].

In fact, in the year 2019, the onset of the main rainy season is yet to be experienced in June as predicted by the metrological department in Kenya. Most farmers have planted twice with crops failing to germinate due to lack of rains. The farmers have therefore lost seeds, fertilizers and operation costs since they need to redo the farm operations.

[8]Female FGD participant from Lugari sub county
[9] Female FGD participant Matungu Sub County

Apart from late rains, farmers have noted prolonged periods of dry spells unlike in the last decade, the dry spells affect both crop and livestock production as farmers cannot plant during droughts. In fact, farmers reported having to look for water for their livestock far from their normal grazing lands, or are forced to buy in pasture. In a key informant interview, an interviewee reported:

> *We are these days experiencing prolonged dry periods unlike in the past sometimes the area becomes so dry that you cannot know that Lugari is an agricultural zone. When the rains become scare, the farmers have to look for water for household consumption and livestock use from the far away non-seasonal rivers, they also have to buy livestock feeds*[10].

The rains are also associated with hailstones, which is unlike the past which destroy crops or forcing the famers to replant stocks. Participants reported that this not only affected crops but livestock which can kill goats or cattle. Likewise, there has been an increase in thunderstorms that sometimes kills livestock.

All spoke of how the changes in weather patterns have affected predictability making it difficult for farmers to know when best to plant crops. One of the participants in a mixed FGD supported this claim:

> *I cannot tell the weather patterns these days, because the rains these days are so unpredictable, you may find that the months when we expect the rains become dry and the months when we rarely expect any rains become rainy…The rains for example comes when we don't expect it, yet the months when we expect the rains to plant it does not come… we don't know these days when to expect long rains and when to expect a dry spell*[11].

Apart from the unpredictable weather patterns, it has also become a challenge for farmers to predict the amount of rain at a given period of time. While a decade ago, farmers always expected heavy downpours in the months of April and May and June only, it was noted that these days a heavy downpour can be received at any time as compared to the previous ten years.

[10] Response from Key Informant interview with the Chief from Lugari Sub County
[11] Response from a male FGD participant from in a mixed FGD Mumias West Sub County

The problem with heavy downpour is that it tends to cause flooding, erosion of farmlands, destruction of properties, and subsequent loss of lives. A participant stated:

> *These days the rains come within a short period of time but with a heavy downpour especially in April. Sometimes the downpour is experienced in December when only short rains are expected ...heavy downpour is a common phenomenon that occurs annually and after such, you hear that some people have lost their crops to floods, animals have been swept away, houses have been destroyed, bridges swept away, and lives lost. Soil erosion especially on sloppy areas is also very common during such periods*[12].

During other months when there are no rains, there is usually a dry spell and as the study participants observed, the last ten years has also been marked by prolonged droughts which commonly begins between January and March and some starting from as early as October to March. Such prolonged dry spell affects both crop and animal production.

> *When I talk of climate change, I just reflect on prolonged periods of drought. I mean during the time when our forefathers grew up, there were no droughts and even when I was growing up in the 1960s, we would only experience a dry spell for less than a week and then there would be rains, these days droughts occur every year and after the droughts there is a heavy downpour that causes flooding. Both droughts and floods affect our lives and there is no time to settle*[13].

Unpredictable precipitation has a marked effect on rural farmers as they can no longer rely on the traditional seasonal calendar for their crop and animal production. This means that they are unable to make new plans and incorporate changes as to when to cultivate the land, and when to plant or weed the farmland. The end consequence is that the unpredictable precipitation affects their ability to sustain their farming activity, which is solely dependent on rain-fed agriculture and their major source of livelihood.

[12] Response from an old male FGD participant in Lugari Sub County
[13] Response from an old female FGD participant in Mumias west Sub County

6.3 Livelihoods of rural women in Kakamega County

Women in rural Kakamega have different sources of livelihoods which include crop production, livestock production and sales of agricultural products. Besides the income from agriculture, other sources of livelihoods such as craftsmanship, charcoal burning, informal employment/casual labour provision and formal employment are also present in small scale. This section discusses the first three sources due to their relevance to this study.

6.3.1. Women in crop production

Crop production refers to the growing of crops for food or fibre under rain-fed or irrigation systems. Usually, the process involves land preparation, planting, weeding and post-harvest processes that are often labour intensive. In terms of crop type maize is the staple food in Kenya more than half of this is produced by women. Apart from maize, other crops like tomatoes, kales, cow peace, sorghum, cassava, sweet potatoes, millet and beans are produced by women. According to the response from women's FGD, women produce mostly food crops and men mostly grow cash crops such as sugar cane and tea.

These crops are often grown together in a piece of land, a practice commonly known as mixed cropping. For example, beans are grown together with maize in one plot as this helps them maximize land use as women farmers only have access to mall portions of family land (often, less than two hectares). This limits them to small scale farming.

There are numerous reasons why women face constraints in terms of their access to land. This includes the patriarchal land ownership system and decisions on ownership of land which is dominated by men. The other is that agriculture is labour intensive, and women lack both human and financial capital to expand their agriculture activities. Further reasons include the dual burden that women fact as in terms of their productive and reproductive roles, both that include house chores as homemakers which limits the amount of time they can devote to agricultural tasks and bigger land areas. These factors coupled with individual deficiencies poverty, sickness, and inadequate agricultural skills mean that women are mainly involved in small-scale farming.

In Kakamega, most poor women who depend on land especially agriculture for their livelihood have limited access to land, and where they have access, they face insecure rights on the farmlands. Insecure rights ad land tenure is a consequence of land ownership and inheritance system based on unwritten customary law that is strongly anchored on tradition and the cultural norms in the area (customary tenure). The traditional cultural norms dictate that land tenure is patrilineal based on the patriarchal nature of the community, which implies that males in a lineage hold power over property inheritance and decisions on the land use. As such, women farmers have neither land nor the rights to use land and have to seek permission/rights to use land from their husbands or brothers. A participant reported:

> *The family land can be big, but we women have no say over it, we use what is a portioned to us by our husbands or brothers. Generally, in this area the man has authority and makes decisions on land use and inheritance. And since the men are mainly interested in sugarcane farming (cash crop) we are often given just a small piece for subsistence farming*[14].

Based on the excerpt above, men decide the size and quality of land assign to women. As such in terms of land ownership, women remain at the mercy of men and in most cases, they opt to give women the portion of land they do not use, which can be the most unproductive neglected areas or fertile areas as a result of fallowing. In cases where women access non-productive portions of land, women in their determination to practice farming have commonly improved whichever piece of land they access using farmyard manures since they rarely afford the formal fertilizers. While most women have access to small pieces of land, some women reported that their husbands lease out or sell the entire family plot money hence deny the women the chance to even access family land. Hence access to land by women is an issue in Kakamega and form part of the challenge that affect women's livelihoods apart from climate change. A participant reported:

> *We women find it very difficult accessing even a small piece of land for crop production, our men would rather lease land to someone doing sugarcane farming or even sell the land. Other men just use the entire land for sugarcane farming and never apportion even a small piece for food crops.*[15]

[14] Response from a young female FGD participant at Malava Sub County
[15]Response from a women representative in a key informant interview at Lurambi

The women who lack access to land provide farm labour to those who own bigger farms and to men who grow cash crops; as such they are able to earn some income to take care of their families and for household consumption. The women who have access to land tend to cultivate small plots, which are manageable in terms of farm inputs and even here, women often have to rely on family labour to help in land tilling, planting, weeding and harvesting the crops. This happens so because the women farmers in the area have limited access to financial capital and only a few can afford the labour requirements and inputs for a larger farm. A female respondent commented,

> *I opted for a one and a half hectare because my husband uses the other piece for sugarcane and also because I may not afford the labour to work on three acres, it requires much money which I don't have*[16].

Apart from limited access to natural and financial capital, women in Kakamega also lack time to manage larger farm with several farm operations since they have to perform other household chores like fetching water, firewood, taking care of the children as well as small-scale trading. Widows are even more affected by lack of time to manage family issues and farming at the same time since they have to do their roles and assume the husband's roles as well. A widow from Lurambi Sub County said:

Before my husband died, we used to plough the entire plot and only leave a small portion for cattle, but since my husband died, the scenario has since changed. I am now the father and the mother in this home, I have to take care of the children, fetch water, wash clothes and utensil and cook for children who are going to school. I also have to go to the market to look for food and to sell the grains. This leaves me with limited time to farm a bigger plot. I only farm two hectares that is enough for the family food[17].

At this point, a woman's reproductive labour affects her productive labour and vice versa. Since productive labour are often outside the domestic spheres as noted by Fajarwati, Tyas, Mei, Hasanati, & Meilyana, (2016) and (Wahaga, (2018). Women therefore have to spend more hours outside the home if they have to engage in productive work which is paid but limit their abilities to provide reproductive work. On the other hand, the provision of reproductive labour

[16] Response from a Key informant with a women group leader in Malava Sub County
[17] Response from an elderly widow in the women's FGD Lurambi Sub County

which is within the domestic setting also interferes with their involvement in income generating activities.

Productive and reproductive work is also reflected in the kind of crops men and women grow. Women who mostly have no land and prefer food crops have to compete with men who mainly prefer cash crops such as sugarcane and tea. For instance, sugarcane farming is mainly considered a male venture while food crops such as vegetables are considered female's crops. Since land access, allocation and rights are patrilineal, men prefer to allocate bigger portions of land for sugarcane because of the income it can generate, whereas women tend to grow crops that produce food for the family. This competition for food versus cash crops is often won by men who are major decision makers on land access and use. A Key informant interview with the crop production officer confirmed the preference men have for sugarcane farming thus:

> *Women find it difficult practicing large scale farming because men who own the land prefer to grow sugarcane, a cash crop that fetch them good money. In fact, you may go to a family and you find that all they have is a sugarcane farm that occupies the entire family plot. That means the woman is left with no option but provide off-farm services to earn a living*[18].

The last reason as to why some women in Kakamega are rarely involved in large scale crop production is because farm inputs for large scale crop production is capital intensive, and since they have limited access to financial capital, they are not able to procure fertilizer, human labour, mechanization and seeds required for large scale farming. A female FGD participant for instance reported:

> *Some women opt for small scale crop production since they lack the money to buy farm inputs such as fertilizer, seeds, and pesticides and to hire a tractor for land tillage. For small scale farming, one can just sell her chicken and pay for farm inputs*[19].

The implication of this is that women are not in a position to accumulate financial capital since their farming is reproductive involving the production of food for the family. This by extension makes them more vulnerable to climate change effects as financial capital is critical in mitigating climate change effects.

[18] Response from a male Key informant- county crop protection officer Lurambi sub county
[19] Response from a female mixed FGD participant Mumias west Sub County

6.3.2 Women and livestock production

Besides crops, livestock production plays an important function in the livelihoods of Kakamega residents as means of poverty alleviation. Although the livestock are mostly owned by men, women too practice livestock production, but tend to own small stock, such as birds (chicken, quills, doves, ducks and bat), sheep, pigs and goats, compared to men who own and control larger animals, such as cattle, and donkeys. The latter is considered as wealth, which is passed down or inherited by male siblings, through a patrilineal system where only men are culturally allowed to inherit livestock, as such; it is difficult for women to acquire livestock. In a key informant interview the officer stated:

> *In this area livestock mainly belong to men, it is men who decide on the use and sale of livestock, even the way families pass down wealth is such that the family wealth such as livestock is passed down to male members of the family. Livestock is considered very important for male because it is used by the male members of the family for dowry*[20].

Due to the patriarchal nature of the community, stringent norms guard ownership and disposal (inheritance, sale and buying) of big livestock. These norms dictate that a woman cannot make decisions to buy or sell a cow, even if the cow belongs to her. Furthermore, when a woman wants to buy a cow, she has to use a male family member to transact the sale on her behalf and the same applies if she wants to sell the cow even if it belongs to her. Women are also prohibited from bringing the cattle home on her own; in fact, this is considered a taboo for a woman and must solicit a male family member to help her. The consequence is that few women can own, buy and sell cattle. In an FGD with female farmers, an informant stated:

> *Here, few women own cows because it is very difficult for women to acquire cattle; this is because traditionally cattle are inherited by the male members of the family. And even if a woman has the money to buy a cow, she has to do so through a man. At the same time, she cannot even bring the cow home by herself; the man has to do that. During sales, the same measures are put that a woman cannot take a cow to the market, in fact no one would buy a cow from a female, so again you have to use a man to sell, so we find it easy with small animals like poultry, sheep and goats which we don't have to consult the men to purchase or sell*[21].

[20] Response from a male Key informant interview with the livestock production officer, Kakamrga county
[21] Response from a middle-aged female farmer in women's FGD Mumias West Sub county

As stated in the excerpt above, women` find it easier to acquire and dispose small animals during climate shocks, as larger animals have cultural limitations. In addition, the cost of acquiring the big animals is relatively high that women rarely afford given their relatively low access to financial capital as compared to their male counterparts. The table below shows the ownership of different types of livestock and gendered nature of this in Kakamega County. As reflected in the table, stocks of high value animals that require higher investment are culturally reserved for men, while the low valued and low investment livestock are those of women. The cultural value placed upon the stock also affects the gender differentiated ownership of livestock.

