WATER SECURITY RISKS AND COPING MECHANISMS AMONG SEDENTARIZED PASTORALISTS IN ISIOLO COUNTY, KENYA

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DECLARATION

This project paper is my original work and has not been presented in any other institution for examination.

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This project paper has been submitted for examination with my approval as the university supervisor.

Signature  Date: 26th May, 2021

Dr. Dalmas Omia

DEDICATION

I dedicate this project to God Almighty my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding. I also dedicate this work to my two most lovely daughters, Aitsa and Aura, you keep me going and to my husband Anthony, you are the best thing that ever happened to me.

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ABBREVIATIONS AND ACRONYMS

ASALs	Arid and Semi-Arid Lands
FGD	Focus Group Discussion
KII	Key Informant Interview
KIRA	Kenya Interagency Rapid Assessment
KNBS	Kenya National Bureau of Statistics
NACOSTI	National Commission on Science, Technology and Innovation
NDMA	National Drought Management Authority
SPSS	Statistical Package for Social Science
UN	United Nations
UNDP	United National Development Programme
WUA	Water User Association

ABSTRACT

This study was conducted in Isiolo Sub-County of Isiolo County. Underpinned by cross-sectional design, the study investigated water security risks and coping mechanisms among sedentarized pastoralists in Isiolo County. The study, specifically, sought to: describe water security dynamics among sedentarized pastoralists; identify water needs and challenges for sedentarized pastoralists; and establish water insecurity coping mechanisms among sedentarized pastoralists. The study was guided by Social Learning Theory and Ecological Framework as lenses of inquiry. The population for this study was sedentarized pastoralists living in Wabera Ward in Isiolo Sub-County and the unit of analysis was the individual man or woman. Data was collected using quantitative and qualitative methods namely; survey, focus group discussions and key informant interviews. The survey questionnaires were administered among 100 pastoral men and women aged between 18 and 60 years randomly sampled. Purposive sampling was used to select the key informants and FGD participants. Quantitative data collected was analyzed through descriptive statistics using the Statistical Package for the Social Science (SPSS) Version 23 and presented in form of tables, percentages, means and frequencies. Using NVivo version 12, qualitative data collected from the focus discussions and key informant interviews were coded and analyzed thematically where the study objectives acted as the parent themes. The study findings indicate that water insecurity dynamics manifest in terms of water access, quantity, quality and cultural implications including conflicts and distress for women and children. In this regard, climate change leads to changing seasons in the study area i.e short and long rains and dry and extended dry periods which are characterized by varying access and availability of water. The main source of water in the study is the borehole which was cited as dependent source throughout the various seasons. Whereas women and children are principally involved in water-related roles, participation of men is minimal in water collection but have strong power in control access to water sources. Water needs for men and women are highly associated with their gender roles where women's water needs are mostly for domestic purpose while men's water needs are for livestock use. The finding shows that men and women in the study experienced water-related challenges such as increased trekking distance, dirty water, water scarcity, high water prices/tariffs, conflict at water sources, domestic violence among others. Pastoral communities have adopted strategies to cope with security risk among them harvesting rainwater, rescheduling water-related activities, borrowing, reusing water and purchasing water. The study concludes that sedentarized pastoral communities have to cover long distances to access water and meet the high water tariffs despite the continuous investment by the government and its partners in ensuring water access is achieved for all populations including those in the ASALs in Kenya. The study recommends that since women are the custodian water at the household level, their voices reflecting on their unique needs and challenges should be incorporated in decision-making around water security by the water user associations. In terms of research, a study looking at social capital as a form of coping with water security among sedentarized pastoralist in Isiolo County should be conducted.

1.0 CHAPTER ONE: BACKGROUND TO THE STUDY

1.1 Introduction

Pastoralism constitutes one of the economic and subsistence systems practiced across the world especially in the drylands (Davies, 2007). It entails extensive grazing for livestock production on rangelands. It is an effective production system in places that are arid or semi-arid, too cold, or too steep and rocky where agriculture and other production systems cannot thrive. Pastoralism is thus an adaptive economic and subsistence system. According to Wakhungu et al., (2014), pastoralism refers to a system where the majority of food and income is derived from livestock. In sub-Saharan Africa, there are approximately 20 million pastoralists- depending primarily on livestock and livestock products (Wakhungu et al., 2014; UNDP, 2018; Sambu and Tarhule, 2013; Herero, 2010)

Estimations further show that 70% of the landmass across the Horn of Africa is arid and semiarid. At least 80% of the landmass in Kenya is classified as ASALs where most pastoralism takes place (UNDP, 2018). ASALs account for more than 83% of the country's landmass and the majority of the areas are in Northern Kenya. According to Kirbride and Grahn (2008), Northern Kenya is home to around 4 million pastoralists, who form at least 10% of Kenya's population. Wakhungu et al. (2014) assert that over 75% of cattle herds in Kenya are reared by pastoralist and that 24% of total agricultural output in Kenya comes from livestock production. This demonstrates the centrality of pastoralism in the country's production and economic growth.

Pastoralists characteristically graze animals on open-access pastures or communally manage rangelands. Nomadic pastoralists move with the animals seasonally depending on the availability of water and pastures. In transhumance, animals are grazed in lowlands in a wet season or winter and move to graze animals in the pasture-rich highlands during dry season

or summer (Davies, 2007). However, another form of pastoralism has emerged: sedentary pastoralism (Kumar et al., 2011) where groups of pastoralists have settled in permanent or semi-permanent areas and have become sedentary. Sedentarization has involved settling the pastoralists in one area and has occurred in various parts of Northern Kenya.

Water security in ASALs and among sedentarized pastoralists is a fundamental issue as the pastoral communities face acute water shortages and a significant reduction in water access (UNDP, 2018). Water security is "the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability." (UN Water, 2013: 1). Sedentarized pastoralists in Kenya have increasingly faced water security risk based on different combinations of factors. The water security issue has also been aggravated by the climate change that has affected the hydrosphere inclusively (Herrero et al., 2010). Thus, ASALs have the risk of water insecurity thus access to adequate safe water for household and livestock consumption is compromised.

Unlike pastoralists who move from one place to another in search of pasture and water for animals, sedentarized pastoralists have settled on a certain area (Choe et al., 2000). This creates different water needs. Among the sedentarized pastoralists, households and animals alike require a reliable and adequate water supply. Water for intensive domestic and animal use intensifies water needs for sedentarized pastoralists. Since they do not move from one place to another, the water supply must be consistent to cater to the dynamic needs. Based on the water security risk, the sedentarized pastoralists have to develop a reliable water supply system through a variety of means. Literature shows that besides diversifying water sources, households among sedentarized pastoralists devise appropriate water use patterns including reduction of water use and reusing water (Kumar et al., 2011).

The study was designed to assess water security among the sedentarized pastoralists in Isiolo County in Northern Kenya which is predominantly occupied by sedentarized pastoralists. The study sought to understand water security dynamics, water needs and use as well as the coping mechanisms among sedentarized pastoralists in the area.

1.2 Problem Statement

Most pastoralists live in ASALs with a high risk of water insecurity based on the physical environmental conditions (Herrero, 2010). Erratic rainfall, poor water infrastructure, and unreliable water supply predispose pastoralists to water security risk despite the established water needs for livestock (Sambu and Tarhule, 2013). In recent times, the sedentarization of pastoralists has been pursued and has limited conventional movement from one place to another in search of water and pasture (nomadism), thereby exacerbating the water security risk. It is important to investigate the water security dynamics in the wake of the continued sedentarization of pastoralism.

Recent studies (Davies, 2015; Njoka et al., 2016) on the subject of pastoralism have examined the ecological carrying capacity of the arid and semi-arid area ability to sustain traditional forms of pastoralism. Further, other studies (Nganyanyuka et al., 2014) while (Wakhungu et al., 2014; Cook et al., 2016) have examined the trends, causes and effects of water insecurity on pastoralism besides assessing conflicts over common pool resources and other associated challenges have only assessed food security among the pastoralists. Whereas as these studies also entail situation of water needs among the pastoralists, they have been carried out among the nomadic pastoralists, thus, a knowledge gap exists on the experiences of sedentarized pastoralists, more so, sedentarization in the context of deepening water insecurity, which this study sought to investigate.

To address the aforementioned, the study answered the following research questions:

i. What are the water security dynamics for sedentarized pastoralists in Isiolo County?
ii. What are the water uses, needs and challenges for sedentarized pastoralists in Isiolo County?
iii. What is the water insecurity coping mechanisms among sedentarized pastoralists in Isiolo County?

1.3 Study Objectives

1.3.1 Overall objective

To investigate water security and coping mechanisms among sedentarized pastoralists in Isiolo County

1.3.2 Specific Objectives

i. To describe water security dynamics among sedentarized pastoralists in Isiolo County.
ii. To identify water needs and challenges for sedentarized pastoralists in Isiolo County.
iii. To establish water insecurity coping mechanisms among sedentarized pastoralists in Isiolo County.

1.4 Assumptions of the study

i. Sedentarized pastoralists in Isiolo County face water security risks at different levels.
ii. Sedentarized pastoralists in IsioloCounty have water needs including livestock and household water uses such as laundry and cooking.
iii. Rainwater harvesting, water trucking and reusing water and are complementing coping mechanisms adopted by sedentarized pastoralists in Isiolo County

1.5 Justification of the study

The study focused on water security and coping mechanisms among sedentarized pastoralists in Isiolo County. The study established rich results on the gendered experiences of sedentarized pastoralists with water security risk in Isiolo County. These results contribute to

the body of knowledge on water security in the ASALs in Kenya in general and specifically among sedentarized pastoralists. The study revealed that water security dynamics involved constant changing seasons where dry seasons are characterized by unreliable water sources and inadequate water access for men and women. While women's water needs were found to be largely for domestic use and men needed water mostly for livestock use, these water needs and uses of water for men and women were found to vary across seasons. Pastoral men and women adopted mechanisms such as rescheduling water activities and recycling water to cope with water insecurity challenges. These findings would be useful to the Isiolo County Water Department in understanding the patterns of water security for purposes of planning for interventions. The findings of the study can also inform the wide range of coping strategies that can be replicated in other areas to build resilience on water insecurity.

From a programming perspective, the unique water security challenges such as high water tariffs and poor quality of water and the different coping mechanism adopted by men and women including borrowing of water would form the basis for evaluating the sedentarization process that pastoral communities in Northern Kenya have adopted. By assessing the water security and the coping mechanisms, the study focused on key water insecurity variables thereby providing an assessment tool on sedentarization of pastoralists in Isiolo County. The findings generated from this study can also act as a reference point for other researchers and academicians interested in the study topic.