Table 8: Gender differentiated livestock ownership in Kakamega

Livestock	**Ownership**	**Decision to buy and sell**	**Reason**
Cattle	Men	Men	Patrilineal inheritance, bride wealth payment by men, and other cultural norms
Donkey	Men	Men	Cultural norms and the value of the stock
Local Poultry	Women	Women	Culturally considered women's, easy to acquire and fetches little money when disposed
Goats	Men and women	Men and women	Ease to acquire, low value, and ownership depends on family arrangement
Sheep	Men and women	Men and women	Ease to acquire, low value, and ownership depends on family arrangement
Pigs	Men	Men	Highly valued, fetches much cash and multiplies fast

Source: Notes from FGD discussions with community members

6.3.3 Women in small businesses/agribusiness

Women's livelihoods in Kakamega are quite diversified. Although some women practice small scale subsistence agriculture, they also run small businesses in the village markets and sell their local foodstuffs produced on their farms in the village centre in areas such as Brutal, Leboa, and Malava. Typically, women dominate the foodstuff markets and from my observation on a market day at Leboa (a trading centre within Malava constituency), the food Kiosk was female dominated while the livestock market male dominated which confirmed the gender differentiated ownership of food and livestock. Typically, women sold chicken in the food Kiosks while men sold cows, goats, sheep and pigs. Fresh food produce, like local vegetables and fruits including, bananas, yams, pumpkins, sweet potatoes and grains including sorghum, millets, maize, beans, peace, and soya beans at Leboa and Brutal markets were sold by women. Other commodities sold by the women include Napier grass to livestock farmers. These sales provided an income for women to meet other family obligations. A woman in an FGD in Lugari Sub County reported that:

> *We women mostly do not just survive on farming; we also sell foodstuff and clothes in the market. We get foodstuffs from the farm and take to the local market, some women also buy foodstuffs from neighbours within the village to sell in the market during market days, and this helps us to earn some income to support our families*[22].

However, women do not only trade in livestock and other agricultural goods. Other livelihood sources for rural women include handcraft, brickmaking, charcoal burning, casual and formal employment. Women doing handcraft make sisal ropes, baskets from reeds, chairs from wood and pots from clay and others thatch houses for people within the community at a cost. The handcrafts are sold at the village market to generate income for rural families and help them cope with livelihood shocks. Women also do brick making with the help of family labour, this is usually done during mean periods to help provide cash for family expenditure. Otherwise on normal day to day operations, brick making is considered men's venture that they do as a source of livelihood. The bricks have ready market in the upcoming Kakamega town and fetches good cash for men such.

Women in Kakamega also earn income through sale of labour; to earn some income; women often do farm operations such as planting, weeding, ploughing and harvesting at a cost to earn

[22] Response from a female in a mixed FGD in Lugari Sub County

some income. Other than farm operations, women also provide household services such as laundry, cleaning and childcare. This is so since most women lack tertiary education that can help them secure formal jobs, as such, only few can secure formal jobs though their chances of securing formal sector employment are significantly low since they dwell in rural settings where formal employment opportunities are limited. Therefore, most women have to rely on agriculture and small-scale agribusiness that are pendent on natural resources and require little capital investment. A female participant in a FGD explained the situation aptly:

> *We as women have very limited choices in terms of livelihoods, because most women drop out of school in primary or secondary, we have limited livelihood choices since we can hardly secure formal employment with the low levels of education. We therefore have no option but to provide casual labour or depend on the available natural resources for livelihoods*[23].

Limited choices to live opportunities for women can be attributed to patriarchy and Socio-cultural in form of societal norms, beliefs and practices that hinder females from participation in education. Women's roles are culturally viewed as housekeeping and childbearing. These roles may not necessarily require a woman to attain formal education. In addition, in congruence with Alabi, (2014)patriarchy ensures that girl-children are often neglected and rejected immediately before or after birth and these are manifested in the negative cultural attitude towards female education, the dowry system that allows women to be exchanged for property or livestock, the control that men have over women's lives and decisions, male privilege in terms of education, female time constraints, and women's lack of self-esteem. These factors and the responsibilities placed on females at an early age prevent limit their access to education and subsequent livelihood opportunities. Despite limited livelihood sources through patriarchal nature of the society, women try as much as possible to diversify their livelihoods as much as possible and are as such able to mitigate climate change effects.

6.4 General effects of climate change in Kakamega County

As discussed, climate change in Kakamega in terms of heavy downpours, changing rain patterns, increased incidences of hail stones, increased temperatures and increased drought are

[23] Excerpt from a middle aged female participant in a female FGD at Lurambi Sub County

becoming more frequent. Heavy downpours typically occur in the months of April and May and sometimes December in Kakamega and are associated with flooding of rivers, soil erosion, destruction of infrastructure such as bridges and houses, leaching of soil nutrients, stagnation of water and associated water borne diseases. During heavy downpours, the runoffs and streams accumulate and empty the waters into the rivers, which in turn overflow and wash crops planted along the riverbanks. This kind of erosion affected newly planted crops the worse and when they are washed away farmers have little or nothing to depend to survive. A widow farmer in an FGD in Lugari constituency reported:

> *For me, the heavy down pour has really affected my life, you know here most people do farming along the plains next to the river, and the entire area I farm is usually washed by the river during heavy down pour. I have been affected in the last three years and have not had any harvest from my farm*[24].

Apart from riverine erosion, floods caused by heavy downpours also severely wash away the topsoil, due to runoffs from the hills; such often leave the land bare and unproductive. When this occurs, food production decreases increasing food scarcity and insecurity. Under such situations, women are severely affected since they are required to still provide food for their families. Under such circumstances they have to obtain food through alternative sources of livelihoods such as offering paid farm labour to those on the hillside. Providing household services at a cost and borrowing from friends, relatives and women groups. Informal employment though is used for coping is subject to availability and often means that women have to travel long distances to work and such interferes with their domestic roles. In addition, women are often exploited being paid less for more work since such opportunities lack clear working terms, but since women are desperate, they often opt for such for lack of a better alternative.

Another side effect of heavy downpours is the stagnation of water in the planting and grazing fields. This causes crops to wilt since it affects aeration in the soil, especially where no intervention measures were put in place. In Malava a female farmer's group chairlady reported.

> *These days unlike in the past, when the rain come in April, it usually rains so heavily and as such there occur floods everywhere even in the farms. These floods usually cause the crops to wilt or at times cause retarded growth which leads to complete loss of*

[24] Excerpt from middle aged widow farmer in an FGD in Lugari constituency

> *harvest. During such periods when there is no harvest in the entire area, we have to buy food from far and those with no ability will resort to other negative behaviour like stealing from the houses and farms which is very common during lean seasons*[25].

Another effect is on soil quality. Heavy downpours leach the soil of nutrients and minerals needed to sustain crop life and good yields. In Kakamega, this has meant that farmers need to use more fertilizers to enhance food production, which comes with increased production cost that may not be affordable to the rural poor. Women in the study reported having to use fertilizers in order to realize proper yield, this was also reported in the key informant interviews. An interview with crop production officer revealed:

The soils in Kakamega have generally lost soil minerals and nutrients due to the heavy downpour we experience. When the main rainy seasons come, we often experience a lot of rains at ago, this leads to leaching of minerals and as a result, today the entire people have to use fertilizers to have any meaningful yield. This has made farming expensive for the rural poor who were used to planting without fertilizers[26].

Stagnant water within the environment is not only a threat to crop production but it is as well a health hazard to both human and livestock. Stagnant water usually provides favourable breeding sites to mosquitoes which act as a vector to both malaria and rift valley fever. Participants reported that during extremely wet periods, malaria is usually high, which poses a threat especially to pregnant women and children under five years of age. Malaria however does not only affect women and children but also affects the men. When men and women are affected by malaria during April-May when labour requirements on farms are in high demand, it affects production through illness and sometimes loss of life. A social development officer reported:

> *Kakamega is a malaria endemic zone and during wet seasons especially during the months of April and May, so many people suffer from Malaria. This reduces the labour force that is supposed to work on farms. In addition, malaria related deaths also go up*[27].

[25] Excerpt from a key informant -female farmer and women group chairlady in Malava Sub County
[26] Excerpt from a Key informant interview crop production officer Lurambi Kakamega county.
[27] Excerpt with a male social development officer at Malava sub county

Heavy downpour in the area are not only associated with Malaria but other diseases such as bilharzia and cholera. While bilharzia is associated with stagnant waters, cholera occurs when due to floods; dirty water mixes with clean drinking water and spread the bacteria from faecal matter into drinking water or water for domestic use, as noted by (Cowman et al., 2017). In Kenya, Kakamega inclusive, cholera outbreaks are often experienced at the onset of rains after droughts and were witnessed in the years 1997-1999, 2007-2010, 2013, 2015 and 2019 (Cowman et al., 2017; Relief web, 2019).These diseases affect the livelihoods of both men and women in Kakamega as they claim resources that would otherwise be used to provide livelihood support and strategies. In addition they lead to unexpected deaths of men and women as has always been witnessed in Kenya (Cowman et al., 2017). Most women are affected when they lose their husbands and remain widows; having to be the family breadwinner and take up the husbands' roles. These diseases also overburden women compared to men since they have to take care of the sick and abandon their household chores and livelihood activities such as farming.

Heavy downpours and water stagnation do not only affect crops production and human health but also has myriad effects on livestock production. First, Rift Valley Fever a common livestock disease in Kenya is associated with above-normal precipitation, in fact In Eastern Africa, RVF outbreaks are often associated with El Nino while in other parts of Africa, RVF outbreaks have been shown to occur after extreme precipitation events(Christopher Paul, Erika Weinthal, Marc Bellemare, 2016). Another livestock disease associated with flooding is leptospirosis and foot rot. These diseases causes tremendous socio-economic impacts on rural livelihoods due to livestock morbidity and mortality(Christopher Paul, Erika Weinthal, Marc Bellemare, 2016).Livestock in Kakamega County are mainly affected by these two main livestock diseases, with foot and mouth rot affecting the small animals such as sheep and goats and rift valley fever for cattle. During a key informant interview, a veterinary officer reported.

> *Here we don't have large herds of livestock due to limited land, but we usually loose even the little we have to two main reasons: rift valley fever and foot and mouth rot. These diseases only occur during the rainy seasons and are associated with stagnant water and affect the production of both milk and meat as well as livestock death*[28].

[28] Excerpt from a key informant interview with male Veterinary officer Lurambi sub county Kakamega County

Livestock diseases do not only lead to livestock death but are also associated with suppressed feed intake in livestock; reduced milk production, hampered reproductive performance, and reduced immunity(Bett et al., 2016). These hamper the production of livestock products and reduce the farmer's income. The farmer also has to use extra resources in treatment and care. While livestock diseases affect both men and women, women suffer more as they rarely recover from loss of livestock to climate related diseases.

Apart from heavy downpours, sporadic rain pattern have a huge impact on farmers in Kakamega(CIAT-International Centre for Tropical Agriculture, 2018). The women farmers spoke of how unpredictable rain patterns make them unable to predict when to plant to have a good harvest. Normally planting takes place in February, but with the rains being persistently late and unpredictable farmers mostly plant in the months of March and April. Late planting negatively affects crop production since in most cases the rainy season ends before the crops mature leading to reduced yields or complete loss of crops. Unpredictable rainy seasons have also led to loss of seeds since when farmers plant seeds anticipating the rains, the rains fail and seeds fail to germinate. The farmers therefore have to incur extra costs in buying seeds, planting and providing labour. Such highly affects women who have limited financial capital and are not able to repurchase seeds. A female respondent from life history narrates:

> *Since we women farmers mostly rely on rain-fed agriculture, we are often affected by rain patterns, when the planting rains delay, the period is affected, since you will find that in February some rain comes, and we plant anticipating rain then it stays until March so that those who planted earlier waste the seeds. That is what happened to me so that I had to buy seeds to plant again*[29].

Sporadic and late rains result in crop losses, extra expenditure on seeds and/ or low yields if the crops survive. At other times, the long rainy seasons exchange and come during short rainy seasons for example sometimes long rains are experienced in October to December. These confuse the farmers since they plant the long rains crops during short rains and short rain crops during long rains. In a key interview with a female representative from metrological department in Kakamega, she revealed:

[29] Excerpt from a middle-aged female from Lubao in a life history

> *We have witnessed that sometimes the long rains shift from April, May, and June to between October, November and December. This is what happened in the year 2017, the seasons shifted, and the farmers got more confused*[30].

These changes in rainy seasons confuse farmers in terms of planting, as seeds may fail to germinate, farmers may plant wrong crops, farmers may have to replant, or farmers may experience complete loss of crops. Since the livelihoods of rural men and women are almost entirely dependent on crops, the farmers suffer from the impacts of such shocks since production is curtailed, food availability becomes a problem and families risk starving.

6.4.1 Effects of climate change on the livelihoods of women farmers

Empirical studies show that climate change and related shocks effect women more than men (Carr, Fleming, & Kalala, 2015; Goh, 2012; Harcourt, 2017; Nellemann, Verma, & Hislop, 2011) due to their productive and reproductive roles. The ability to cope with or respond to climate related challenges depends on the asset bases individuals have. Climate change does not only affect agricultural productivity and food security, but affects health, workload, family/ social relationships, income of women farmers among others.

In Kakamega, just like other counties in Kenya, women play key roles in food crop production as owners and producers of food crops; during droughts, women spend more time looking for food for household consumption due to reduced or failed crops, meaning that they have to purchase food which is normally higher during such periods. This is difficult, since rural farmers have limited, and availability of cash depends on the sale of their produce. Added to this, during periods of prolonged drought, men leave to look for jobs in the urban are to earn money. In such situations they often opt to sell their sugarcane plantation before maturity or lease out their farms to support the family. Women in the process can lose access to land and have to seek employment or resort to off farm income generating activities such as small businesses and casual labour including washing clothes to the better off families and taking up odd jobs. When women take up jobs outside the family, they end up spending more time and energy on jobs that are exploitative. A women representative in a key informant interview reported:

[30] Excerpt from metrological department in Kakamega

> *During extremely dry periods, we women can do anything to get money for the family. Some women offer household/ domestic labour to better families for as low as Kshs 100 per day and most of them struggle to access such jobs because that could be the only way to survive*[31].

Having to work long hours for little money and far away from their homes means that they spend less time on their domestic roles such as taking care of the children, cooking in time, and handling other family duties. The inability to handle family/ household chores due to leaving early and coming back late at night is reported to have aggravated gender-based violence (GBV). In a focus group discussion, a female participant reported:

> *During drought we as women have so many duties, we look for income generating activities far away from home and at times we have to get basic household needs such as water from far yet during that time most women are beaten by their husbands and sent away because their husbands feel that they have not performed their roles. Such incidences are very common during dry periods/ scarcity*[32].

Gender based violence is reported to be common in Kakamega during periods of food scarcity, (Senay Habtezion, 2013), causing conflicts over access to resources (Goh, 2012), household tasks (Nellemann et al., 2011) and due to them coming home at late hours which exposes them to violence(Leduc et al., 2008).

Apart from exploitation and gender-based violence, women are often forced to sell their household belongings to feed their families during drought-stricken periods when they can never get food from the farm. Since most rural women lack cash, they pawn or sell their property such as kitchenware, poultry or any asset that belongs to them. The act of disposing assets can only help women to cope with short term effects of drought since in most cases women are left poorer and vulnerable to the ravaging effects of prolonged shocks. It therefore means that when shocks are prolonged, women suffer more as reported by Johnson, Kovarik, Meinzen-Dick, Njuki, & Quisumbing, (2016).In a key informant interview with a female representative from Kenya Women Finance Trust (KWFT)–reported:

[31] Excerpt from female Women representative in a key informant interview Kakamega town Lurambi Sub county
[32] Excerpt from females focus group discussion in Matungu sub county

> *Most women around dispose or pawn to people the assets they have gained over time at a cheaper price as the only option to survive and that are how most women lose the hard-gained assets, they have acquired over time*[33].

Another factor that aggravates the effects of climate change on women is differential access to land as a factor of production. The amount of land one can access or one owns can exacerbate the effects of climate change. Since women have comparatively limited access to farmland as compared to men, these small pieces once affected by climate related shocks take long to recover. Typically, women lack alternative land to move to, unlike men who sometimes own bigger portions and are able to move to better places. If men are affected by floods for instance, they are able to move to the higher grounds since they own bigger, which makes the effects of climate change more pronounced on women than men. A key informant with the county disaster management officer revealed:

> *Men generally own bigger tracks of land compared to the women and make decisions on land, when climate related shocks occur, they can easily move to another location where he will not be affected. Even if he has no land in a better place, he can easily ask his or her brothers and get a better place for himself*[34].

Women unlike men during disaster may not be able to move to better parts due to their limited access to land, in addition, while men can decide to sell or lease part of the land to access cash to cushion themselves from the effects of climate change, women lack such opportunities. This makes land an important natural asset that can help cushion vulnerable communities during climate related shocks (Awojobi, 2017).

Climate related shocks affect not only food production and availability, but consumption. Food scarcity subsequently affects food intake because during food scarcity, women feed the children first or may skip meals for the sake of their families Such behaviour affects women's health negatively since they become weaker and malnourished(Bizimana et al., 2016; Goh, 2012). For lactating women, such periods are more dangerous as the baby suckles from an under-nourished and starving mother, further draining her energy. A female FGD participant in Malava said:

[33] key informant interview with a female representative from Kenya Women Finance Trust (KWFT)
[34] A key informant with the county disaster management officer

> *Here since it is the role of women to feed the family, most women reduce their food consumption during food scarcity and some skip meals to spare food for the children. This affects the health of mothers especially lactating or expecting women who need special dietary requirements*[35].

Women in Kakamega also experience the effects of climate change on their health. Carrying heavy loads especially water over long periods of time as already mentioned above cause cumulative health damage to the spine, the neck muscles and the lower back, thus leading to early ageing among women.

In addition, the health implications of water borne diseases already discussed are magnified on women since they mostly interact with the water sources when fetching water for household use which is their gender role in fact, expectant women are more vulnerable to the effects of climate change on health since they are twice as "appealing" as non-pregnant women to malaria-carrying mosquitoes; the same is the case with children under the age of five years who easily contract malaria. A women representative for Kakamega County said:

> *Climate change highly affects women than men like when you go to the hospital, you will find that more women have been hospitalized because of Malaria, this is because women play roles that expose them to malaria and expecting women are more susceptible to malaria*[36].

Most women due to their low socio-economic status are often unable to cope with the effects of climate change on their livelihoods, they are in a comparatively risk of being affected by anxiety and psychological disorders after disasters. In Kakamega, women reported that they suffer psychological torture thinking how to cope with the effects of climate change on their livelihoods. In a FGD a participant asserted:

> *In some cases, the effects changes in weather and climate hit so hard that we even become psychologically impaired especially when you think of the children going without food and you have no means*[37].

[35] A female FGD participant in Malava
[36] A women representative for Kakamega County
[37] Excerpt from a female FGD participant in Lugari Sub county

In conclusion, women in Kakamega comparatively face greater challenges due to the effects of climate change as a result of their socio- economic status, and their gender differential access to forms of capital necessary for them to cope. This includes their limited access to resources such as land, education, financial services, information and development services (Agarwal, 2010; Nellemann et al., 2011). Finally, the Socio cultural hurdles such as gender roles, lack of decision making powers, low levels of education and inadequate access to different forms of capitals constrain women from responding to climatic risk in time and effectively (IPCC, 2007b; Ongoro & Ogara, 2011). But, women in Kakamega are not just victims of effects of climate change but have revised ways to cope with the effects of climate on their livelihoods.

6.5 How women cope with the effects of climate change on their livelihoods

How women respond depends on their access to different forms of capital (Goh, 2012; Nellemann et al., 2011; Park, 2017). Despite the limitations in terms of asset accumulations, women in Kakamega use different assets to respond to climate. Understanding how they use various capitals and related assets is key to understanding their coping strategies. The different forms of assets used by women in Kakamega to cope with the effects of climate change include assets linked to natural, human, physical, financial and social capitals.

Natural capital in the form of land, forests, rivers and biodiversity are not easily accessed by women (Cleveland et al., 2014), but in terms of crops, one sees how they have shifted to planting more drought resistant crops such as sorghum and cassava. These plants are known to endure and can overcome the effects of climate change, unlike maize. There is also a greater investment in short term crops that may not require long rains, such as sweet potatoes. A woman farmer said:

> *When we predict a less rains or a prolonged dry period, we decide to plant drought resistant crops such as cassava and some variety of sorghum (the red one), these are able to do well even during the short rains and can also overcome mild droughts*[38].

Another method that has been used to cope with the effects of climate change on women's livelihoods is crop diversification. Although the Kakamega area is known for maize

[38] Excerpt from A WOMAN FARMER in a mixed FGD Matungu sub county

production, women have become more diversified and have started to plant crops such as beans, sweet potatoes, wild vegetables, cow peas, tomatoes, pineapple and other horticultural crops Diversification helps since not all crops are affected by climate change at the same time and means that at least there is some source of nutritious food. Crop diversification has been used by several communities in Kenya to cope with the effects of climate change on rural farmer's livelihoods. In a key informant interview the crop production officer reported:

> *What has helped women cope so much with the effects of climate change in this area is that they are able to diversify crops; they plant several varieties of crops unlike men who only do sugarcane. You will find that for women, when beans fail, they have maize, if maize doesn't do well, they have cow peace, cassava, yams, sweet potatoes local wild vegetables, watermelon, pineapple among many other crops and so they always have options*[39].

Women also depend on wild fruits and vegetables derived from the natural environment such as guavas, which are quite resilient to dry spells. However, like cultivated crops these fruits and wild vegetables are soon depleted. Some women in Kakamega opt to fetch and sell in the nearby centre and construction sites. In key informant interview, the chief from Lubao reported:

> *Some women resort to selling water in fact women wake up as early as 4:00 am to look for water so that they can sell and get money. However, it is not the best strategy because it is dangerous for them to walk outside at that time*[40].

Although fetching water for sale can generate an income, it is very labour intensive and can result into spinal code complications and early aging. In addition, fetching water and firewood often exposes women to insecure environments where they are exposed to forms of GBV.

Other forms methods of coping from natural capital include charcoal burning, deforestation for firewood, and brick making. However, these activities have a hugely detrimental effect on the environment as trees are cut down for both charcoal and fuel. This is sold on the markets in the nearby urban centres such as Malava, Chavakali and Kakamega as explained by a female participant:

[39] crop production officer
[40] Excerpt from a key informant - the chief from Lubao –Malava sub county

> *When life becomes very difficult and I have no food, I just get to the forest and cut some wood, dry them and take to the market. Another option is to burn charcoal and sell in the nearby centre to get cash*[41].

Coping mechanisms that involve cutting trees is a negative coping strategy since they are essential for carbon sink, and the reduction of climate change effects. Cutting down of trees also increase of the effects of climate change due to droughts and flooding as they reduce water catchment and interfere with rain patterns. In addition, when the trees are not replenished, the soils remain bare and subject to soil erosion as well as windstorms. Apart from dependence on forests, some women though a small portion, practice brick making. Brick making is also a negative coping strategy since clearing the land and tilling the soil leaves behind bare land and holes that develop into gulley as a result of erosion. Brick making is also very labour intensive and hard work.

Human capital

Human capital is an embodied form of capital that entail skills, education, labour/manpower (Tapati et al., 2015) and is instrumental in coping with the effects of climate change on livelihoods Rural women farmers in Kakamega most cases lack access to technical skills on climate change since most of them have attained no professional training on agriculture, lack access or have limited access to climate information and agricultural extension workers rarely reach them. Women therefore cope by using indigenous knowledge to predict weather and climate patterns that enables them to make a choice of crops to plant for a given period. Indigenous knowledge has meant that they tend to preserve indigenous seeds and grains for future use without being destroyed by the crop pests and diseases. Women in Kakamega also apply their indigenous knowledge to make natural pesticides and herbicides to control climate induced pests and diseases. In an interview with a representative from one acre's fund, a male key informant reported:

[41]Excerpt from a female FGD participant from Lugari Sub County

> *Women farmers mostly rely on their indigenous knowledge to predict weather patterns, to know the crop to plant. Some women use ash as pesticides and are able to make herbicides from plants. Such knowledge is only learnt by experience*[42].

Women in addition to human capital rely on financial capital to cope with the effects of climate change on their livelihoods. Women access micro-financial institutions within the area. The two most common that help advance loans are K-REP bank and Kenya Women finance trust. From these two institutions, women go for unsecured small loans that they pay back later with a small interest when they get cash. These institutions offer financial services to women so that they are able to use money constructively and provide saving schemes to provide reserves when necessary. A participant in an FGD in Malava reported.

> *I have always survived through loans from K-REP bank, they have known me over a long period of time, and they give me loans during scarcity which I always refund with some interest when I get produce from the farm*[43].

These micro financial institutions are of help to rural women in Kakamega since the loans they provide prevent women from disposing off their assets. Women are therefore able to leverage the effects of climate change and maintain their asset base despite the prevailing adverse climate changes. Another form of financial capital that women rely on is diversification of livelihoods especially to poultry farming. Poultry especially chicken and duck have increased as a result of climate change in Kakamega County (Mulinya, 2017). In life history, female farmer narrated how chicken production has helped her to cope with the effects of climate change:

> *I started with five chicks and now I have 90 local breeds, during dry periods when food is limited, I just sell one chicken and am able to buy sugar, cooking oil, cooking floor salt and another thing that I need for household consumption*[44].

Apart from sale for income generation during lean periods, the study participants also reported that chicken is used for asset accumulation since they fetch a lot of money during December festivities, some women keep their chickens up to December when they dispose of them at double the price. By this women get to earn a good amount of cash at once that helps them to

[42] Except from male key informant metrological department Kakamega
[43]Excerpt from females FGD Malava Sub county
[44] Excerpt from life history account of an elderly woman in Mumias west sub county

acquire other assets that require large sums of money to acquire such as household utilities and equipment, motorcycles for local transport and some have even purchased or rented land with the proceeds from chickens. A female FGD participant reported:

> *I bought one-acre piece of land that I farm from my neighbour using money from chicken farming. I earned 70 thousand Kenyan shillings in December 2010 when I sold all my chicken except chicks and used the whole amount to purchase the land. This land has since helped me to plant different crops for household use*[45].