1.6 Scope and Limitations of the study

The study is a cross-sectional descriptive study and was conducted in Wabera Ward in Isiolo Central Sub-County of Isiolo County. The study adopted both quantitative and qualitative methods to collect data. The study targeted men and women living in Wabera Ward in Isiolo Central Sub-County and who were sedentarized pastoralists aged 18 years and above. The

study focused on the water insecurity dynamics, the water needs and challenges for men and women and the coping mechanisms adopted by sedentarized pastoralists in Isiolo County.

The study was guided by the Social Learning and Ecological Theories to explore water security risk and coping mechanisms in Isiolo County. The Social Learning Theory viewed the research problem from a social and learning perspective which helped explain how coping mechanisms are adopted. The theory did not cover natural aspects of the problem that may not involve social learning or processes. Nevertheless, the key aspects of socio-ecological experience and coping were accounted for by the Ecological Framework.

Community entry and rapport was a key challenge for the researcher and would have impacted discloser on the part of the study participants thus affecting the quality of data collected. However, the study overcame this limitation by using community gatekeepers such as village elders and women leaders during community entry to create rapport and assured the respondents of the confidentiality of the information they would provide. The research being an outsider, the language barrier was another key limitation that this study encountered. To overcome this limitation, the research recruited local research assistants and trained them in conducting quantitative and qualitative research. The local research assistants supported the researcher in data collection as well as acting as local guides, translators and mobilizers.

1.7 Definition of key terms

Coping mechanism: In this study, they encompass efforts and strategies that sedentarized pastoral men and women adopt to cope with the challenges of water. The demands of water for men and women within the sedentarized pastoral network must be met in the face of deepening water insecurity thus coping strategies.

Sedentarization: Involves the process of nomadic pastoralist settling in a specific area. This limits their constant mobility in search for water and pasture which is a characteristic of nomadism.

Sedentarized pastoralists Refer to pastoral men and women who were previously practising mobile lifestyle become settled in a specific place. This population does not move from place to with their livestock like the nomads but are settled in a specific area and still engage in livestock keeping and other income-generating activities.

Water security risk: Refers to the probability and possibility of a group of people experiencing water stress and challenges thereof as a result of water stress caused by changes in climate and other environmental shocks.

Water security: Refers to the reliable and acceptable quantity and quality of safe water for domestic use and livelihood production.

2.0 CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of the relevant literature on the study. The literature is reviewed along the lines of the study objectives and constitutes water security-related discourse pertinent to the study. This includes the dynamics of water security risk; the water uses and needs and; the water insecurity coping mechanisms. The chapter concludes with a discussion of the Social Learning Theory and the Ecological Framework as lenses that guided this study.

2.2. Dynamics of water security risk

According to the Global Water Partnership (2000), water security refers to the situation in which "'every person has access to enough safe water at an affordable cost to lead a clean, healthy and productive life while ensuring the environment is protected and enhanced". Water security is conceptualized as the ability of a population to have sustainable access to enough quantities of water in acceptable quality for human consumption, production. It encompasses the capacity of households to access water sustainably. However, in the phase of heightened water security risk, many people across the globe become water insecure (Hall and Borgomeo, 2013).

Climatic variability compounded by other risks, access to adequate and safe water has been compromised, rendering communities and populations water insecure. Due to the actual and potential global water scarcity, UN Water (2013) incorporated the aspect of protecting people from water-related disasters in its definition of water security. Although the globe is facing water security issues, arid and semi-arid lands (ASALs) have been significantly affected, owing to the harsh physical environment.

In Kenya, although more than half of the population lives in rural areas, only 49% has access to safe water in the domestic water supply (UNDP, 2018). The problem is exacerbated in the rural ASAL, which includes Isiolo County. According to Wekesa and Karani (2009), water sources in the ASALs include direct use of natural resources such as surface water- rivers, streams, springs and artificial water sources including dams, and pans. Other water sources include developed groundwater including shallow wells and boreholes. The water security dynamics encompass water availability, gender implications, food security, health and conflict among other topical water security-related issues.

Water constitutes an important component of household food security for humans and livestock. There is an intricate relationship between water and food security risk and the two are characteristic of ASALs and are mutually reinforcing (Galaty, 2013). Both are exacerbated during drought and have other environmental connections including climate change. The water security risk is a precursor for food insecurity. Thus, the food security risk is an important undercurrent in water security risk discourse.

Further, based on gender roles and gender relations, water security risk produces a distinct and conspicuous gender tinge. Although men and women might have similar water needs, gender roles produce different ways in which water security risk is experienced. Women are often vested with the role of replenishing households with water and performing household chores that involve the use of water (Lusuva, 2009). Thus, during water scarcity, women are affected concerning the gender roles related to water use. On the other hand, men especially in the pastoral communities have the responsibility of looking after the cattle. Water security risk thus has important gender implications/dynamics (Isiolo County Integrated Smart Survey, 2017).

During the drought in the ASALs, women and children walk for long distances to search for water, whose quality is not guaranteed. The women's gender role of supplying households with water has a gender connotation and has resulted in the women and girls facing long queues waiting to get water during water rationing days. Girls and boys also spend a lot of time fetching water. Studies have shown that the role has had a far-reaching impact on the education of the girls (Lusuva, 2009; Galaty, 2013). According to the Isiolo County Integrated Smart Survey (2017), the proportion of households trekking less than 500m remained at 73% while more than 2km increased up to 22% in 2017. This indicates that nearby water sources have been depleted. In the 2017 survey, 43% of people reported at least 1-hour queuing time and waiting for more than one hour accounted for 43% (Isiolo County Integrated Smart Survey, 2017).

Health, hygiene and water safety are other dynamics associated with a water security risk. The Isiolo County Integrated Smart Survey (2017), reports that as of 2017 19% of watery diarrhoea accounted for 19% of morbidity in Isiolo County. Further, increased women workload due to water and pasture shortage and food shortage due to the prevailing drought, causing high maternal malnutrition.

The ever-changing climate in arid and semi-arid lands of Northern Kenya, Isiolo included, means that there is variation in patterns of rainfall, episodes of more drought periods, depletion of water resources and other rangeland resources such as pasture (Lusuva, 2009). This increased climate variability has led to changing demographic dynamics of the pastoral communities which are manifested in the increased sedentary lifestyle and the rapid growth of small peri-urban centres in the pastoral system.

The two reasons have been advanced behind this settled lifestyle of pastoralist communities (i) the loss of livestock dues to extended drought leading to loss of livelihood (ii) climate

variability leads to loss of common-pool resources which sustain the livelihoods of these communities hence increased conflict over resources. Wekesa & Karani, 2009; Lusuva, 2009; Galaty, 2013). Water security risk is thus a phenomenon for both settled and nomadic pastoralist with the most disadvantaged groups being women and children as they are the ones burdened with the role of ensuring the household is water secure (Njoka et al., 2016).

Water insecurity in pastoral systems is characterized by situations where water availability is below the recommended quality and quality. Literature on water scarcity points to the fact that water scarcity is both a man-made and natural disaster resulting from the effects of climate variability as pointed out in the previous paragraphs. In Isiolo County, the main sources of water are boreholes which a few perennial rivers such as the river Ewaso Nyiro which traverses several counties in Northern Kenya (Njoka et al., 2016). There is a high loss of rangeland pasture in the ASAL counties. As result, conflict over these limited sources of water and pastures has been witnessed as a key dynamic of water security risk.

2.3 Water use, needs and challenges

Water is an important resource and sustains life. Although water is a universal commodity, its use may vary from one subsistence system to another and from one setting to another. In the ASALs, occupied mostly by pastoralists, water is mainly used for livestock and household or domestic use. Different areas also face different water challenges. In addition, sedentary pastoralists practice small scale crop farming and this forms another water need. In domestic circles, water is mainly used for cooking, cooling, promoting hygiene through laundry and washing household items (Lusuva, 2009). Water has also used a solvent. In Isiolo County, water needs are still high and the Isiolo County Integrated Smart Survey (2017) shows that the majority of the households consume at least 20 Liters per day.

According to Hadger, Klein & Schopp (2005), water consumption is embedded in the social context and that the lowest consumption occurs during the dry season. The size of the household, access to water resources, residence (urban and rural) and seasonality are important indicators and influencers of water use and consumption patterns. On residence, there is a discrepancy in not only quantities of water consumed and purpose but also a defined difference in consumption among 'rich' and 'poor' households in urban settings. Households also form the centrepiece of water use and consumption. Household size and characteristics differ significantly in urban and rural settings.

Water use and consumption stem from the cultural models that are related to water. This produces a wide range of cultural knowledge of watery environments. For instance, among the Samburu and the Rendille, the need for water for livestock consumption is reinforced with folk knowledge and practices regarding predicting rainfall. In other circumstances, water use and consumption patterns are part of resource-related conflicts. Among the pastoralists in East Africa, water is the bone of contention and conflict, including cattle banditry (Omosa, 2005). In addition, the use of water for irrigation has also attracted conflict with authorities as the focus is on irrigation control within small-scale communities. The bureaucratic control of agriculture supported by irrigation is inevitable.

According to Sheridan (2002), irrigation and agriculture are culturally embedded. This is where symbolic correlations between agricultural and human fertility are produced in certain communities such as the Pare in Tanzania. As a form of water use and consumption, irrigation systems have symbolic and material forms of capital aspects (Sheridan, 2002). This has formed the platform for maintaining age and gender-based social differences relating to water rights, labour and resources.

The water demands in the households however exceed water supply and availability, especially in the ASALs. Water scarcity is often the result and communities affected are water insecure. Unreliable water supply and the subsequent water shortage are the overarching water challenges that persons especially in the ASALs have to contend with (Isiolo County Integrated Smart Survey, 2017). The quality and safety of water is another challenge. Although there may be a supply of water the quality might be compromised through contamination. Open and surface water sources and the risk of contamination during trucking contribute to the challenge of poor water quality (Cook et al., 2016).

Where good water is scarce and men and women need it for different purposes, such as household uses and cattle, competition and conflicts over its division are common. Examples are livestock areas in Botswana, northern Tanzania and Gujarat and areas with high fluoride content in groundwater which damages teeth and bones of humans and animals (Galaty, 2013; Wilk & Jonsson, 2013). Conflicting interests in water and land use in the catchment areas of community water supply systems also have an increasingly negative impact on the availability and quality of drinking water (Galaty, 2013; Wilk and Jonsson, 2013).

2.4 Coping Strategies

Historically, communities and individuals have developed measures to survive amid unfavourable social and environmental conditions and risks. The adopted coping strategies demonstrate not only resilience but also an adaptive mechanism. Communities in areas experiencing frequent drought and climatic shocks leading to water security have adopted distinct coping strategies in different combination. The adjustments the communities make are mainly social and target responding to water security risk.