Poultry plays a key role in addressing food insecurity and malnutrition in rural households as a source of protein. Since chicken eggs are a rich source of protein, the women in Kakamega have a source of protein that can reduce malnutrition which is quite common in the rural areas.

According to the livestock production officer, women mainly depend on chicken because it requires little capital investment but has a high return, in addition. As such, chicken farming is encouraged culturally as a female source of livelihoods. The men also encourage the women to rear chicken because it is a special meal to welcome visitors. An excerpt from the livestock production officer, he said:

> *You know chicken is a delicacy in this area, when one has a visitor, the special meal for welcoming visitors here is chicken, in addition, you will find that the men perceive chicken as a woman's livestock and are happy when a woman slaughter chicken because they know that certain special parts – the gizzard (imondo) is preserved for them*[46].

Poultry is also used to strengthen social ties among the Luhyas of Kakamega. When one has a big flock of chicken, the chickens are given either to a neighbour, friend or family members to keep after which the chicks are divided between the owner and the person given. This practice enables those who do not have chicken to acquire them and also strengthens social ties in the community. The people who give out chickens become socially bound with the families they give the chicken to as such they are able to share other family resources during scarcity.

Another important capital is social capital Social capital refers to the network of relationships that an individual has in a social system based on social organizations such as trust, norms and

[45] Excerpt from a female FGD participant from Lugari sub county
[46]Excerpt from a male key informant - livestock production officer

networks that can improve the efficiency of society by facilitating coordinated actions (Whiteley, 2015).In Kakamega County, communities and families exhibit a lot of trust and are able to lend and borrow from each other during scarcity. During hunger, families borrow from relatives based on the family bonds. This form of capital is known as bonding capital and is widely used in the rural village setting where families lend and borrow grains, maize flour, chicken and even small amounts of money. This form of capital helps to cushion vulnerable families as they are able to share resources with other members of the community. In an FGD a male informant said:

> *Here we live as a community; we lend and borrow from each other when we lack and that has helped us overcome climate related challenges. We cannot let anyone suffer when we can help. When I have no salt or food, I can simply borrow*[47].

Social networks also extend to communal institutions such as women groups and churches. Kakamega County, almost every woman belongs to a women group. The social groups are either called Self Help Groups or women groups which typically help women to secure loans, build trust, access training services and also link women to formal institutions that they can rarely access individually. The women are able to save with the group when they have surplus income and borrow during scarcity. These groups also provide social support to women during tragedies and a climate related disaster. Apart from social support, the groups give financial support and help members start small business venture. The groups therefore enable women to be able to accumulate different forms of capital and diversify their livelihoods and become resilient to the effects of climate change. In a narrative with female farmers in Lubao, she reported:

> *As women we have survived on groups…I belong to Amani women group. The groups have helped me to access loan as a member during scarcity, it has uplifted me financially, provided me with different forms of trainings, and has often linked us to other farmers organizations and has been very instrumental in providing us with support during calamity*[48].

Churches, especially friends from church provide support during calamity and support the destitute. While members to a church pull resources together in form of offerings, the resources

[47] Excerpt from a male informant in a male FGD Matungu Sub county
[48] Excerpt from a life history narrative with female farmer in Lubao Malava Sub County

are redistributed to the poor and needy in form of basic services especially during dry seasons or during hunger. The church also provides psychosocial support to members. Friends church also acts as a source of information to farmers since critical announcements in the community are made through the church. In addition, members of the church who are of different social class find a linking point in church where they help support each other in several ways. In a key informant interview with a religious leader, he reported:

> *This church called friends church is a real friend to the community, we are not only church members but also friends, we support one another socially, spiritually and financially and when anyone becomes sick, we visit them and also provide basic needs to the destitute*[49].

The effect of social capital and how it increases resilience is narrated in the life history of Mary interviewed in this study. Mary is head of the household of four, and a widow who lost her husband in the year 1998 in floods that swept him cross the Shatala River She is a farmer and grows bananas, vegetables, maize and beans in her one hectare piece of land, rears chickens and goats and also runs a small-scale business where she sells food items including fish in the local market.

Mary has suffered a number of setbacks when she became sick and when the drought resulted in her losing her crops, cattle and her business. She was however able to claim back her livelihood through the support by an NGO-One Acre Fund, that has trained her in modern farming methods and provided her with farming implements, seeds and fertilizers. Mary has grown her financial capital through K-rep Bank where she gets loans for school fees and to purchase more farm inputs. Mary is also a member of Amani women group which gave her social and financial support.

What this shows is the importance of bridging and linking capital. Resilience is concerned with individual or collective capacity of a community or neighbourhood to deal with shocks and stressors and resume to normal daily life through cooperation following shock(Delta & Green, 2014). Studies shown that where communities work together or with external organizations and government, they are in a better position to recover from the effects of climate change on livelihoods (Bazylevych& Kupalova, 2014).

[49] Except from a key informant interview with male a religious leader- Lugari Sub County

In terms of resilience and social capital, bonding capital in the form of ties with neighbours and relatives are usually the first to assist, depending on whether these family and communal social networks are still functional. Families lend or contribute food to their stricken relative. Bridging social capital stems from community-based groups, farmer's groups, community networks, credit groups, savings and credit societies, and cooperatives provide strong financial and social backing that enhances adaptation through resilience building. These often help women to link up with government and other institutions for support. For example, the Kenya Women Finance Trust, K-REP bank and one-acre fund improves the access of women to economic, social and agricultural extension services. These organizations also link farmer's communities to government institutions. At institutional level, (linking capital), the county government through the department of social services provides shelter and basic need programmes that support the poor and destitute. This program has ensured that poor old women are provided with decent housing that can protect them from heavy rains. Such destitute old women are also provided with foodstuff beddings and small stipend to enhance their livelihoods during climate related shocks. In an interview with the county social development officer, the female SDO said:

> *To help improve the condition of the rural poor farmers, we provide several services; the most captivating is the shelter programme that provides support to poor rural widows whose houses are either destroyed by floods or winds. The widows are provided with shelter, beddings, food and seeds*[50].

Apart from the shelter programme, the county provides fertilizers at subsidized rate to farmers and has employed agricultural extension officers to provide technical support to women farmers. The challenge is that the extension workers are few and cannot reach every farmer. In addition to interventions by county government, linking social capital has is also provided by the national government through provision of three main cash transfers programmes targeting poor and vulnerable members of the community of which majority are women. These include cash transfer for orphans and vulnerable children (CT-OVC), the cash transfer for persons with severe disability (PWSD) and the older persons cash transfer (OPCT). These forms of cash transfer focused to cushioning the poor and vulnerable in the society has been very crucial in Kakamega County.

[50] Excerpt from a female sub county social development in Lurambi sub county Kakamega county

Most widows benefit from the CT-OVC programme that provides regular prompt cash to a tune of Kshs. 4000 to households with orphans biannually and has helped them to acquire livestock, buy basic needs and ensure that the orphans are cushioned from the effects of climate change on their livelihoods. The widows who live with orphans have also been able to buy farm inputs and cushion their lives from climate related shocks. In a narrative with one of the beneficiaries of CT-OVC, she said.

> *The government has helped us by providing us with 4000 Kshs bi-monthly, this money has not only helped me to take care of the orphans but has really supported my livelihood, I now have chicken and goats that I bought from that money and through that I have diversified my life.*

6.6 Conclusions

In conclusion, climate change in Kakamega is a reality and has been observed in terms of changes in temperature, precipitations and variability in weather patterns. These changes come with prolonged dry periods and increased down pours of rain associated with floods. The effects of these changes are widespread and are felt on crop and livestock production as well as human life. While these effects are homogeneous on all populations, in Kakamega it is worth noting that the effects of climate change have a heavier toll on women compared to men.

The findings show that the effects are aggravated on women because women have limited access to forms of capital/ assets such as land, education, financial services, information, and development services necessary for coping compared to men hence limited adaptive capacities. The limited access to assets limit women from capturing livelihood opportunities to diversify their livelihood options and reduce overdependence on already depleted natural resources (Agarwal, 2010; Nellemann et al., 2011)

Women in Kakamega over rely on natural resources for their livelihoods, but these natural resources are quite sensitive to climatic change effects and execrate the vulnerability of women to the effects of climate shocks than men (Awojobi, 2017; Giannini et al., 2013; Nelson & T. Stathers, 2009; J. Parry et al., 2012) and women are tied by sociocultural hurdles manifested in terms of gendered roles, patriarchy, communal power dynamics and different social that

constrain women from responding to climatic risk in time and effectively (IPCC, 2007b; Ongoro & Ogara, 2011).

However, women in Kakamega are not mere victims of climate change but have also devised ways to cope with such effects of climate on their livelihoods. Such coping mechanisms are dependent on the different forms of capital women can access, including natural, human, financial, physical and social capital and the various assets associated with this. By accessing these various forms of capital in diverse ways, women are able to cushion their livelihoods and adapt different forms of social capital.

CHAPTER SEVEN

DISCUSSIONS AND CONCLUSION

7.1 Introduction

This study set out to interrogate: the extent to which climate change affects the livelihoods of rural women farmers in Kakamega County in Kenya; the types of assets women farmers draw on to mitigate the effects on their livelihoods; how gender and intersectional issues affect adaptation to climate change among women farmers; and how women adapt and build resilience to the effects of climate change on their livelihoods. The chapter starts by discussing the aspects of climate change experienced in Kakamega and how these aspects affect the livelihoods of farmers. It then looks at the asset's women use to mitigate the effects of climate change, and how gender roles and norms affect access to assets and adaptation to climate change. Finally, the chapter investigates adaptation and resilience building strategies adopted by women farmers amidst climate-related shocks and conclude by giving recommendations and proposing areas for future study.

7.2 Aspects of climate change in Kakamega County in Kenya

Kenya is ranked 151stout of 181 countries in the ND-GAIN vulnerability index3 (2017), indicating that it is the 31stmost vulnerable country and 37thleast prepared to cope with climate change and its effects. The effects on the country vary given the diverse climatic conditions. In the northeast parts of the country, Kenya exhibits a tropical climate with hot and humid coastal areas, and temperate inland with extremely dry conditions in the north (Schmidt et al., 2017). A large portion of the country is arid or semi-arid, with a varied rainfall distribution across the country, with 80% of the country receiving less than 700 mm of rainfall annually, with the northwest and east receiving as little as 200 mm annually. The Nyanza region, and especially near Lake Victoria and the central highlands east of the Rift Valley, can receive between 1,200-2,000 mm rains annually, although this is never constant.

The participants in this study spoke of how the weather patterns have become so variable that they find it difficult to predict the onset of seasons, which has affected their crop and livestock production. The most profound changes in weather patterns are witnessed in Kakamega County

due to rainfall variability, which has affected planting and harvesting with dire consequences for food security in households. Often women spend most of their resources preparing farms and planting without any assurance of a meaningful harvest, and this is particularly true for those who concentrate on food crop farming. Normally, Kenya has two cropping seasons:1) the long wet season between April and May, which is the main period of crop production (Schmidt *et al*., 2017), and the short wet season between October and December. The long wet season between the months of April and May has declined from 60 to 30 days (J. Ochieng et al., 2016a),while the short wet season has often had increased intensity of rainfall, with the wet season sometimes continuing into January and February. Such changes have led to higher total rainfall for the normally short rainy season (Republic of Kenya, 2010b). However, the long-wet season between April and June has shown a general decline in rainfall and in the place of long rains, prolonged and frequent droughts are experienced.

Besides the changing rainfall patterns, rising temperatures associated with climate change are precipitating extreme and harsh weather conditions in Kakamega County (CIAT- International Centre for Tropical Agriculture, 2018;Republic of Kenya, 2010b;Republic of Kenya, 2018). These temperature changes exacerbate extreme climate events such as droughts and floods in the area, which in turn increases the vulnerability of those who rely on natural resources for their survival, such as pastoralists and crop farmers. As such, women farmers in Kakamega are among the many farmers in Kenya who are most often hit by the effects of changes in temperatures, both directly and indirectly. The effects of climate change on the livelihoods of rural farmers are discussed in the section below.

7.3 Climate change and livelihoods of rural women farmers

The effects of climate change on livelihoods are wide ranging, and do not only impact on the natural environment, but physical infrastructure, economic life, human health, and the general welfare of people. The results of this study show that rural farmers are often not equipped to adapt or to mitigate the effects timeously, with the population segments most at risk including women, children, and persons living with disabilities in the rural areas. However, they are not passive victims of climate change. This study has shown that they use various strategies to cope, adapt and build resilience to the ravages of climate change.

Climate change affects the livelihoods of both men and women farmers in Kakamega County of Kenya, but in different ways. This is because women tend to be reliant on the natural environment for their livelihoods, whether this is through crop production or livestock production, or on other natural resources such as charcoal burning, which is also dependent on the natural environment. The following sections discuss how climate change affects the livelihoods of women.

7.3.1. Diversification of crop production as a strategy

This study showed that one of the strategies that women used to mitigate the effect of climate change was to diversify the crops they plant, with long season crops being planted alongside short season crops. For instance, they would plant maize together with beans, and plant millet, which is drought resistant, during short rainy seasons. Other crops such as sweet potatoes and cassava are planted between seasons and ensure women can access food during scarcity. However, while crop diversification is an important survival strategy, this practice is limited by access to land.

Insecure land tenure is a factor that limits diversification. Insecure land tenure among women is a consequence of the land ownership and inheritance system based on unwritten customary law strongly anchored in tradition and the cultural norms in customary tenure (Wily, 2018). The traditional cultural norms dictate that land tenure is patrilineal, based on the patriarchal nature of the community (Wily, 2018), which ensures that males in a lineage hold power over property inheritance and decisions on land use. As such, women farmers have neither land nor the rights to use land and have to seek permission to use land through their husbands or brothers. The size of land allocated to women by their husbands or brothers, together with gender-based control of crops which affects what women can plant, limits women's production capacity, meaning they are often unable to withstand the effects of climate change, especially when subject to prolonged droughts. One of the key findings of this study is the gendered nature of crop production. While men mostly focus on growing crops for cash income, such as sugar cane, women tend to produce food crops on a small scale mostly for household consumption. Rural women grow mainly maize which is a staple food in Kenya and the western region (Diiro et al., 2018), and other crops such as beans, tomatoes, kale, cow peas, sorghum, cassava, sweet

potatoes, and millet. These crops are small, given their limited access to land, which is governed by the patriarchal land ownership system (Wily, 2018).

In the past decade, various land acts and legislation have been enacted in Kenya to help women secure land tenure, such as the Land Registration Act, the National Land Commission Act, and the Land Act (Kimeu & Maneno, 2017). Such legislation includes various sections to help secure equal rights to land tenure for men and women. In addition, the Kenyan Constitution of 2010 upholds the right of women to own property, and underscores gender equality. However, in practice the implementation of the stated legislation remains superficial, and many women are unaware of these provisions.

What this indicates is that both land usage and access are factors that influence the ability of women to plant crops and to diversify their agricultural production in response to climate change. Underpinning this is the effect of patriarchal land tenure, which needs to be addressed to enable rural women to adapt and build resilience to climate-related shocks. It is clear that there needs to be more active public engagement, such as public education and community engagement forums. To sensitise community members on women's land rights, as well as the benefits of allowing women to access land to enhance food security.

7.3.2 Variation in livestock production

The discussion in section 7.3.1 above focused on crop production, but many also own livestock. This too is gendered as women tend to own only small stock, such as birds (chicken, quails, doves, ducks and turkeys), sheep, pigs, and goats, with men owning most of the cows. It has been demonstrated that, much like land, livestock is passed down or inherited by male siblings through a patrilineal system where only men are culturally allowed to inherit livestock, making it is difficult for women to acquire livestock. In fact, the patriarchal nature of the community puts stringent measures and norms in place to guard ownership and disposal (inheritance, sale and buying) of big livestock. These norms dictate that a woman cannot make decisions to buy or sell a cow, even if the cow belongs to her; she must use a male family member to buy or sell it. Women are further prohibited from bringing cattle home even if they acquire it using their own income. Based on cultural norms, the woman must ask a male figure to take the cow into the home.

Findings from this study suggest that although livestock is a form of livelihood diversification for women, it is heavily controlled by patriarchal relations. Studies (Kristjanson*et al.*, 2010; Teufel, Baltenweck& Girard, 2019)have found that women's control and decision-making over assets such as stock is important in determining their livelihood trajectories in the community. As such, interventions that provide women with more access to and control over livestock can help since they are proven to boost increase household food security, child nutrition, the wellbeing of women, and the education of family members (Teufel *et al*., 2019).In addition, by owning and controlling assets such as livestock, women gain power and authority in their households and communities and lessen their risk of mistreatment. At the same time, given the traditional responsibility of women to provide household food security, their ability to control decisions on whether to sell or consume the family's animal and animal products, including the freedom to use the income from the sale of livestock and livestock food products, has the potential to enhance women's capacity to mitigate the adverse effects of climate change on their household's livelihood.

7.3.3 Expansion of involvement in small businesses/agribusiness

Besides involvement in small-scale subsistence agriculture, it has been shown that a number of women have small businesses in the village markets, such as Butali, Lubao, and Malava, where they sell locally/home-grown foodstuffs. From the market observations, women sell local vegetables, fruit, yams, pumpkins, sweet potatoes, and grains including sorghum, millets, maize, beans, peas, soya beans, and even napier grass, used by livestock farmers. Women are also involved in the sale of poultry within their food *kiosks.* Yet here too one sees the impact of patriarchy. The observations, corroborated by the interviews, show that the livestock (cows, goats, sheep and pigs) are sold by men, and if a woman wants to buy them, she has to use male members of the family or community. Despite women being able to own the small animals, the sales are done by men who remit the proceeds to women. Men are also involved in the sale of dogs, especially at Lubao Market.

Despite rural women diversifying their livelihoods, they often fall victim to the influence of climate change, since most of the items they sell are produced from or dependent on the natural environment and are affected by the extreme climatic events (Atela et al., 2018). Furthermore, women lack decision-making capacity over certain livestock like cattle, which limits how much

women can diversify. Other market-based means of livelihood diversification include sale of handcraft such as sisal ropes, mats, baskets from reeds, and pots from clay, and sale of charcoal. Though helpful in creating some source of income, such products are also dependent on the natural environment. This can lead to the over-exploitation of certain resources and have a negative impact on the environment, thereby causing destruction to vital ecosystems. Based on these observations, it is apparent that women who are empowered to own, use, and dispose of high value assets to support their livelihoods are most likely to mitigate adverse effects of climate change. Conversely, powerlessness of women farmers, concentration of food crops in small farms, powerlessness in ownership, and control and use of assets of value is likely to enhance their vulnerability to the shocks occasioned by climate change.

The study indicated that one of the approaches useful in mitigating the effects of climate change on livelihoods in the community entails women farmers challenging norms and traditions that limit their ability to participate actively in food production. Women have to switch to roles traditionally reserved for men, like engaging in cash crop farming, increasing land under food crops, and participating in decision-making in matters that affect livelihoods. A strategy to mitigate the effects of climate change is to embark on other labour-intensive tasks often performed by men. Women have to rethink fitting in to narrow and low-paying labour like planting, weeding, ploughing and harvesting, or working as domestic servants as climate change mitigation interventions. This enables them to earn some income to sustain their livelihood while at the same time constraining their health and time (Goh, 2012).

Through diversified livelihoods, rural women farmers are able to manage risk and gain extra income and resources to provide some food security. The discussion above illustrates how patriarchy, the livelihoods of women, and climate change interlink. Whether it is involvement in subsistence agriculture, making handicrafts, selling their labour, or keeping livestock – all these sources of income are connected to the natural environment, and influenced by patriarchy. However, literature Kaijser and Kronsell (2014) argue that the influence of patriarchy in limiting livelihood trajectories may not be universal, but intersects with the age, level of education, cultural background, ethnicity, and economic background of the individual. The current study did not interrogate this, but it clearly warrants further investigation.

However, this study has found that climate change has a gender dimension in terms of its consequences, and the adaptive mechanisms and mitigation strategies used by women to overcome the effects of climate change on their livelihoods. Gender-based inequalities and

social exclusion are key factors undermining people's and communities' capacities to cope with and recover from disaster risks and climate events. It is apparent that a combination of power structures, intra-household dynamics, decision-making processes in and out of the home, and inequalities in terms of workloads, employment and income, restrict many women in Kakamega from accessing and securing livelihoods and achieving control over their lives. This undermines their ability to anticipate and prepare for major disasters and shapes their susceptibility and exposure to climate extremes (Carr *et al*., 2015).

Evidence indicates that disparities exist between men's and women's access to and control over key assets in Kakamega County. Rural women in Kakamega generally have fewer assets and rights than men; they are more vulnerable to losing their assets and rights due to separation, divorce, or widowhood; and they have less access to capital, extension services, inputs, and other resources related to agricultural production. Nevertheless, women's asset holdings often have positive effects on important development outcomes, including household food security and human capital formation. Consequently, helping women gain greater access to and control over key assets can increase resilience of households and communities to climate change. To achieve this, there is an urgent need to scrutinise the factors determining resource allocation and power distribution and take affirmative action to ensure women have equal access to key livelihoods assets.

7.4 Diverse effects of climate change on livelihoods

Another key finding is that climate-related shocks are gender-disproportionate, and women and men experience and react to the impact of climate change differently, although the effects of climate change are felt by both men and women's asset base, including natural, human, physical, social, and financial capital (Nellemann *et al.*, 2011).

As discussed in the previous section, the ownership of natural capital including land and the natural environment is controlled by men (Onwutuebe, 2019). While they too are affected by climate change, the over-reliance of women on rain-fed crops makes them particularly vulnerable.

In terms of human capital, when climate change affects crop yields, food scarcity becomes inevitable (Gallaher *et al.*, 2013). Women suffer more in terms of human capital, as they are

the first to be rushed into food rationing and skipping meals. As a result, women and children become malnourished, with limited immunity against common diseases. Furthermore, findings show that during such times, women bear increased responsibilities for taking care of domestic chores, as well as performing the roles of men who often move to urban areas to seek employment opportunities. These responsibilities rob women of time, when they often need to seek work to earn an income.

Findings also show that when women work off-farm, it is often a distance from their homes, which means that they come home late. Tension then arises between having to perform productive labour to earn an income, and their reproductive labour in terms of their household responsibilities, especially in patriarchal societies associated with inflexible gender roles. According to Goh (2012), this often results in work-family conflicts and has been associated with an increase in gender-based violence. Not only are women subject to this within their own homes, but also when commuting to and from their homes and work.

Their vulnerability is increased when they are expected to perform other household tasks typically assigned to women, such as collecting water and firewood, both of which are influenced by climate change. During floods, most natural sources of water become unfit for human consumption due to mixture with surface run-offs. In turn, dry seasons are associated with water scarcity and women often have to move long distances to fetch water for both livestock and household use. Besides the risk that contaminated water has, carrying heavy loads of water over long periods causes cumulative health damage to the spine, neck muscles and lower back, leading to early ageing among women (Nellemann *et al*., 2011). Thus, the ramifications of climate change for women are far more extensive than for men in terms of the effect on their human capital.

This is not limited only to physical effects on women, but includes the proportionate psychological impact (Goh, 2012; Hoddinott & Kinsey, 2000). For instance, Ongoro & Ogara, (2011)that women were more affected and became more fretful than men during droughts, as they had to take up complex responsibilities as producers and providers of food. Mitchell, Tanner and Lussier (2007) in Goh, (2012) found that that the psychosocial effects related to floods were more pronounced for women. Not only did it cause a loss of their livelihoods, but also affected their networks of support. Furthermore, climate-induced problems such as water, fuel and food scarcity made women's lives increasingly difficult as they had to spend more time and labour on these tasks.

Climate change also affected women's physical capital, though no substantial differences were observed between men and women. In terms of damage to infrastructure, floods often affected communication networks and roads, which affected trade at the market. However, the distress sale of physical assets among women was reported to be common during periods of drought. Such distress sale of assets and small livestock made women suffer more the effects of prolonged shocks on their livelihoods. Despite limited gender-differentiated impacts of climate change on physical capital, literature shows that climate change affects women more due to their inadequate access to the physical capital necessary for adaptation to climate change (Cleveland *et al*., 2014).

In terms of social capital, including social ties and relationships, the study found that women suffer more than men. Women lost family networks due to divorce associated with climate-related conflicts, or lost touch with their husbands who moved to urban settings and started new families abandoning their initial families back in the village. Climate-related migration and scarcities led to deterioration of women's social and communal groups, although in some cases this was mitigated through government intervention. For example, through the Ministry of Social Services, the county government of Kakamega launched a shelter programme for older persons and widows affected by climate change, including food subsidies in the form of maize and beans, and a stipend. In addition, organisations such as One Acre Fund initiated programmes to help women by providing farm inputs and agricultural skills to equip them with the knowledge and skills to deal with the negative effects of climate change.

Despite the loss of family ties and bonds, rural farmers were found to have gained links with the government institutions that finally brought in social assistance programmes. It was therefore observed that while the effects of climate change led to destruction or decrease of bonding and bridging social capital, linking capital increased, as observed in the linkages built between the community and organisations. However, Claridge (2018) underscores the fact that all forms of social capital – bonding, bridging and linking – are important networks that help mitigate the effects of shocks on livelihoods and are often applied to leverage vulnerability. As such, all are required to create synergy to help the rural farmers mitigate the effects of climate change on their livelihoods.