Diversifying water sources is also a coping strategy adopted. In response to a water security risk, households increase the number of water sources to enhance water quantity and

availability (Majuru, et al., 2016). The strategy entails relying on multiple water sources to not only avoid depletion but also improve reliability. Drilling boreholes or shallow wells, harvesting rainwater, storing water, and purchasing water is used collectively (Nganyanyuka et al., 2014).

They include a change in water use patterns and various innovations aimed at increasing water quantity and harvesting. Rainwater harvesting and management is one of the strategies that water insecure communities especially in the ASALs have adopted. Prolonged rainfall shortage contributes significantly to a water security risk, especially in the drylands. However, in the short and long rains water can be harvested and stored for future use. Relying on the rain calendars and patterns, households prepare for rainwater harvesting and storage spaces. According to Aroka (2010), Rainwater harvesting involves the diversion, collecting, storage, usage, and management of runoff through various schemes and as sustainably as possible. This allows future use of the collected water. According to Cook et al., 2016 and Nganyanyuka et al., (2014), this coping mechanism is evident in Kenyan and Tanzanian pastoral and non-pastoral communities and entails storing water in large capacity tanks.

The coping strategy however is rainfall-reliant and may not be useful in prolonged rainfall shortage. In addition, although rainwater harvesting can be simple, effective harvesting demands resources including water storage spaces such as drums, tanks and other containers. The strategy is also not reliable because of not only being rainfall-dependent but also lack regular replenishing of water, meaning that households can use the stored water for only a short period. Nevertheless, the method remains a useful water security risk coping strategy.

Closely connected to rainwater harvesting strategy, building water harvesting structures comes in handy to help communities and households cope with water insecurity. Apart from

portable water structures such as tanks, dams and other water reservoirs can be built to accommodate water for continued use (Choe et al., 2000). Overhead water structures also help store water once it is harvested or piped (Cook et al., 2016). The stored water can then be distributed for use within the community and by the households. Building water harvesting structures are however associated with cost or economic implications for poor-resource households.

Sedentary pastoralists do not only keep livestock but also practice crop farming on small scale (Wakhungu et al., 2014). To ensure crop production and overcome the limitation of rainfall shortage, irrigation is deemed a survival technique. The harvested and stored water can be piped to the farms for irrigation. This coping strategy however applies to sedentary pastoralists practising crop farming and subject to the availability of a good water supply for irrigation. This would call for piped water or comprehensive water harvesting and storage structures.

Pastoralists facing water security risk have resorted to coping strategies that are useful at the household level. The strategies focus on efficient use of water and avoid wastage. Reusing water is a common practice among pastoralists. According to Chaminuka and Nyatsanza (2013), households facing water security risk use water for different purposes to reduce the amount of water used. According to the Isiolo County Government (2016), drilling of boreholes and laying of pipes to cater for human and livestock use are strategies amid drought, with high potential and has the great achievement. Diversified sources of water also reduce the dependability on the piped water.

Reusing water often involves using the same amount of water for different chore such as using the laundry water to flush toilets or wash the floor (Smiley, 2016). Households also post-pone or reschedule certain water-consuming chores including laundry and reducing the

number of meals cooked per day and reserving drinking (Gerlach and Franceys, 2009). These practices aim at reducing water use. However, the strategy may pose another risk: hygiene and sanitation. The desired optimum and reduced use of water are associated with the risk of deteriorating hygiene and sanitation. In the pastoral communities, water-borne diseases including acute diarrhoea have been reported (Isiolo County Government 2016; Majuru, et al., 2016).

Water trucking and pricing is another strategy for coping adopted by water-stressed communities. Households purchase water from tracking services offered by vendors and other private sources (Nganganyuka et al., 2014). In the ASALs, including Isiolo, water trucking and pricing are common, although the strategy is riddled with cost implication (Gulyaniet al., 2005). Isiolo County Integrated Smart Survey (2017) shows that water vending and pricing in Isiolo County is at 5%. Additionally, water is prone to contamination during trade and transportation. Nevertheless, there are water-treating options adopted by households to improve water quality and safety. Treating water can also be used as a coping strategy in itself as it makes unusable water usable. In a 2017 survey, 38.6% of the households consuming water from unprotected sources were found to be treating water by either boiling or using chemicals in Isiolo County (Isiolo County Government 2016).

2.5 Theoretical framework

The study was guided by two theories. i.e Social Learning theory and Ecological Framework. The Social Learning Theory stems from the work of Bandura (1977), a psychologist. Social learning theory rests on the assumption that human beings have an inherent capacity to learn. At the centre of the theory are three key concepts. The first rests on the idea that people can learn through observations; the second provides that internal mental states are key parts of the learning process while the third tenet postulates that learning doesn’t always result in

behaviour change. Human beings, thus, learn from the environment and this accounts for their behavioural patterning and modelling. The theory is medial, coming between cognitive and behavioural psychology because of its focus on memory, attention, and motivation that serves to guide action.

According to the social learning theory, learning occurs within a social setting and mainly through modelling which involves observing others. Human behaviour is understood as a persistent change in the interaction between the environment and cognition. According to Bandura (1977), modelling must fulfil certain conditions for effectiveness. These conditions are attention, retention, reproduction and motivation (Bandura, 1977). The observable must gain the attention or keenness of the observer who is also the learner. The learner retains the observed and can reproduce that in another social setting. Motivation entails the platform or having sufficient reason and will to put into practice or imitate what is learned (Bandura, 1977). The focus is less on behavioural determinants and more on how people learn. Learning is often built on this theory and features positive and negative role models and a character who is trying to decide on a behaviour. Social learning often explicitly engages stakeholders in knowledge creation through collective reflection and action

The Ecological Theory is grounded on Bronfenbrenner's (1979) ecological systems model. The ecological system model proposes that human behaviour is meditated upon by the physical and social environments and particularly the interrelationships among personal, situational and socio-cultural factors (Bureloma et al., 2018:55). The theory has become popular in contemporary research on human behaviour. The theory conceptualizes water security risk as a multifaceted phenomenon and offers a comprehensive theoretical approach to understanding it explicitly (Bronfenbrenner, 1979). The Ecological theory (Oxfam 2004) integrates complexities of the social context in which water insecurity occurs, provides a

more adequate characterization of the diverse causal and risk factors for water scarcity as well as a combination of personal, situational, and socio-cultural factors. The theory also establishes a significant relationship between the incidence of waters security risk and socio-economic factors and socio-demographic factors.

The theory proposes four interconnected levels conceptualized at the individual, relational, community and societal levels. At the individual level, factors to consider entails personal characteristics and experiences that influence the individual's behaviour and response to water scarcity including personality traits, attitudes and beliefs, history and experiences, sex/gender and age (Oxfam, 2004). The second level is the relationship that encompasses factors in the immediate context in which water scarcity takes place, frequently the family or other intimate or acquaintance relationships that influence the risk of water security. They include patriarchal family structure/male dominance and control, family relationships and interpersonal disparities in economic, educational and employment status (Bureloma et al., 2018; Oxfam, 2004). Then there is the community level at which factors to consider encompass the institutions and social structures and environmental characteristics that contribute to or protect against water scarcity including poverty and associated factors (e.g., overcrowding, unemployment, and low socioeconomic status), lack of institutional support, social environment (Oxfam, 2004; Bureloma et al., 2018). Finally, the societal level comprises the overarching social-cultural values, attitudes and beliefs that encourage people to respond to water security risk.

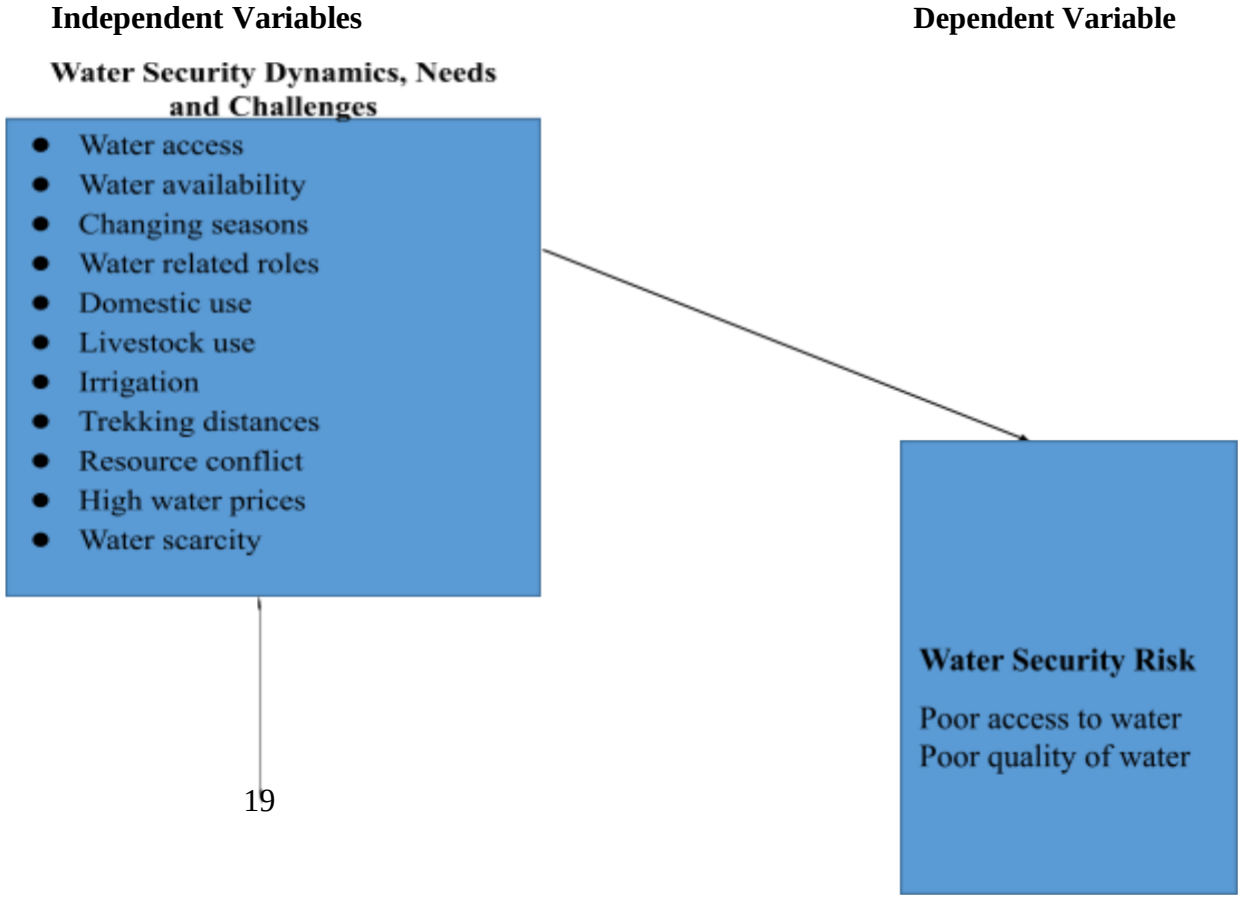
2.6 Relevance of the Theories to the study

Social Learning and Ecological Theories helped address the study objectives, hence their relevance. The theories viewed behaviour, experience and course of action as a function of learning within a social context. In exploring the water security dynamics, the theories helped inform the social construction and learning of such undercurrents such as gender that has a

wide implication on water security. Further, the theories helped explain how communities come to learn of water use including being cognizant of the challenges and knowledge on how to overcome them. The theories fundamentally helped in explaining the adoption of the coping mechanisms to water insecurity.