In terms of financial capital, income losses from climate impacts on agriculture were also felt more by women than men. Since women mostly depend on rain-fed agriculture, unpredictable rain patterns led to late planting and subsequent reduced crop yields. Women therefore had no

extra food to sell at the market to earn income, which jeopardised their market-based livelihoods. To cope, women often opted for risky loans that charged high interest rates which were difficult to pay back, or which auctioned family property when women failed to pay. When women's groups and family networks broke down, women sought loans from the Kenya Women Finance Trust. Most of them failed to pay these loans back as they used cash on subsistence, and as such, their family property was auctioned to pay the debt. The only financial benefits that came with climate change were the safety net programmes from the government, especially the cash transfer for orphans and vulnerable children which targeted widows. Though the government of Kenya provided hunger safety net programmes to four extremely stricken counties, Kakamega was not among them. As such, women suffered more in terms of financial capital. The dire need for financial capital among women in Kakamega County during extreme climatic events calls for safety net programmes targeting vulnerable women across the country, rather than just in specific counties.

From the findings, it is observed that the effects of climate change are felt more by women than men due to factors beyond climate change itself. The gender-differentiated effects of climate change can be attributed to many factors, including existing gender inequalities caused by unequal power relations between men and women; gender roles that expose women more to climate effects; patriarchal structures within the community that exacerbate unbalanced relations and discrimination against women; and customs and norms that bar women from owning certain assets necessary for climate change adaptation. As observed by Onwutuebe, (2019), gender discriminations against women in terms of power relations, roles and the discriminatory distribution of resources is ostensibly an expression of cultural practices entrenched in patriarchy (Mubaya, Mafongoya & Obert, 2017).These have become a major factor in enhancing vulnerability by excluding women from decision-making and ownership of key assets, which not only makes them vulnerable to climate change but also deprives them of the ability to adapt and build resilience to its effects on their livelihoods.

As discussed by Walby (1990), the idea of patriarchy through the lens of liberal as well as Marxist feminists can be observed contributing to women's subordination. The use of authority and communal structures to control the allocation of resources and roles to benefit men at the expense of women is a factor that deprives women and excludes them from key decision-making positions, as well as from accessing key assets. The domestic roles of fetching water and fuel and looking for household food, though not paid, expose women more to the effects

of climate change. Their controlled decision-making capacity and access to different forms of capital limits their adaptive capacity to the effects of climate change. Women therefore remain vulnerable to the effects of climate change as a result of deprivations and exclusions based on patriarchal societal norms that perpetuate poverty and unequal relations with men (Onwutuebe, 2019). Literature also show that disasters have resulted in higher mortality rates among women, which are partially linked to the vulnerability produced through patriarchal relations (Arora-Jonsson, 2011). This meets the description of patriarchy by feminists as the harbinger and leading institution that perpetuates discrimination, and the foundation from which gender inequality is perpetuated and reinforced. Accordingly, radical feminists have challenged patriarchal relations within society that perpetuate discrimination against women, and which contribute to their deprivation and vulnerability (Turner *et al*., 2014)

However, despite the general observation that women are often more negatively affected, the literature presents some exceptions to the pattern. Men may be more negatively impacted by climate change because they own land, as noted by Goh (2012) and Johnson *et al*. (2016), or because in some cases women are able to invoke cultural norms that make men responsible for household food security (Kristjanson, Mango, Krishna, Radeny& Johnson, 2010). However, the effect of climate change on men and women should not be seen as a binary. The opportunity to conduct contextualized studies using an intersectional lens is therefore important.

7.5 Utilising assets to mitigate effects of climate change

Based on ABCD and SLA, assets or capitals form an essential part of a livelihood. A Livelihood becomes sustainable when it has an accumulation of assets necessary for coping with shocks. Assets such as natural, human, physical, social, and financial capital are all important for rural livelihoods. For women farmers, access to such forms of assets is necessary to help them both sustain their livelihoods and cope with the devastating influence of climate change. Key to the findings is the fact that the livelihoods of rural farmers in Kakamega are highly dependent on natural capital. Virtually all forms of livelihood strategies adopted depend on this. The first strategy is to diversify crops through the use of mixed farming, growing crops and rearing livestock on the same piece of land, or making products from resources from the natural environment. However, this overdependence on natural capital, when subject to prolonged changes in climate, often further depletes natural resources, leading to environmental

degradation and making women even more vulnerable. In Kakamega, women's limited access to natural capital has made it difficult for them to cope with the effects of climate change.

Another finding that emerged from this study is that women famers have a considerable amount of indigenous knowledge and human capital in terms of how to mitigate the effects of climate change. Such knowledge has been passed down through generations, as well as gleaned from women's experience in farming in terms of the management and sustenance of the environment and how to adapt during climate changes. This means that they become both the holders and practitioners of indigenous climate knowledge (Vu *et al.*, 2011). The problem is that such indigenous knowledge is often not considered "scientific" or accurate, as it involves the use of subjective judgements (Ibnouf, 2014). This is most unfortunate, as this indigenous climate information can be used to not only supplement and verify modern scientific data but could help women access accurate climate information that can help them adapt. However, this study found that women often have limited access to scientific climate information since traditionally only men are thought to need such information. In rural Kenya, women remain relegated to the domestic sphere, while men operated in the public sphere which often excludes women, in effect denying them access to relevant information.

One of the main strategies that women use to cope with the effects of climate change is to use their social capital, and bonding capital is particularly important. Typically, they rely on their family relations and networks based on kin and blood relations to share goods and labour. It was found that families often helped each other by sharing excess crops or helping to cultivate land. However, these close bonds of trust and reliance between friends and family can be disrupted by climate-related factors, such as when people are forced to relocate, or where it results in conflict over natural resources such as access to water. This is further discussed in detail in section 7.6, dealing with social capital and building resilience.

Access to bridging capital is just as crucial. Church-based women's groups and community-based development/farmer groups provide support to women and link them up with other organisations during climate-initiated shock. While families lend members of their kin food and household necessities, groups such as churches and women's groups provide both livelihood information and skills to mitigate climate change, as well as material, emotional and psychological support to their members. These groups are vitally important in linking the community and individual farmers with government and other NGOs to provide training and facilitate access to resources. Reflecting on the findings, social capital appears to be the main

asset that women use to access other forms of capital. However, this too can be fragile. Where family- or community-based groups lose their agility or are weakened by climate change, it can affect their ability to link up with external institutions, The lynchpin for rural women is the need to actively strengthen community-based groups and NGOs at the local level to not only build cohesion and trust, but to develop their capacity to access wider support from business and government (Claridge, 2018).

Using the sustainable livelihoods framework to analyse the effects of climate change and assess how ABCD plays out at the local level has been useful to understand how women cope with the shocks of climate change in Kakamega. What also emerged very clearly was how unequal access to these assets has a profound effect on women. In terms of access of social capital, there are variations between women and men, as well as between women. This necessitates an interrogation of how a patriarchal relation affects women's adaptation to climate change.

7.6 Inflexible gender roles and their effect on adaptation to climate change

A key finding of the study is how women's reproductive roles added to their vulnerability and ability to adapt to the effects of climate change. First, rural women farmers are the main providers of household food and rely mainly on rain-fed agriculture crops, as witnessed across Africa (Alston, 2013; Carr, 2008).When climate change slowly depletes natural resources including forests and water sources, and by extension affects the yield of staple crops, women suffer more. This is because they are primarily responsible not only for food production in the household, but also fetching water and household fuel to cook food, which is not only burdensome and taxing physically, but can also make them more susceptible to gender-based violence.

What this implies is that women carry a heavier burden in terms of the effects of climate change on their lives. Where they are expected to travel long distances to obtain water, fuel and food, or have to work off-farm for meagre income, it places pressure on their reproductive roles. However, some scholars claim that climate change has largely eliminated gender discriminative roles as women often have to take up roles usually reserved for men in order to survive. In my study, I found that women make bricks for sale and sometimes work on construction sites. However, some of the men's roles that women take on may require a lot of energy and are performed within a hazardous environment that can affect the health of women.

Gender also influences the ability of women to participate in or influence decisions that affect their livelihoods. Based on the patriarchal nature of African communities generally, and the western region of Kenya specifically, men are the main decision-makers. As such, women often have limited space for decision-making, and usually have to consult men. Thus, in cases of emergency or disasters, women are often more affected due to their lack of decision-making power. In Kakamega, the decision to buy and sell cattle, land, and all productive assets remains a man's right, while women can only make decisions over buying and selling of cattle products. Furthermore, decisions on migration, land use and sale are made by men (Coulibaly et al., 2015). Men are often granted higher status through the productive assets they own and control, while livestock, equipment, and land are owned and controlled by the male household head. Women traditionally control only household food crops and livestock products.

Consequently, we see that ownership and control over assets is important their use determines the extent to which people can to climate change. For example, one can sell an asset to relocate, get cash, or change livelihood strategies, but these options are less available to women than men (Carr *et al*., 2015; Park, 2017). Assets also help people to secure loans that can be invested in livelihood-improvement opportunities. However, due to the patriarchal nature of many African communities, women are often deprived of the access to and authority over major productive assets. Once more, it is this that increases women's vulnerability.

Access to human capital is also controlled through patriarchal societal norms. Most rural women farmers lack access to education, and their concomitant high levels of illiteracy mean that they miss information (or lack the understanding) on climate change disseminated through mainstream media, including radio, television, newspapers, and written forms. Such women can only access information disseminated through public gatherings–*barazas*–from which they are often excluded. Furthermore, in some Kenyan communities, women are restricted from participating in mixed public meetings where men congregate. Studies in Kenya have also found that women remain largely excluded from climate information and adaptation strategies since the information is often disseminated through radio and mobile phones, which are controlled by men (Ongoro & Ogara, 2011). Among pastoralist communities in Northern Kenya, early marriage is another traditional practice that encourages illiteracy among girls and women. Education is not considered important for women as it is the belief and custom that women's duty and contribution to society is to give birth.

Based on the above discussions, it can be deduced that inflexible gender roles, inequalities indecision-making and access to assets, and discriminatory allocation of roles, affects women's ability to cope with and adapt to climate change. As observed by Adger, Huqand Hulme (2003), socially-constructed gender roles and privileges maintained through patriarchal structures such as family, religion, and schools can be a big barrier to women's adaptation and resilience to climate change (Onwutuebe, 2019). However, it is important to note that deprivation and patriarchal discrimination are often limited by certain factors, as put forward by Walby (1990), who notes class and race as factors that intersect with several other social factors, such as ethnicity, age, socio-economic background, and level of education, to determine the levels of deprivation.

In fact, as noted by Crenshaw (1991), the intersectional factors highlight that not all women in the community are deprived in the same way, and gender, age, class, ethnicity, race, economic status, and marital status serve to include or exclude individual women from the assets or resources required for adaptation. As such, intersectionality literature shows that the analysis of a single variable such as gender is not sufficient to understand the impact of climate change on livelihoods. Accordingly, it is necessary to adopt an intersectional analysis of how climate change affects women, and what factors contribute to their experience of different forms of deprivation (Gonda, 2017). Unfortunately, given the design of the study and timelines, this study did not investigate the intersectional factors influencing the effects of climate change on women farmers and their adaptation mechanisms. However, cognisance should be taken of this in future studies.

7.6 Resilience-building strategies

As discussed in section 7.5 above, women are not passive victims of climate change, but use various assets to cope with its effects. Based on resilience theory, resilience is achieved when an individual or community takes a positive trajectory of functioning and adaptation after a disturbance or shock (Boon *et al*., 2012:383). Resilience-building involves building people's capacity to cope with stresses and shocks by anticipating, preparing for, responding to and recovering from them (Shakya, Cooke, Gupta & Bull, 2018). The process does not simply look at what a community, individual or household has in terms of capital, but also focuses on

agency – what they do with their capital and institutions. In discussing resilience, this study looks at both resilience pathways and agency.

In Kakamega, three different resilience pathways were identified: 1) absorptive coping capacity, or how a population is able absorb the effects of climate over a short period of time; 2) adaptive capacity or incremental adjustment, which involves the activities done in anticipation of climate change to help reduce its effects; and 3) transformative capacity, which involves transformational responses that make women more able to overcome the influences of climate change (Tanner *et al.*, 2017). All the three forms of resilience are essential for livelihood adaptation, as they are interconnected, mutually reinforcing, and exist at multiple levels from individual to household, community, district, and national, and they overlap within social-ecological systems. Due to this overlap, you may find one programme that strengthens two or three forms of resilience (Aguirre, 2017), such as the national government cash transfers in Kenya, which enhance both the adaptive and absorptive capacities of individuals and communities that are beneficiaries.

Absorptive capacity involves taking intentional protective action to cope with known shocks and stresses to help a community bounce back from shock or stress. It entails anticipating, planning, coping with and recovering from specific known shocks and short-term stresses to limit the negative impact on individuals, households and communities (Reed *et al*., 2013). This study showed how women farmers in Kakamega used their indigenous knowledge (human capital) to predict changes in climate and pending natural disasters, often coming together as families and linking up with community-based and church-based groups to share climate-related information and coping strategies (social capital). Hence, in the absence of scientific information, they depend on their lived experiences of climate change to develop strategies to mitigate its effects. For example, women watch the movements of certain birds and insects to predict the onset of rainy seasons, meaning they can prepare in advance. Since women farmers lack contact with the agricultural extension officers and meteorological department, they rely squarely on indigenous knowledge, which may not predict how long the dry spell or rains shall last. As such, it is important that such knowledge be corroborated by scientific information from the meteorological department to furnish rural farmers with detailed, reliable, and time-bound climate information.

In fact, social capital is key to building resilience among rural women. Women have been able to use their family networks, neighbours, friends, and community groups to enhance their

adaptive capacity to reduce the effects of climate change. This included pooling various assets (financial, natural, physical, social, and human) to collectively deal with the impact of climate change. However, their transformative strategies were in some cases facilitated, and in other cases limited, by involvement in broader safety net programmes. At national level, the government provides both food rations and cash transfers to help women bounce back from climate-related shocks and has a climate adaptation budget and strategy document. The problem is that the programmes are often not well-implemented and coordinated which means that some members of the community benefit from multiple programmes, while others fail to benefit. In the rural villages, there is often limited awareness of these national programmes and resources to help rural farmers. Hence, there is a need for greater public awareness to facilitate access.

Women farmers in the area also use other adaptive strategies to survive. Adaptive capacity emphasises flexibility, and the capacity of a system or an individual to make incremental changes in terms of continuous adjusting, learning, and innovation. In terms of adaptive strategies, through the various women's groups and community organisations, women in Kakamega share knowledge and decide on what climate-resilient crops to plant based on their shared knowledge and prediction of weather patterns, as a kind of insurance against unpredictable climatic conditions. For example, they have moved towards a greater integration of crops with livestock production to enhance productivity, efficiency, and sustainability. The ability to share knowledge, financial, technological, and other forms of human capitals influences the effectiveness of this adaptation strategy.

Transformative strategies of building resilience were also observed among women farmers in Kakamega, which involve making intentional changes or arrangements to halt or lessen the risk factors of climate change, including vulnerability, poverty, and inequality. Essentially, the process involves addressing the root causes of poverty, injustice, vulnerability, inequalities, and risks that pre-dispose communities and nations to climate-related shocks. It takes the agency approach that strengthens the capacity to understand and consciously engage in long-term change processes that shift power, beliefs, values, and ways of thinking and behaving to support greater levels of justice and equity. In terms of transformative resilience developments measures, in Kakamega at the communal level women are already taking up roles traditionally filled by men and are challenging the patriarchal societal rules.

In response to climate change and as a push towards financial inclusion for all, financial institutions are now providing loans to women without discrimination for the first time. The county government have also initiated programmes focused on women, and there are national programmes to address gender inequality and to mainstream gender in all decision-making processes. Assertive affirmative action initiatives to empower women are developing, such as the women enterprise development fund and *Uwezo funds*, to enhance women's access to financial capital. What is clear from this study is that there needs to be a transformation in the existing gender order to implement transformative coping measures which influence the allocation of resources and address the underlying power relations that exacerbate gender discrimination. This needs to occur at all levels – household, community and national – if the gendered effects of climate change are to be addressed effectively.

7.6.1 Social capital and resilience

The social ties of everyday social interaction area valuable resource in building and maintaining resilience, through mechanisms such as risk-sharing, mutual assistance and collective action (Becker *et al*., 2015). Social capital is an important element for coping with climate stress (reactive resilience) and is central to adaptive capacity (proactive resilience) (Osbahr et al., 2010), which is particularly important for critical transformations in the context of climate change. So how does social capital build resilience?

The study confirmed that social capital can build resilience through the three major pathways associated with the different levels of social capital that exist (Babaei *et al.*, 2012). These include bonding, bridging and linking capital, all of which are important to overcome the impact that climate change has on the livelihoods of people living in rural communities. Bonding social capital enhances resilience among rural women farmers who share strong social bonds and often share similar demographic characteristics. In Kakamega, for example, family ties proved important in building community and household resilience, as they share resources. Family members are the first to reach affected members through the provision of essential goods such as food stuffs, in cases of crop failure or climate-related disaster. The findings also show that families in Kakamega often move to relatives who have bumper harvests to borrow crops such as grains in order to survive, which are retuned in the next season. These networks of family support meet not only physical, but also the psychological and economic needs of

family members in the aftermath of climatic events (Becker *et al.*, 2015; Folke et al., 2010). Cohesive family structures and networks are seen as vital to building the resilience of people affected by climate change. Indeed, in Kakamega it was found that people first turn to their families, before seeking assistance elsewhere.

Another form of capital that proved instrumental in building resilience to climate change is bridging social capital, which is often characterised by weak crosscutting ties (Claridge, 2018). These ties were commonly found to work among women in church groups, women farmer groups, and women self-help groups. Church groups provided emotional, spiritual and even physical support to members hard hit by climate. A good example in the study was the Friends church, which is a common church across the western region. The Friends and Catholic churches provide members with spiritual, emotional and financial support, especially when faced with livelihood shocks (Schuman, Dokken, Niekerk, Loubser & Africa, 2006). In other studies, churches promote community work involving tree-planting, and are one of the key institutions within the community to help spearhead climate change adaptation and resilience-building among the residents of Kakamega.

Apart from church-based groups, women farmers groups and self-help groups in Kakamega played a major role in building resilience by bringing rural women farmers together to promote savings. Such savings are accessed by women during scarcity and were often used to help women diversify their livelihoods through investment in non-farm based ventures. In addition, through the savings, women could rebuild their livelihoods after impacts of climate change, especially where they were forced to sell livestock or household goods to survive.

The women's groups also link women farmers to organisations that promote agriculture, such as the One Acre Fund, which provides women with quality seeds and farm inputs, and trains small-scale women farmers in groups to attain maximum yields. The organisation also provides tree seeds to women farmers as a way to help mitigate the effects of climate change. Through links with such groups, rural women farmers have been able to grow crops and attain good harvests, despite the constraints. This is congruent with the literature that finds that linking farmers to local organisations can be instrumental in building resilience to climate change (Olivier, 2015).

Women's groups have also proved important in linking women farmers to institutions that provide technical climate information. In Kakamega, women's groups provide links to

institutions such as the Kenya Agricultural Research Institute (KARI), which provides information on both climate and how to adapt to changes in weather patterns. While institutions may provide advice on climate change and how to act, literature has proved that there are different levels of uptake (Aguirre, 2017). In fact, work in rural areas notes that informal institutions such as social groups are important sources of information. When such information is passed to groups, it reaches community members in simple understandable language and context (Aguirre, 2017), and they are more likely to heed the warning and interpret this knowledge through a lens of existing and local knowledge (Clarke, 2013). Hence, an important finding of this study was just how important the links between governmental institutions, civil organisations, and communities are to enable people to adequately cope, and respond and adapt to the effects of climate change on their livelihoods.

This pertained not only to disseminating information about the effects of climate change. In the context of Kakamega, women farmers through their community organisations were also linked to financial institutions such as Kenya Women Finance Trust, K-Rep Bank in Malava, and women-based CBOs. These organisations provided women with loans, which enabled them to purchase land and acquire the necessary implements to improve their farming methods. Financial institutions also offer women insurance for major life events, savings and credit facilities, social assistance facilities, and access to public goods and services.

7.6.2 Role of government institutions

The discussions above have focused on social capital and non-state actors. However, such a view fails to consider the role that higher-level formal institutions play in promoting and facilitating social capital and resilience amidst climate change effects. An important aspect of social capital and resilience is the interaction of individuals and groups with the institutions of the state (Aguirre, 2017). This is because climate change cuts across many domains, including governance, macroeconomics, and social policy, meaning defining interventions should be inclusive of the state institutions (Mckune *et al.*, 2015).

In this study, the role of state actors, especially at county and national government level, were of paramount importance in mitigating the effects of climate change on communities. The county government of Kakamega provides social protection services to residents affected by climate change, which includes shelter programmes to poor widows, the provision of food

subsidies, and bedding to those affected by floods. In terms of physical infrastructure, the county helps to maintain rural access roads and infrastructures destroyed by natural disasters. County governments are closer to citizens and are therefore more able to integrate climate action across sectors through bottom-up priority-setting (Chillrud, 2017).

7.7 Conclusion

In conclusion, in examining the gendered effects of climate change on women, their adaptation and resilience building mechanisms, the key findings are illustrated below:

The key findings show that changes in weather patterns, including temperature changes, variability in precipitation, and prolonged dry periods, are the major climate changes affecting the livelihoods of women living in the Western Kenya region. The effects are real and influenced by extreme climatic events, including floods and droughts. The effects are most profound on women as producers of food security, due to their reliance on the natural environment for their livelihood and survival. This makes them particularly vulnerable, especially where their ability to adapt is influenced by patriarchal societal values which hamper their ability to tap into different assets.

The effects of climate change on women's livelihoods are exacerbated by their limited access to the forms of capital necessary for coping, such as land, education, financial services, information, and development services. Women's limited access to production assets is influenced by patriarchal norms, values and laws that perpetuate male dominance and promote social exclusion of women. Women farmers are therefore excluded from opportunities to diversify their livelihood options and reduce their overdependence on natural resources. Further, women are tied by the sociocultural hurdles of gendered roles, communal power dynamics, and differential social constraints that inhibit them from appropriately adapting and responding to climatic risk in time and effectively.

However, women are not mere victims of climate change. This study has shown that they have agency and that this is largely facilitated through their use of social capital to help build resilience and cope with climate. Through their purposeful use of social capital, they have been able to access resources and challenge gender norms. This has helped them to overcome cultural patriarchal inhibitions to some extent, drawing them out of victimhood and enabling

them to become active agents of change. As such, climate change has affected their vulnerability, but also built their capacity to challenge the societal norms that limit their access to natural, human, financial, physical, and social capital.

7.7.1 Contributions of the study

The study contributes to literature on women as agents of climate change adaptation and resilience. Inspite of women's limited access to capital, they act as agents of change by using the limited forms of capital they are able to access to build resilience and sustain their livelihoods. Specifically, women thrive through the use of different forms of social capital. They use bonding; bridging and linking forms of social networks to cope adapt and build resilience. As such, the need to strengthen social networks among women in Kakamega is eminent in as a major way to mitigate the effects of climate change on women's livelihoods. Budgets aimed to mitigate the effects of climate change on food security should invest in strengthening the different forms of social capital for women farmers adapt to the effects of climate change on their livelihoods.

The study shows the need to increase women farmers' access to different forms of capital since their limited access to such forms of capital increase their vulnerability to the effects of climate change. Increasing women's access to both natural and financial capital is a concrete way to their capacity to respond to shocks. This can be implemented through an assertive affirmative plan that improves women's access to land ownership, education, extension services, and access to financial resources. Added to this is the need to address the negative effects of patriarchy, which undermine women's ability to respond to climate change shocks and which marginalises their voice. This study advocates for gender equality and equity as a way to enhance women's capacity and contribute to the achievement of visions 2030 through improving gender equality.

The study through strengthening the capacity of women to participate in rural agriculture and build resilience to climate change contributes to achievement of two main SDGs- food security and combating the effects of climate change. Such is part of the Kenyan presidential big four agenda. The study provides key recommendations for enhancing women's capacity to build resilience to climate change and increase production. Such inevitably contributes to food security and can indirectly influence nutrition, affordable health care, housing and manufacturing which are the big for presidential agenda (Arucy, 2019).

7.7.1 Research limitations and policy considerations

Despite the study underscoring the importance of intersectionality in understanding how climate change affects women differently, this was not adequately explored due to the fact that my participants were relatively homogenous. As such, the intersectional lens remained limited in the study, but is clearly important when doing a similar study in other parts of the country which are more diverse in terms of race and class. Another limitation, given that this was a sociological study, is that I did not interrogate the psychological effects of climate change on women and the particular stress this evokes in coping with food insecurity.

Nonetheless, the study pointed to some important findings that could translate into policy recommendations in order to address the effect of climate change on rural farmers, particularly women.

- Patriarchy comes out as one of the key factors that influences biased decision-making and distribution of resources, thereby exposing women to effects of climate change and barring them from coping and building resilience. Thus, the study recommends that to deal with the root causes of vulnerability and deprivation among women farmers, gender analysis should be conducted in both local and national institutions, along with gender mainstreaming coupled with communal sensitisation meetings on gender initiated at grassroots levels.
- Because gender discrimination in access to key production assets is still upheld by the communities despite the availability of gender-equitable policy frameworks, interventions should focus on implementation of the constitution and promoting equality and equity between genders. In addition, local community leaders such as chiefs and village elders should be sensitised to implement the constitution at the local levels, and there should be clearly defined measures for those who contravene the constitution and deny women the rights to own land. There is need to expand the hunger safety-net programme to target poor and vulnerable women across the country, unlike the current programme focused on the four regional counties which is not helping rural farmers at the local level.
- The study shows that women farmers mostly depend on indigenous knowledge that is localised and contextual to respond to climate change. However, this information is often not time-bound; therefore, corroboration of indigenous knowledge on climate change with scientific information should be done. Such information should be

packaged in a simple understandable way and disseminated to the rural farmers timeously to enable rural women farmers to understand and apply them to anticipate and adapt to impending climate chocks.