The theories suggest that many new coping behaviours can be acquired by observing and imitating others, extracting information from those observations, observing rewards and punishments (called vicarious reinforcement), and making decisions about the performance of the behaviour. In this model, reinforcement plays a role in learning and combined with observation is entirely responsible for learning. Since according to the theories, human beings learn from the social environment, the study was informed on how communities, households and individuals devise coping strategies and perhaps choose the feasible one from among the options. The relevance of the theories is thus demonstrated in their relationship with the study variables as shown in the conceptual framework.

2.7 Conceptual framework



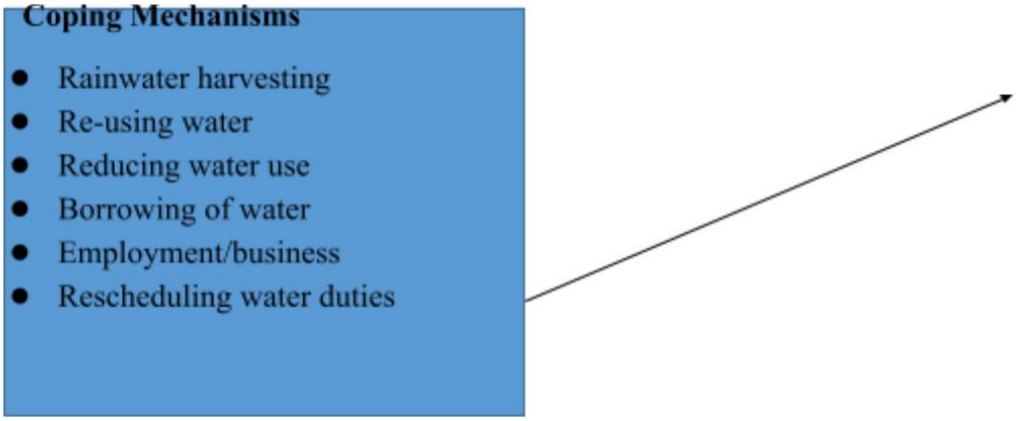


Figure 2. 1: Conceptual Framework

Source: Research Data (2021)

3.0 CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter outlines the methodological design and approach that was used to characterize the water security risk and coping mechanisms among sedentarized pastoralists in Isiolo County. The chapter includes a description of the study site, study population and unit of analysis, and the sampling procedure. It further describes data collection methods as well as data processing and analysis approaches. The ethical issues that guided the study are explained herein.

3.2 Study site

The study was conducted in Wabera Ward in Isiolo Sub-County, Isiolo County (Fig. 3.1)**.** Isiolo is located in Northern Kenya and borders Laikipia, Tana River, and Meru Counties to the South, Marsabit to North, Wajir, Mandera, and Garissa to the East and Samburu to the West. It has an area of 397 km^2, a population of 143, 345 people and a density of 360 persons per km square (KNBS, 2010; KIRA, 2014). Isiolo County is inhabited by Turkana, Borana,

Somali, and Meru communities. Borana forms the largest portion of the population. In regards to religion, the residents of Isiolo County are either Muslims or Christians. However, the heavy presence of mosques in the county is a clear indication of the dominance of the Muslim religion.

Isiolo Central Sub-County has a total population of 90,835 as per the 2019 census report distributed as follows: Wabera ward with a population of 17,431; Bulla Pesa ward 22,722; Burat ward 23,774; Ngaremara Ward 7,520; and Oldonyiro ward 20,388. The 2019 census results also showed that Isiolo Central Sub-County had a population density of 24 persons per square Kilometre. The sub-county total population is projected to grow to 98,900 in the year 2022 (KNBS, 2019; CIDP, 2018-22). Wabera Ward has been categorized as an area dominated by sedentarized pastoralist who keep small herds of livestock but have settled in semi-permanent houses (CIDP, 2018-22).

The county is characterized by the scarcity of arable land and pasture that has fueled conflicts among the communities residing in the county. The majority of the inhabitants, the Borana, practice nomadic pastoralism. This mode of production presupposes constant movement from one place to another in search of water and pasture for livestock such as goats, camels, and cows. According to Njoka (2014) in this setup men and young boys are entrusted with livestock rearing and securing the community against external attacks like cattle rustling. On the other hand, women and girls are relegated to the household and perform duties such as caring for the children, construction of mud houses and all domestic duties including fetching water for the household.

The county lies in two ecological zones namely semi-arid and arid. The semi-arid zone has medium potential. It has become an area of sedentarized agro-pastoral activities. The county is hot and dry in most months of the year with two rainy seasons. The short rain season

occurs between October and December with a peak in November while the long rain occurs between March and May with a peak in April. The topography of the landscape influences the amount of rainfall received (KIRA, 2014; CIDP, 2018-22).

According to KIRA (2014), Isiolo receives annual rainfall ranges of between 150mm and 650mm. The mean annual average temperature ranges between 12^0C and 28^0C. Isiolo is one of the counties in Kenya classified as ASAL and experiences substantial water security risk According to the Isiolo County Integrated Smart Survey (2017), the county faces recurrent rainfall shortages as illustrated by the 2016 rainfall failure. This makes the residents rely on other water sources which include piped water system, river or spring, unprotected shallow well, *Laga*, protected shallow well, trucking water vendor, earth pan and dam with infiltration well (Isiolo County Integrated Smart Survey, 2017). More than 80% of the land is communally owned and is under the trust ship of the county government. Public land constitutes 10 per cent of total land and includes land for schools, administration, army barracks, health facilities and game reserves. The remaining less than 10% of the land is under private ownership and was alienated for private investment in housing, industrial and commercial purposes. Over 80 percent of the land cannot support crop farming and is used as grazing land by the pastoralists (Isiolo County Integrated Smart Survey, 2017).

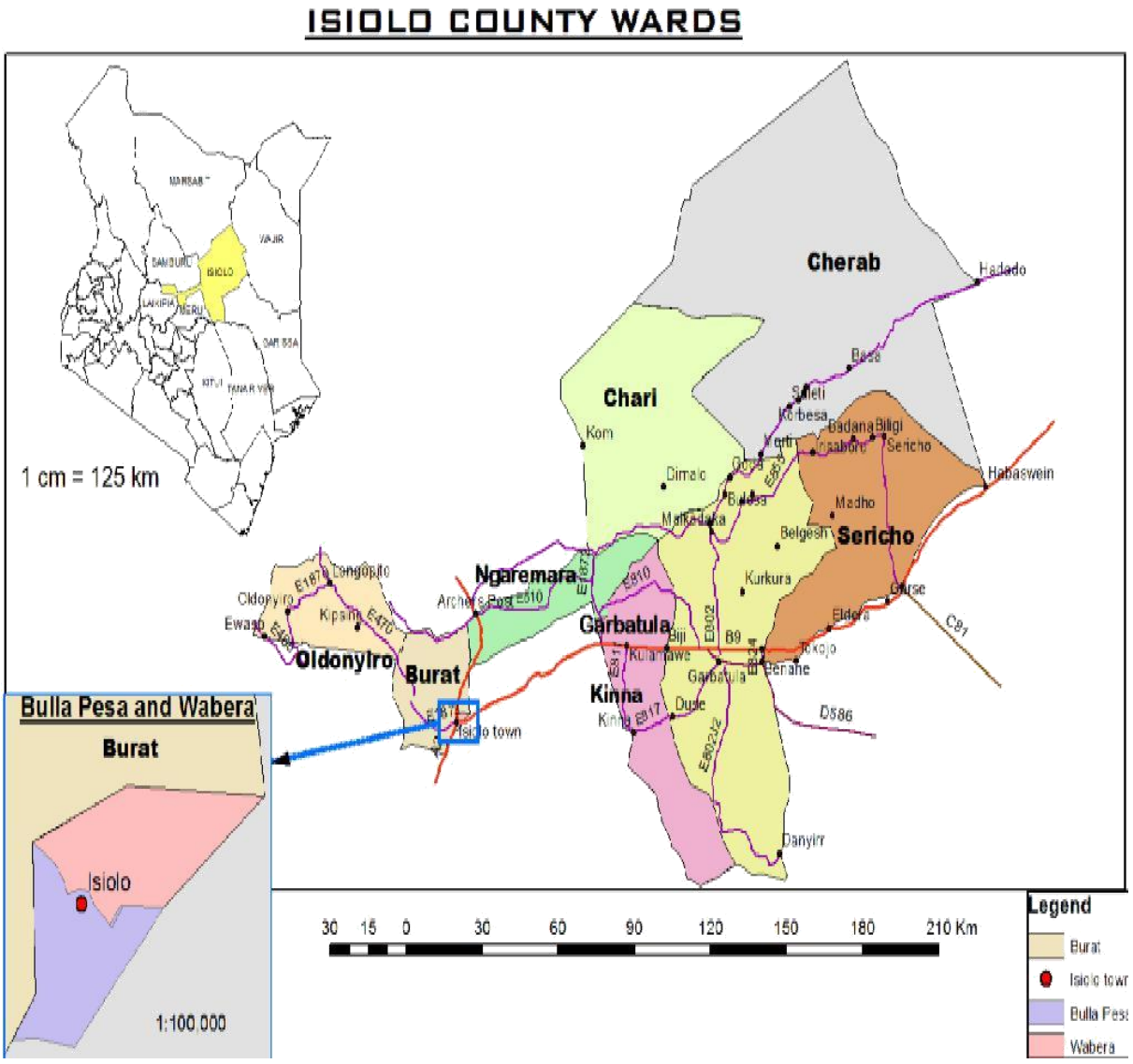


Figure 3. 2: Map of research site

Source: www.informationcraddle.com

3.3 Research design

The study employed a cross-sectional descriptive study design and used both quantitative and qualitative methods in collecting data. Descriptive research design (Creswell, 2009) suited this study as it guided the study in generating rich data about the state of affairs regarding water security risk and coping mechanisms in the study area while at the same time providing the lens for drawing valid recommendation and conclusion. Specifically, while the survey questionnaire provided quantitative data, focus group discussions (FGDs) and key informant

interviews (KIIs) provided qualitative data. The data was collected in the period between the months of February and March 2020. The selection of respondents for the survey was done through random sampling with strict fidelity to the set inclusion and exclusion criteria while the participants in the focused group discussions and key informant interviews were purposively selected.