- The findings show that social capital is one of the forms of capitals that women use to build resilience against climate change. Bonding and bridging capital are most often based on family ties and community groups and have helped women to survive the effects of short-term climate changes. However, long-term shocks have seen these bonds break down. There is a need to strengthen local organisations that are based on trust and provide immediate support during shocks, to build resilience to climate change. In addition, in the spirit of ABCD framework, community organisations should be empowered to use locally available resources to enhance their livelihoods.
- The linkages between rural farmers and government institutions are dwindling, yet government often comes in when communities are already vulnerable. As a way of enhancing resilience among rural farmers, strengthening communal networks and groups through training and timely climate information provision is key. Since NGOs have more established relations with the communities, there is a need to strengthen the linkage between government, civil society, NGOs and the community to help build sustainable support systems for climate change adaptation and resilience-building.
- The study shows that the effects of climate change are more profound for the socially deprived within the community, and in most cases, deprivation is caused by shifts in power, and favours based on gender, tribe, and social affiliations. The government should use existing institutions to shift power, beliefs, values, and ways of thinking and behaving to support greater levels of justice and equity.
- The study shows that institutions such as government often come in when communities are already vulnerable to shocks, which may not be the best way to build long-term sustainable resilience among communities. The need to implement absorptive resilience programmes is an opportunity for the both the county and national governments. Climate change planning, and funding and implementation of projects that help reduce the effects of climate change is a national requirement.
- Since the study shows women's adaptive capacity is compromised by limited access to capitals, and that women suffer the effects of climate change more profoundly, there a need to set aside climate adaptation funds that women can easily access to help them

adapt during climate-related shocks. Such funds can help women affected by climate change to easily adapt and build resilience.

- Finally, since women are key stakeholders in climate mitigation, their involvement in planning and climate budgeting can help the government implement gender adaptation measures that are sensitive to women.

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APPENDIX

Appendix 1: FGD Guide

I would like to welcome everyone and thank you for being here with me today. You are asked to participate in a research study conducted by Pauline Nelima Liru. Ph.D. student (Sociology) from the Department of Sociology and Social Anthropology at Stellenbosch University, South Africa. The *result of this research will contribute to my thesis.* You were selected as a possible participant in this study because you are one of the people who have been here for some time and have experienced change in climate.

Mulembe vosi, karibu sana mushikhalo shino indalo ya vulano.Ndakhayanzile muvevarechelefu hano no omukhana wenyu omukabras uvukulilanga amasomo kake ka PhD. (kaikulu) mushivala sha South Africa.Okhulondekhenanende(mwaavandunendeezifamiliavamenyamushivala) (sociology).Omuchango kwenyu nikwo kulaweleshia Pauline Ovulafu vwookhumanya ovwononi vwookhupatilika khwo elwiuva, (climate change).

I am here today to learn from you and share your experiences about how climate change is affecting your livelihood especially those women that are engaged in agriculture as their major livelihood in this community. With your permission, we will discuss this and any other questions related to climate change. Your answers will be very helpful the country and your community formulate more effective policies and strategies to improve the situation of food security and livelihood in Kenya.

Embelehanovulanookhuhambilahalalaokhumanyeombumabadilikokelwiuvakalerangaovuono nishinakhufwakhulianendelimenyaliavanduvakabras. Muno muno avandu veshishele. Ovuyeti vyenyu nivywamaana sana. Eshivalasha Kenya nendeekominityyosikhulanyolaovuyetiokhulondakhananendeelwivaokwononaofwakhulianen de a Maisha kava Kenya vosi.

We want this group to be a safe place for you to be honest. Everything that is said in this group today is off the record. Your name will never be used. We will only refer to your comments by saying ‘a community member said this’……. For the purpose of capturing all the important information you are giving us, we will be taping our discussion today. The tapes will be kept safe and private and heard only by the investigators in this project. When we are finished with the tapes for our research, the information recorded in them will be erased.

Khwakhayanzile omukhungano kuno kuve nende eliampana nende vuatoto. Kosi kakhulalomaloma hano kalawela hano. Mumaandishi sikhulataja amera kavandu tawe. Khulava nende eshifa shokhutepa kosi kamulomaloma mala khuvishe avundu halayi.Emilimo chosi nichakhawa khulafuta amakhuva kosi kakhulomelome.

We will spend about 45 minutes to an hour together today. During that time, we should be respectful of each other. Some of the rules we want to set for our discussion are:

Khulavukula amasaa arubaini na tano (45 minutes).

1. One voice at a time.
2. Do not interrupt when another person is talking.
3. Everyone's opinions are important. Be careful not to criticize anyone.
4. Confidentiality: what is shared in the meeting today should not be shared with other people after the meeting.
5. Speak loudly and clearly so that we do not miss any of the ideas you share.

1. Omundu mulala khulomaloma
2. Okhalomalomao owashio nalomaloma tawe
3. Ni maana sana okhuhelesia owasho heshima arusie amaonikake
4. Kakhulomaloma hano khukhazia khulomaloma nende avandu vayilwanyi tawe
5. Khuyanze okhulomaloma khuulilikhane

What else would you wish to add to make our discussion successful?

Mbushina shonyala watasakhuno okhumeta khukakhulomelome?

Please answer the questions based on your experience or what you understand are the experiences of other members of your community.

Noyanza jiba amarevoo khulondakhana nende mwanga welewire

Before we begin, let us get to know each other. We will go round the circle and each person will tell the group something about themselves, such as where they are living,

Community knowledge about status of Climate change Eshikhalo okhulondakhana nende elielewa liaamapatiliko kehewa ama anga

1. What do you understand about climate change?

Note: Moderator to guide on the aspects of climate change, drought, floods cyclone precipitation.

Welewa ombushina okhulondakha nanende amapatilikokehewa mu kabras?

2. What are the **<u>main livelihood activities</u>** for people in this community?
Ni furakwa nende ovunyolelo shina vwa a vandu vakabras varumushilanga?

a. General climate change and effects

1. What changes in the climate and weather have people observed over the past 5 years?

   (probe temperatures, precipitation, cyclones, floods, droughts, etc.)

   Ni mapadiliko shina khu hewa ka vandu valolile khulwe miaka jirano?

2. Which climate related hazards occur in the area, when, how often and how strong are they?

   Ni hewa aina shina yachangie kabisa, khulwa muda shina nende zingufu shina?

3. Have changes been observed in the occurrence of these hazards (frequency, intensity, etc)
   Ni Tofauti shina yavelewo khulwa muda shina? Vusuro shina?
4. How do climate change and related hazards affect the lives of men and women in this sub county.
   Amapatiliko ke hewa kaleranga ovuononi shina khu a vasakhulu nende avashele?

b. Capitals and assets women draw upon to deal with the effects of climate change on their livelihoods

Ovunyolelo nende ovuvishilo vwaavashele, Hewa ileranga ovononishina?

1. How do women deal with the effects of climate change on their livelihood?
   Avanduveeshishelevarumushilangashinaokhukabilianandeehewaintamanuino?
2. What assets/ capitals do women draw to deal with the effects of climate change on their livelihoods?
   Avanduveeshishelevarumushilangashinaokhukabilianandeovononivwehewaindamanuino?

Probe

- **Human capital**- the skills, knowledge, ability to labour and good health and physical capability important for the successful pursuit of different livelihood strategies.
- **Natural capital-** (land, water and biological resources such as trees, pasture, and biodiversity)
- **Physical capital-** (infrastructure such as roads, irrigation works, electricity, reticulated equipment and housing.)
- **Financial capital-** (Earnings, financial savings, access to credit, and debt levels, disposable assets like livestock, chicken etc.)
- **Social capital** -the social resources (networks, social claims, social relations, affiliations, associations) upon which people draw when pursuing different livelihood strategies
- Which do women resort to in order to deal with climate change effects on their livelihoods?

c. Gender and power dynamics that affect women's access to resources ability to adapt and mitigate the effects of climate change on their livelihoods.

Ovuwezokatiyaomusakhulunendeomushelemunzukhuvelekhonendeovuamuzivosivosi?

1. Are there gender differences in adaptive capac-ity and priorities for adaptation? How do they affect access to resource and adaptive capacity?

Probe

- information, education and training on issues such as seasonal forecasts and climate change projections,
- suitable adaptation approaches and technologies , and new livelihood options;
- Ability to make choices and decisions regarding adaptation measures, livelihood options decisions, and perhaps whether to relocate as a response to changes;
- access to resources, such as finance, land, and knowledge; strong social capital and support networks to foster sharing of skills, knowledge, access to resources, and emotional support.
- What are the most important livelihood resources to different groups within the community?

2. Typically in this area, which types of assets belong to women?
   Okhulondekhana nende ori, emalishina ilindwanka nende avandu veshishele?
3. Who has the right to use the most assets / who makes the decision about the uses of assets (such as land, which crops to plant)?
   Ni wina uli nende ovunyali vwookhurumushila omukunda?
   - Who has the right to rent the asset?
   - Who has the right to sell the asset?
   - Who holds the right to lend the asset to someone else?
   - Who holds the right to decide who can/cannot use the asset?
   - Who takes the decision about how to spend revenue generated from the asset?
   - Who makes the decision about inheriting the asset?
4. What affects women's access to capital/ assets (probe physical, social, human, financial, and natural capital)
   Ni shina shizuiangaka avandu ve shishele okhwimilila emali ya mwi boma?

d. How climate change is affecting women's asset bases and their survival strategies.

Ni injilashina ye hewa indamanu injilililanga ovunyolelo vwa vandu veshishele? Ne injila shina yavarumushilanga okhuonia emianduchavo?

- How does climate change affect women's asset base in this sub county?
- How does such changes affect women's survival strategies?

e. Way forward

1. Which assets/ capital help women to better cope with the effects of climate change?
2. What do you think can be done to help women better cope with the effects of climate change on their livelihoods?
3. Are there any other information you would want to clarify?

Thanks for your time and responses. I appreciate your time and patience.

God bless you all.

Asante sana khulwookhufwila okhumbulilisia nende okhukhonya kama omwana wenyu.

Omwivulwa wenyu khumasomokanjeilwanyi we shivala.Nyasaye avalinde koo.

Appendix 2: Key Informant Interviews guide

I would like to welcome you and thank you for being here with me today. You are asked to participate in a research study conducted by Pauline Nelima Liru. Ph.D. student (Sociology) from the Department of Sociology and Social Anthropology at Stellenbosch University, the *result of this research will contribute to my thesis.* You were selected as a possible participant in this study because you are one of the people with Key information about women farmers' livelihoods and climate change adaptation in this County

1. What changes in the climate and weather have people observed over the past 5 years? (probe temperatures, precipitation, cyclones, floods, droughts, etc.)
2. How have these changes affected the livelihoods of women in this sub county?
3. How do women cope with the effects of climate change in this area
4. What assets/ capitals do they draw to to mitigate the effects of climate change?
5. Are there gender differences in adaptive capacity and priorities for adaptation?
6. If so what brings about the gender differences in adaptive capacity and priorities for adaptation?
7. In your opinion who has the ownership of different kinds of assets/ capital and why so? (explore all the five forms of capital)
8. What factors affect the ownership of assets between men and women?
9. Does climate change affect the asset base of women in this community? If so, how and why?
10. Which assets are most affected by climate change and how?
11. What do you think could be done to help women better build their livelihoods and be in a position to mitigate the effects of climate change?
12. Do you have any other recommendation concerning the study?
13. Would you be having any idea if the government is supporting women on adaptation and mitigation of climate change?

Thanks for your time.

Appendix 3: Observation Guide

1. General guidelines

- observing people as they engage in activities that would probably occur in much the same way if you were not present
- Engaging to some extent in the activities taking place, either in order to better understand the local perspective or so as not to call attention to yourself
- Interacting with people socially outside of a controlled research environment, such as at a bar, market places, religious gathering, or market –establish cassual conversations. If casual conversation gives way to more substantive discussion of the research topic, you would need to disclose your identity, affiliation, and purpose
- Identifying and developing relationships with key informants, stakeholders, and gatekeepers

2. **Duration:** Observation should take thirty to forty-five minutes

3. Where to conduct observations and what to observe

- Observe duties women undertake (within homes, farms and groups), how they relate and their conversations
- Observe women in the market place (what they sell and buy), observe the conversation and how they relate
- Observe women conversations in women groups, churches
- Attend a public baraza if possible and make notes from women's behaviours, attendance, contributions and their interactions with men note the topics discussed and whether women contribute.

Remember to remain within the research objectives

Appendix 4 Life history guide

Should be administered to older women

Have been practicing agriculture for more than a decade in the area.

- Could you tell us about your life history since you were born?
- What climate changes have you observed over the last 20 years?
- How have you responded to climate changes and shocks that you have faced through life
- Are there changes in assets you have used to adapt during shocks over time ?
- Who were you closest to when you were growing up?

Have you had changes in asset holdings since the last 20 years?

At what point in life did you accumulate livelihood assets that helped you adapt to climate? (Get as full a story as possible – opportunities, investments, luck, help from others, policy interventions, help from government/ NGOs)

Is there a time you became more vulnerable to the effects of climate change?

What made you more vulnerable to the effects of climate change? Probe for a full story shocks, coping strategies, barriers to entry and exit)

Probe how social capital has helped build resilience

Probe Links with family/ 'friends' and how it affects their adaptation?

Probe for relationships with employers/ richer households – how have these affected you?

Probe for Relationships with employees/ poorer households – how have these affected you?

Probe for Social networks (women groups, clubs, church, SACCOs etc.) – how have these affected you?

Probe for Kinship networks – how have these affected you?