Regarding the fieldwork process, the data collection was conducted in two phases and the process was staggered (Creswell, 2014) to allow the data collected from the questionnaires to inform questions in the FGDs and data collection in the FGDs inform questions in the KIIs. The first phase involved the collection of quantitative data through the surveys then the second phase involved the collection of qualitative data through group discussions and key informant interviews. Some of the items identified in the survey questionnaires were incorporated into the FGDs to build consensus. While the sample size for the survey method was calculated for representativeness, the sample size for the qualitative methods was based on the principle of saturation and the emphasis was put on information need (Orodho, 2003).

On analysis, quantitative data collected were analyzed using the Statistical Package for the Social Science (SPSS) Version 23. The computed data was analyzed using descriptive statistics (Shamoo & Resnik, 2009) including frequencies, means, and percentages. On the other hand, qualitative interviews and fieldnotes were processed through transcription and translation. After the data were transcribed, they were coded using NVivo 12 based on the study research questions and the data generated through fieldnotes and interviews. The data were analyzed using a content and thematic analysis approach where the key research questions were the guiding themes. Verbatim quotes have been used alongside the presentation of the findings to project the voices of the informants. The study also adhered to key ethical issues throughout the data collection process and reporting of findings.

3.4 Study population and unit of analysis

Study population (Resnik, 2011) is a group that theoretically bears the desired characteristics of the study from which a sample is drawn. In the study, a sedentarized pastoralist in Wabera Ward was chosen due to ease of access to the population and is one of the wards marked high level of sedentarization and water insecurity in Isiolo County besides Burat and Ngaremara Wards. Sedentarized pastoralists living in Wabera Ward in the Isiolo community constituted the study population for this study. The unit of analysis was an individual sedentarized pastoralist defined as a man or a woman.

3.5 Sample size and sampling procedure

The study used simple random sampling to select the required sample size in the Wabera Ward. The study assumes that the number of females to males who are sedentarized and experience and water stress is equal, i.e., enjoy a maximum variability. As such, it is important to collect quantitative information at the household levels to compute the patterns of gender relations, participation in the water-related roles, access and control over water sources and resources, the gendered participation in water-related decision-making and how these relationships shape the experience of men and women with water stress.

The following formula was used to calculate the sample size:

$$n = \frac{z^2 pq}{e^2}$$

Where:

n = required sample size

p= 1-q (variance expected in the responses assumed to be 50:50 proportion rate).

Z = Z score value at 95% confidence level (standard value of 1.96) q = Estimated responses.

d = Level of precision or margin of error at +-5% (standard value of 0.05).

The formula for calculating sample size is

$$n = \frac{(1.96)^2 (0.5) (0.5)}{(0.5)^2}$$

$$= 96$$

This is rounded to 100

Thus,

n=100 respondents

The sample size was befitting to represent the sedentarized pastoral community members in Wabera Ward. While acknowledging that the population of Wabera Ward was not homogenous, the researcher obtained the list of households in the Wards from the office of the chief and Ward administrator which acted as the sampling frame. The sample frame obtained was based on the demographic data and the clustering of households in the Ward using statistics from the Kenya National Bureau of Statistics (KNBS), the County Government of Isiolo and the Arid Lands Resource Management (ALRM) in Isiolo which are made available through the public administration officers.

From this frame, a sample of 100 households was selected randomly for the survey questionnaire. In recruitment, a set of criteria for inclusion was used where the study participants were at least 18 years old, were men and women sedentary pastoralists and had lived in Isiolo County for at least 3 years to have experienced the water insecurity phenomenon to express the same.

3.6 Data collection methods

3.6.1 Survey questionnaire

Questionnaires were administered to 100 respondents in the study area. The questionnaires were structured with closed-ended questions and some open-ended questions to provide the respondents with the opportunity of giving details to the questions. The questionnaires were used to collect quantitative data on water dynamics such as varying seasons marked with varying levels of access to water for men and women, changing quality of water and prices of

water, conflicts on common-pool resources among others. The questionnaire also provided information on water needs for women and men such as domestic and livestock use. Further, the borrowing, rescheduling of water duties, buying and investing in storage were brought out of the key coping mechanisms with water insecurity. The data was collected among sedentarized pastoralists residing in Wabera Ward. The questionnaires were administered to study participants by the researcher with the help of local research assistants fluent in the local Borana language spoken in the study area. A survey questionnaire (Appendix I) was used to collect data.

3.6.2 Focus Group Discussions (FGDs)

Focus group discussions were held with sedentarized pastoral community members in Wabera Ward to obtain qualitative data on the water security and coping mechanisms. This method generated rich data on the experiences of men and women in the community with water security risk and coping mechanisms in times of crisis. The FGDs were sex-disaggregated and carried out with three groups of men and a similar number with groups of women. The disaggregation helped encourage disclosure, based on the study site's gender norms and relations as well as intergenerational experiences based on age differences.

The FGDs brought out information on the community coping mechanisms with water stress such as water harvesting as well as postponing other water-related duties until enough water is available. The group discussants also agreed on the different challenges such as trekking for longer distances in search of water as well as conflicts at water points as some of the key challenges they experience as a community with water stress. such as high-water tariffs and felt experience of water insecurity, needs and the coping mechanism among sedentary pastoralists.

The FGDs were conducted under trees in the community. The FGDs were women-only and men-only and were composed of 12 participants. The gender disaggregation took care of gender disparities that would have affected the willingness of either gender to participate in joint discussions. To be effective, the researcher categorized the participants into the following separate group discussions with males and females as below:

- ★ Youths (males and females) between 18-35 years
- ★ Middle-aged persons (males and females)36-49 years
- ★ The elderly group above (males and females)50 years

The researcher facilitated the discussions while two research assistants acted as note-takers and translators whenever there was a need. An FGD guide (Appendix III) was used to collect data.

3.6.3 Key Informant Interviews (KIIs)

These interviews were conducted with six (6) informants based on their expertise and knowledgeability in water security issues in the County. The key informants included: one (1) official in the county department of water, one (1) local water user/association management committees official, one (1) community gatekeeper, one (1) local leader/Ward administration, one (1) National Drought Management Authority (NDMA) and one (1) official from the NGO operating in the area and specifically involved in water security and livelihoods. The KIIs gathered information on the water security situation and the dynamics thereof. A key informant interview guide (Appendix IV) was used to collect data.

3.6.4 Secondary sources

In developing the context for this study, Isiolo County Government Disaster Risk Report and Smart Survey were reviewed to capture the situation of climate variability, drought and water stress in the County. Other literature for consideration were those on water insecurity and pastoralism. This paper has relied on literature from various sources such as books,

peer-reviewed journal articles, government and organizational publications. Other key materials that have informed this work include those from UN-Water, Gender and Water International, UNDP and Global Water Partnership. Such studies offered normative frameworks and/or themes that gave key considerations during the development of study tools. These have been continually been sourced to enrich the study findings.

3.7 Data analysis and presentation

The questionnaires items were be coded and then the data entered into SPSS. Data were then scrutinized for erroneous and missing values that could have been entered during entry by counter checking with the questionnaire. After which data were explored to identify any outliers and extreme values and to test for normality to determine the appropriate statistical techniques. Reliability tests (Resnik, 2011) were performed by visual check, percentiles and outliers with accompanying statistical tests. Analysis of the data was done using descriptive statistics (Creswell, 2014), which included means, standard deviations, frequencies and percentages. Graphical illustrations were deployed to enhance the findings. Whereas mean values have informed the study on the expected score or measure from a group of scores in a study, standard deviations have informed the researcher about the distribution of scores around the mean of the distribution. Equally, the frequency distribution and percentages recorded the number of times a score occurs and the extent of occurrence of a particular observation respectively.

In qualitative analysis, data from the FGDs and KIIs were converted from voice records to written text. This involved verbatim transcription in the language of the interview and the transcripts were translated into English. After each verbatim transcription, the transcripts were labelled properly using a system of labelling adopted by the researcher. The research used an inductive (Creswell, 2009) approach to develop codes that were used to guide the analysis process. The researcher implemented open coding (Resnik, 2011; Orodho, 2003) by

reading and re-reading through the transcripts, to identify emerging themes (codes) and trends.

A codebook (Shamoo & Resnik, 2009) was developed by the researcher at this stage and the researcher kept on updating the codebook until the coding process was completed. The codebook was informed by study objectives, questions, data collection themes and findings from the desk review of documentation. These codes were then applied to the data texts. All the transcripts were then coded and reviewed to ensure there was agreement in the coding. The data were then analyzed through content and thematic analysis. Data analysis, however, was done in line with the study objectives acting as the parent themes. Juicy quotes illustrating key themes have been extracted and used in the presentation of the findings as a means of projecting the voices of research participants.

3.8 Ethical considerations

Before proceeding to the field, the researcher obtained a research permit from the National Commission for Science, Technology and Innovation. To commence fieldwork, an authorization letter was also obtained from the County Commissioner of Education Isiolo County. While in the field, the researcher informed all the study participants about the purpose of the study, procedures, risks and benefits using the informed consent form. Consenting was both verbal and written. Participation in the study was voluntary and the participants were informed of their voluntary participation and freedom to withdraw at any stage. The participants were also free to decline to answer certain questions.

Confidentiality and anonymity were maintained throughout the study. The participants were informed that the information they gave would be handled with the utmost confidentiality and that it would not be used for other purposes of other research purposes. The identity of the participants was concealed at all times and any identifiers were removed. The researcher

acknowledged the sources where secondary information is obtained from and bear the obligation to the scientific community. For quality purposes, the researcher will attempt to disseminate the findings of the study back to the community through local administrative channels and shared them with the scientific community through publications. Copies of the final research project will also be availed at the University of Nairobi Library for academic purposes.

4.0 CHAPTER FOUR: WATER SECURITY RISK AND COPING MECHANISMS FOR SEDENTARIZED PASTORALISTS

4.1 Introduction

In this chapter, the findings and discussion on water security risk and coping mechanism among sedentarized pastoral communities in Isiolo County based on interviews and responses from questionnaires are presented. The chapter has three sections where the first section presents the response rate of the respondents, the second sections provide the socio-demographic characteristics of the study respondents and the third section is a presentation of the findings of the study based on the three objectives.

4.2 Response rate

The response rate for this study simply indicates the number of respondents who participated in the study in comparative terms but concerning the total number of the sampled population. A total of 100 survey questionnaires were administered to the respondents of the study in their households. Out of the 100, only 4 questionnaires were incomplete while 96 were dully completed. This presented a response rate of 96% which was deemed representative by the researcher and was analyzed to respond to the research questions adequately as shown in Table 4.1 below. The response rate of 96% represents all the respondents who answered all the questions in the questionnaires fully that provided the needed information for analysis.

Table 4. 1 Response rate

Response rate	***Frequency (n)***	***Percentage (%)***
Completed questionnaires	*96*	*96%*
Incomplete questionnaires	*4*	*4%*
Total	***100***	***100%***

4.3 Socio-demographic characteristics

In terms of gender, the study findings indicate that majority of the respondents 57.3% were women while the rest were men, accounting for 42.7% as shown in figure 4.1 below. For this

study, men and women are affected by water security risk differently and thus would likely have varying strategies to cope with water stress.

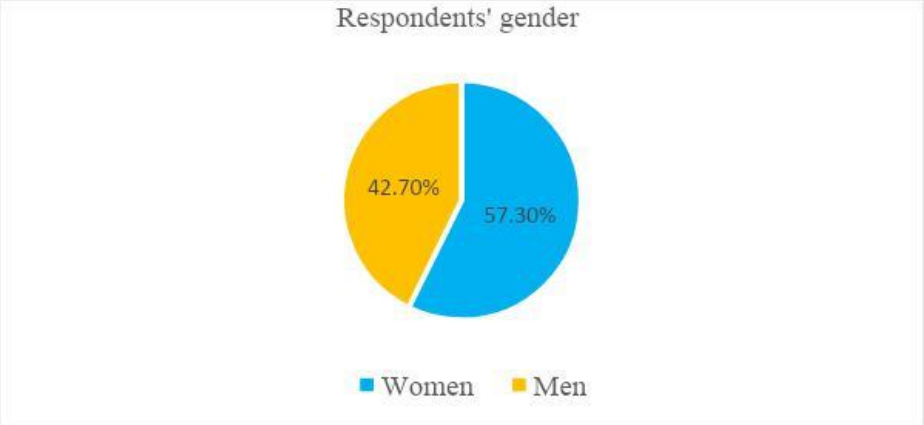


Figure 4. 1: Respondents' gender

Thus, it was important for the participation of both men and women to capture different opinions and experiences. From the findings, women are intrinsically linked to water resources as compared to men because of their responsibilities in the management of water. The respondents indicated that men and women of different ages experience water security risk differently and even employ different coping mechanisms. The majority of the respondents 68.8% noted that gender was a key factor influencing the vulnerability of men and women to water security risk. The cross-tabulations findings indicate that there is a significant association between gender and experience with water security risk (x^2 = 68.8567, *p*-value = 0.000) as shown in table 4.3 below.

Qualitative findings show that since women are responsible for the collection and management of water especially at the household level, the study finding shows that they experience challenges such as difficulty in accessing water, covering, long distance to access water and being left alone in the homes since men/husbands migrate to other areas in such of water and pasture for livestock. During migrations, men also experience challenges such as conflicts with both wildlife and human beings for the little resources of water available. At

the same time, when men migrate because of climate risk, women become the household head and also provide security for homestead. One of the focus group discussants illustrated this through the following quote:

> *"…. this problem affects us more than men or our husbands because we are the ones with the biggest responsibility of ensuring our households have water"* ***(FGD#2, Female 34 years old).***

These sentiments were confirmed by one key informant who had this to say:

> *"Water scarcity is a big challenge in this area and it affects both men and women in different dimensions. Women suffer most because all the duties related to fetching and managing water are their responsibilities and therefore when there is drought, they have to spend more time searching for water from places that are far from their homes. Men also experience challenges because of their unique water needs such as watering livestock which then requires that they migrate to other places in search of water"* ***(KII #2 NGO Official).***

Thus, respondents' gender was important in this study because of the study's interest in understanding the experiences of men and women with water insecurity, water needs and coping strategies in the study area. From the findings, its clear women and men experience and express water security issues differently which are informed by their socially constructed gender roles. As postulated in the Social Learning Theory and Ecological Framework, women and learn about their different roles including water-related roles which manifest later in life on how they respond to crises such as water scarcity threat.

Further, based on gender roles and gender relations, water security risk produces a distinct and conspicuous gender tinge. Although men and women might have similar water needs, gender roles produce different ways in which water security risk is experienced. Women are often vested with the role of replenishing households with water and performing household chores that involve the use of water. These findings corroborate those by Lusuva (2009) who found that women and men experience crises such as water security risk differently based on

their gender division of labour. He found that women unlike men have an everyday house and care work that makes it difficult for them to cope during times of drought where they have to travel long distances in pastoral communities to fetch water.

Concerning the age of respondents, the findings of the study show that about half of the study respondents were aged between 31 to 40 years accounting for 49% of the total number of the study respondents. Those who were aged between 18 to 30 years accounted for 18% of the number of respondents while those who were aged between 41 to 50 years accounted for 25% of the total number of study respondents. Only 8% of respondents were aged between 51 to 60 years (Table 4.2).

Table 4. 2: Respondents' age

Age Category (Years)	*Frequency (n)*	*Percentage (%)*
18-30	*17*	*18%*
31-40	*47*	*49%*
41-50	*24*	*25%*
51-60	*8*	*8%*
Total	***96***	***100***

The age of the respondents was investigated because it showed the years of experience for men and women in the study area relating to water insecurity. In terms of age, the quantitative results show that elderly women and men are likely to be vulnerable to water security risk because of their dependence on their families. These groups of pastoralists are considered weak and sometimes get no assistance from their families. The majority of respondents indicated that age was a key variable in determining the impact of water security risk on men and women. The cross-tabulation results (Table 4.3) show that there is a statistically significant relationship between the age of the respondents and vulnerability to water security risk (x^2 = 68.8567, p-value = 0.000) which implies that water security risk experiences and vulnerability is significantly influenced by gender.

Table 4. 3: Age and gender risk vulnerability

Gender and Age	***(%)***
Elderly women	*45.0*
Elderly men	*34.0*
Disabled	*54.3*
Female-headed household	*24.5*
Married men	*25.9*
Married women	*57.3*
Youth	*34.5*
Cross tabulation	***Chi-Square (p-value)***
Gender and Risk Vulnerability	*68.8567 (0.000)*
Age and Risk Vulnerability	*46.88 (0.002)*
Marriage and Risk Vulnerability	*279.36 (0.001)*

Findings from the qualitative data show that mature and elderly men and women have experience in coping with water stress and hence can anticipate the risks and cope better in times of crisis. Further, findings show that children are the most affected during times of water scarcity because of their dependence on their parents. One of the key informants exemplifies this fact:

> *"When you talk about age, obviously children and young people are the most affected. You know children can't take care of themselves and they don't have good knowledge on what to do during such times……"* ***(KII#4 NDMA Official).***

Regarding marital status, four levels were investigated in the study. This included; single/unmarried, married, divorced/separated and widowed. From the study findings, an overwhelming majority of the study respondents indicated that they were married thus accounting for 62.5% of the total number of study respondents. Respondents who indicated that they were single or unmarried accounted for 14.6% of the total number of study respondents. Those who indicated that they were separated or divorced accounted for 14.6% of the number of study respondents while only 8.3% of the study respondents indicated that they were widowed as shown in figure 4.2 below.

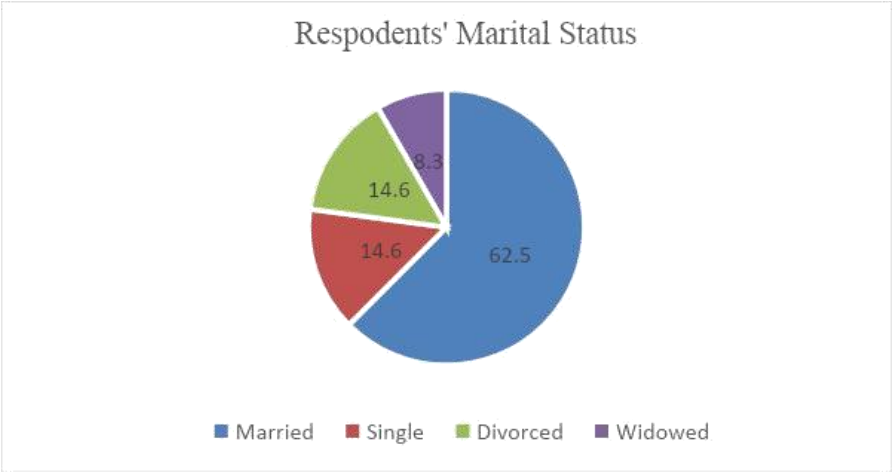


Figure 4. 2: Respondents' marital status

From the findings, sedentarized pastoralists who are married can cope better as compared to those who are single or divorced. Marriage affords men and women support that they draw from in times of water stress where the coping mechanism for married women and men differs radically from those of unmarried men and women. In the same breath, elderly and unmarried women are more vulnerable to challenges of water insecurity as compared to other groups of women. Female-headed households might be vulnerable if they do not have sons to assist in the herding of the animals. Also, female-headed households are vulnerable because they have less income and they are not well-represented in decision-making within the community. Married women are more vulnerable than married men because of their reproductive and communal roles. The disabled on the other hand are likely to be vulnerable because they have limited opportunities and they experience discrimination by some of the family members and the community.

In terms of education level, the study investigated three education levels namely; primary, secondary and tertiary levels. Results of the study indicate that slightly above half of the study respondents indicated to have attained a primary level of education which accounted for 53.8% of the total number of study respondents. Respondents who indicated to have not attended school accounted for 21.9% of the study respondents while those who had attained a

secondary level of education accounted for 18.3% of the study respondents. Those who indicated to have attained tertiary levels of education accounted for 8.6% of the total number of study respondents as shown in figure 4.3 below.

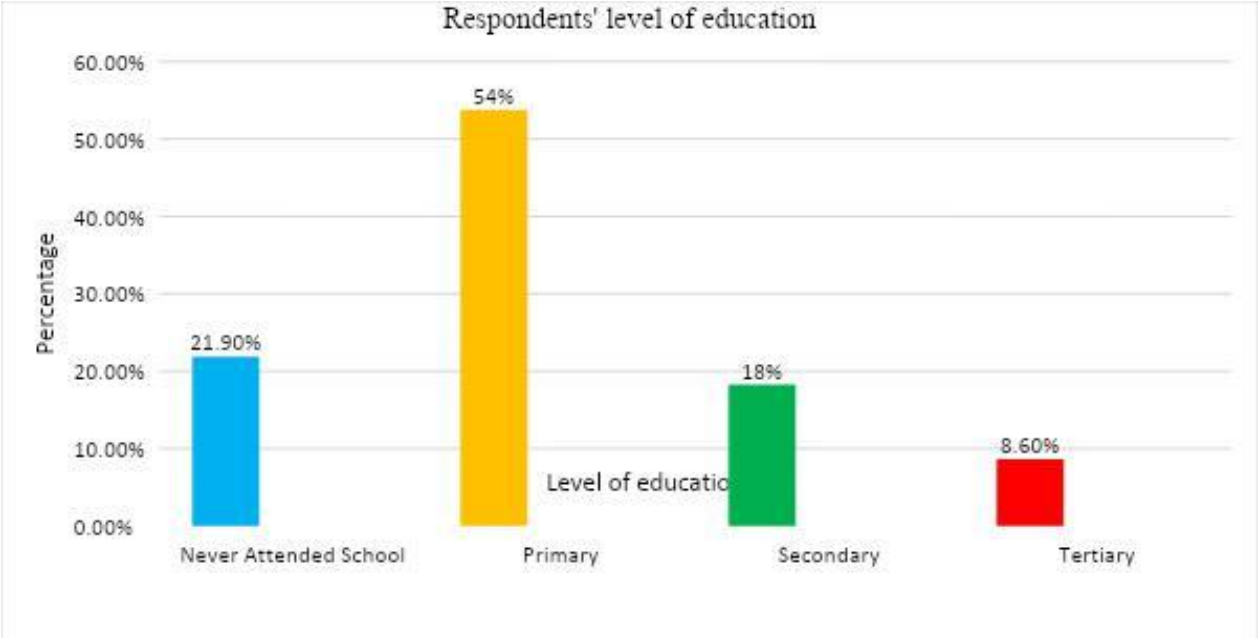


Figure 4. 3: Respondents' level of education

Education was found to be a key factor moderating the experience of sedentarized pastoralist with water stress in Isiolo county. Men and women with higher levels of education have opportunities to secure employment and create jobs for themselves thus earning an income that can be used during times of water shortage.

Consider the following quote from one of the group discussants:

> *"Educated people are even aware of the environmental changes and because they are likely to have better sources of income through employment can plan well for dry seasons"* ***(FGD#1 Male 46 years old).***

Education improves the agency of men and women in the pastoral network thus the high the level of education the higher the capacity to anticipate, cope and recover from water insecurity challenges.

On occupation, the findings show that out of 100 respondents, 33 indicated to be engaged in livestock keeping as their occupation thus accounting for 34.4% of the total number of study respondents. Respondents who indicated that they were businessmen and women accounted for 15.6% of the study respondents. Those who indicated to be engaged in crop farming accounted for 19.8% of the respondents while those who indicated to be casual labourers accounted for 8.3% of the total number of respondents. While 6.3% of the respondents indicated that they were involved in the trading of livestock and crop products, 8.3% indicated to be engaged in formal and salaried employment. Those who indicated to be unemployed were 7 in number thus accounting for 7.3% of the total number of study respondents as shown in table 4.3 below.

Table 4. 3: Respondents' occupation

Occupation	***Frequency (n)***	***Percentage (%)***
Livestock keeping	*33*	*34.4*
Business	*15*	*15.6*
Crop farming	*19*	*19.8*
Casual Laborer	*8*	*8.3*
Trading in livestock	*6*	*6.3*
Formal employment	*8*	*8.3*
Not employed	*7*	*7.3*
Total	***96***	***100***

Understanding the occupation of the study respondents was important in this study since the income generated could be used in securing water in times of crisis. Different types of occupation meant different exposure to the challenges of water security. For instance, a sedentarized pastoralist who kept livestock were more vulnerable to water crisis as compared to other types of occupation like a business and formal employment. Livestock keepers had challenges of looking for water during times of drought not only for their use but for their livestock as well. Businesses men and women, traders and those in formal employment were better placed to cope with water scarcity because with the income they are better placed to

secure water storage tanks and even purchase water during times of scarcity. From the findings, casual labourers and those not employed were also vulnerable to drought since their purchasing power is dependent on others which reduces when drought sets in as noted in the quote below:

> *"When you have money because you are employed or from your business, you will not have problems when there is drought because you can purchase water or even hire labourers to fetch water for you…. with money, you have the power to buy big storage facilities……"* ***(FGD# 4 Male 37 years old).***

Thus, occupation is a determinant of access to water within the household, especially during the dry season. Water can always be accessed through employment, generating income to be used in purchasing water and social transfers and other forms of solidarity within households.

4.4 Water security dynamics among sedentarized pastoralists in Isiolo County

This objective of the study sought to describe the water security dynamics among sedentarized pastoralists in Isiolo County. From the findings, sedentarized face distinct water security patterns associated with increasing water security risk which is caused by the disruptions and variations in socio-ecological environments of the study area. There are changing seasons in Isiolo County leading to periods of water scarcity and stress. The finding also shows that there are different sources of water in the study site with some being preferred in some seasons and by a specific gender. In this objective, it was established that water access and use is gendered and that many water-related responsibilities are vested in women and young girls. These themes have been explored in details in the following sections with the view of understanding the changing seasons in Isiolo County and the overall effect on water availability for various groups of people.

4.4.1 Patterns of water security

Climate variability and change have been linked with multiple direct and indirect impacts to sedentarized pastoral men and women which have led to the variation in water availability. The occurrence of climate variability limits the available rainfall and groundwater which directly influences the level of access and use of water. The study findings indicate that water security dynamics manifest in terms of water access, quantity, quality and cultural implications including conflicts and distress for community members especially women and children. In this regard, climate change leads to changing seasons in the study area i.e short and long rains and dry and extended dry periods which are characterized by varying access and availability of water.

The seasonality of changing water access indicates that water availability, access and collection times for sedentarized pastoralists changes across the year. For instance, during the rainy season,

a greater variety and number of sources of water are typically available. Even so, round trip collection times for water are still over an hour at some and up to four hours at one in particular. During the dry season, many springs, seasonal streams, shallow wells and even boreholes tend to dry up and households are forced to look for alternative sources. This can mean travel beyond the immediate village. This means not only longer distances to fetch water for many households but longer queues at the water point. That most households use the more convenient but unprotected ponds when available, rather than travel to a more distant but improved source, reflects a widely expressed preference for convenience over water quality.

The time is taken to fetch water (go to the source, collect water, and return) emerged as a key dynamic of water insecurity. This was true across the survey questions, discussion groups, and key informant interviews. The time taken to fetch water is more than 2 hours for more than 60 per cent of households in rural areas in the dry season and surprisingly still more than

37 per cent in the wet season. This was confirmed by the results of the personal diary study where women in the rural areas reported an average time of 1.5 hours per day to collect water in the wet season.

Further, respondents were asked to indicate their understanding of the major weather changes/various seasons that occur in the study area. The results obtained are presented in table 4.4 below.

Table 4. 4: Seasons

Changes	***Frequency (n)***	***Percentage (%)***
Short rains	*23*	*24%*
Long rains season	*20*	*20.8%*
Dry season	*38*	*39.6%*
Extended dry season	*15*	*15.6%*
Total	***96***	***100***

As shown in the table above, the study area is characterized by four seasons namely; short rains, long rains, dry seasons and extended dry season. Accordingly, the respondents indicated their knowledge on the seasons as short rains (24%), long rains (20.8%), dry seasons (39.6%) and extended dry season (15.6%). These results show that the most experienced season in the study area is the dry season which accounted for 39.6% of all the responses. The extended dry season was the least experienced in the area accounting for 15.6% of the total responses while short rains and long rains were indicated by responses as seasons that are not dependable accounting for 24% and 20.8% of all the responses respectively. Isiolo county being part of the ASAL counties in Kenya is characterized by drought and hence affirming the findings from the respondents.

These quantitative findings were supported by qualitative findings from groups and key informant interviews.

Some of the participants noted the following:

> *"…. yes, sometimes we have short and long rains in this area but most of the time we experience drought which has always made water availability a big problem"* ***(FGD#2 Female 30 years old).***

> *"Right now, we are having short rains and then sometime in January you will see drought coming back again until May there is when we may have long rains"* ***(FGD#1 Male 40 years old).***

The results show that changing seasons leads to seasonality in water access thus providing a varying water availability chart across the year. During long and short rains seasons, water access challenges are reduced since men and women access to water from sources that are fed by rainwater. In dry seasons, water sources dry up thus leaving men and women vulnerable to the effects of water scarcity for them and their livestock. Men and women have to travel a long distance to collect water while at the same time they take longer at the water collection points such as the water kiosks and boreholes. These findings are similar to those of Galaty (2013) who observed that there is an intricate relationship between water and food security risk and the two are characteristic of ASALs and are mutually reinforcing. He noted that both are exacerbated during drought and have other environmental connections including climate change.

4.4.2 Water availability

The respondents were asked to highlight their mains sources of water. The various sources of water for men and women across various seasons are presented in figure 4.5 below. The findings show that the most common sources of water in the study site are boreholes (33%), dams (18%), water kiosks (11%), shallow wells (20%), seasonal rivers (7%), and rainwater (10%). The results of the study show that men and women in the study area use water from both protected and unprotected sources. The communities in the study area discern which water sources to use for household and livestock needs and at which times of the year.

However, the overriding determinants of the sources of water to be used are dependent on the season, distance and quality of water.

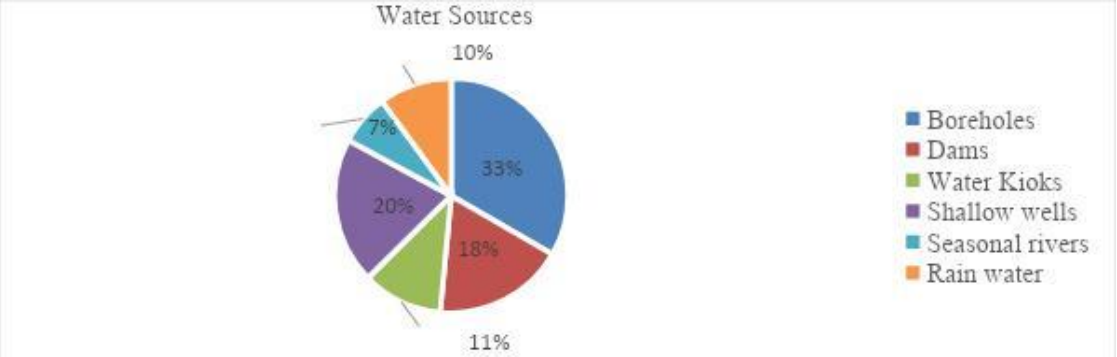


Figure 4. 5: Sources of water

From the findings in the figure above, the main sources of water for respondents in Wabera Ward are the boreholes followed by shallow wells while the least source of water is the seasonal rivers. From the results, since boreholes are more sustainable than any other sources of water mentioned, they are dependable in both dry and wet seasons. Shallow wells, rainwater and seasonal rivers are useful for non-household needs of water, they are only available during wet/rain seasons. Water kiosks with tapped water from the county sewerage company are prevalent in the study are but most of the study respondents indicated the high-water tariffs charged as the main reason why many shy away from using them even though they provide the safest and clean water.

In supporting the above results, some of the focus group discussants had this to say:

> *"Our main source of water in this community are the boreholes…. sometimes they can dry up so that we go to the water kiosks whose water is very expensive"* ***(FGD#2 Female 45 years old).***

> *"We water our goats and cows in the rivers nearby but when there is drought, we try digging the shallow wells or use the dams to water our animals"* ***(FGD#1 Male 27 years old).***

Thus, the results show that water sources for men and women in Isiolo County, Wabera Ward varies according to seasons. During wet seasons, rainwater, rivers and boreholes are the most commonly used, however, usage of these sources depends on the need for water. During dry and extended drought periods, some of the sources such as rivers dry up hence leaving boreholes as the most dependable sources of water. In addition, many of the respondents noted that water kiosks provide the cleanest water but the tariffs are very high for them hence the non-use.

In agreeing with these findings, one of the key informants asserted that:

> "*There are many sources of water here but the boreholes are the most preferred. Although the boreholes do not provide the cleanest water, they are mostly preferred because water is free, unlike the water kiosks which charges very high tariffs"* ***(KII#1 WUA, Leader).***

The findings of this study are similar to those of Wekesa and Karani (2009), who observed that water sources in the ASALs include direct use of natural resources such as surface water-rivers, streams, springs and artificial water sources including dams, and pans. The duo further highlighted that other water sources in Northern Kenya include developed groundwater including shallow wells and boreholes. In concluding their results, Wekesa and Karani noted that water security dynamics encompass water availability, gender implications, food security, health and conflict among other topical water security-related issues.

4.4.3 Water access status

Since water access is a key variable in the water security dynamic, there was a need to understand the water access status among the study respondents. The respondents were asked to indicate their access to water in term so the physical distance between the water source and their households as well as the methods used to get water. The findings are presented in Table 4.5 below.

Table 4. 5: Water access

Water access	*Frequency (n)*	*Percentage (%)*
Less than 1 km	*16*	*16.7*
1-3 km	*51*	*53.1*
Over 4 km	*29*	*30.2*
Total	***96***	***100***

The findings show that 16.7% of the respondents would access their water in less than one kilometre, 53.1% who are the majority would access their water from 1 to 3 kilometres distance and 30.2% would access their water in over 4 kilometres. From the results, the distance to water sources varied according to the season with distances increasing to over 10 kilometres during the dry and extended drought periods.

Most of the respondents, however, noted that during wet or rainy seasons water access in terms of distance would reduce because of water harvesting and availability of more ground/surface water such as seasonal rivers. This vulnerability was felt particularly keenly where there is a high dependence on surface water sources, many of which dry up readily in the absence of rain. Those relying principally or solely on rainwater collection also indicated that they felt water access to be highly insecure, unsurprisingly, given very high rainfall variability. However, those using rainwater to supplement other sources benefitted from the additional supply it offered when available. Thus, source proximity is a key determinant in water access. These findings are not unique to this study but have been pointed out by other studies. Results from the Isiolo County Integrated Smart Survey (2017) recorded that the proportion of households trekking less than 500m remained at 73% while more than 2km increased up to 22% in 2017 when nearby water sources were been depleted. In the 2017 survey, 43% of people reported at least 1-hour queuing time and waiting for more than one hour accounted for 43%.

4.4.4 Water collection and management responsibilities

Findings show that the burden of collecting water for domestic use is left to women and girls. There were full agreements in the findings from all sources that women have full responsibility for domestic water collection and management. However, this responsibility and burden come with some control and power. The woman who owns the house controls the household water supply: she decides how much to collect, how to collect it, when, and how it will be used. If water is stored, she manages access. Even her husband may be denied water if she thinks what is available is not enough. Findings indicate that water collection times vary across the seasons of the year. In the wet season, participants from the FGDs noted that there is a reduced burden resulting from water-related duties because a greater variety and number of sources are typically available. The following voices put the situation into perspective:

> *"Women and children especially girls are responsible for collecting water for the household"* ***(FGD# 4 Male 41 years old).***

> *"Women and children – mostly girls are responsible because men don't fetch water"* ***(FGD#2 Female 29 years old).***

Further, it was revealed from the results that women and girls have therefore evolved a system of co-dependence in managing the household and water-related roles:

> "*If you have girls, they will help you but you will also need to help them. You can decide to collect firewood and the girls fetch water" (****FGD# 3 Female 33 years old).***

However, in situations where girls are away in school the mother is forced to bear this responsibility alone:

> "*It is only me who fetches water and maybe when my daughters are not in school"* ***(FGD# 2 Female 42 years old).***

These findings were corroborated by those from one of the key informants who noted that:

> "*The absence of girls who are of age to fetch water in a household, either because the children are still young, or the older girls have gone to school or gotten married, is a source of both emotional and physical stress for the woman who must take responsibility for all roles related to fetching water"* ***(KII# 5 County Official).***

Some water management roles are specifically allocated to men. These include digging of wells and pans, constructing fences, cleaning of wells and controlling livestock during watering. At the same time, men also dominate water management committees in the Water User Associations (WUAs). In some settlements, women are responsible for the management of boreholes.

Thus, in pastoral communities, women and girls are generally responsible for water collection and therefore bear the greatest burden including other household chores. But the gender aspect of water security extends beyond this. This means that women not only bear a high workload when water access is good, but when collection times are high, they may be forced to extend their working hours well into the night, undertaking risky journeys in the dark (early morning), or abandon other tasks completely (such as preparing meals for their households) and as a result, they may face domestic conflict. From the study, it can be deduced that women shoulder the greatest burden due to water scarcity because they are tasked with household and water-related duties. This also in a way gives them the power to budget and make the decision regarding its use. The role of men in water-related duties in this community, from the study, is marginal and largely reduced to the provision of financial resources to source for and transport water.

The results of this study are in agreement with those of Lusuva (2009) who recorded that women are often vested with the role of replenishing households with water and performing household chores that involve the use of water. Thus, during water scarcity, women are affected concerning the gender roles related to water use. Similarly, the Isiolo County

Integrated Smart Survey (2017) highlighted health, hygiene and water safety as other dynamics associated with water security risk where it reported that as of 2017 19% of watery diarrhoea accounted for 19% of morbidity in Isiolo County. The report further, provides that increased women workload due to water and pasture shortage and food shortage due to prevailing drought, causing high maternal malnutrition.

4.5 Water needs and challenges for sedentarized pastoralists in Isiolo County.

The study second objective sought to investigate the water needs and challenges for sedentarized pastoralist in Isiolo County. The findings of the study indicate that there are varying water needs for men and women in the study ranging from domestic water needs, livestock and other needs with different participation of men and women. The findings also show that in pursuit of their water needs, men and women experience several challenges as discussed in the sub-themes below.

4.5.1 Water needs

The findings of the study show that water needs for men and women vary depending on their livelihood sources and seasons. For instance, women water needs are for household-related chores and use while men water use are largely for watering livestock as shown in the figure below. However, women and men in business activities all have the same demand for water as shown in the figure below.

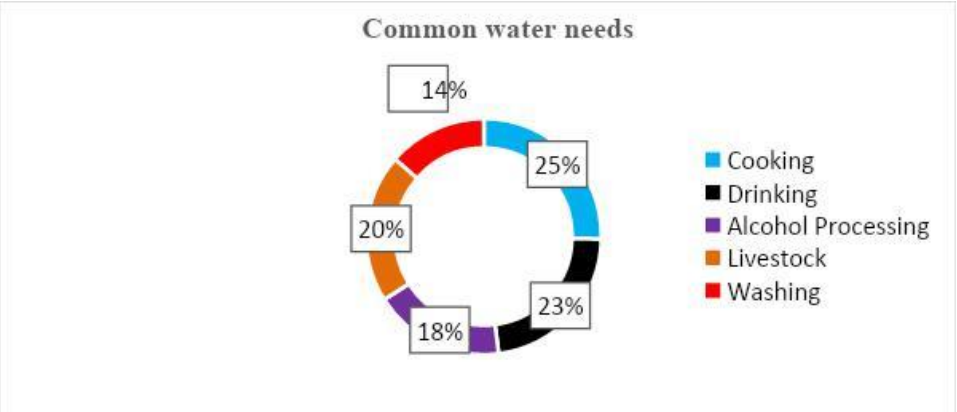


Figure 4. 6: Common water needs

From the figure above, the common uses of water include cooking, drinking, business use, livestock, and washing. Findings indicate that common uses of water at the household level are mainly for drinking, cooking, birthing and washing which are given priority across the various seasons. Further, the results of this study indicate that water needed for these four household needs are the responsibility of women and girls with men featuring minimally. The main water needs for men, on the other hand, are mainly for livestock use. Washing and bathing as was highlighted to be the least concern water need for men in dry periods. The following quotations exemplify the situation as perceived:

> *"Women are responsible for household water needs and that is essentially what they will need water for"* ***(FGD# 4 Male 29 years).***

> *"We use water for bathing, washing clothes and utensils, cooking and drinking…. these are our duties because men are not allowed to do such activities"* ***(FGD#2 Female 33 years old).***

> *"Yes, we have water needs just like women……we use water to bath and water our livestock but sometimes during drought, the most important water needs for us is for drinking and watering out livestock"* ***(FGD#1 Male 46 years).***

The results of the study show that water needs for men and women are acted upon by the seasons and source of livelihood. Water in the study area is also used by men and women for construction and farming although on a minimal scale. From the findings, women water needs are higher than that of men, However, findings also indicate that despite women having more uses and needs for water than men, access to these sources of water is sometimes controlled by men who then prioritize their water needs to that of women. Thus, to some extent, males control female access to water sources. For example, where domestic water sources are shared with livestock, priority of access is ostensibly controlled by men. Their

control is pragmatic. In the study location, women and girls are sometimes given priority so that they can return home to complete other household chores including childcare.

According to the findings, access to shared water sources is not a matter of competition between female and male users. Nor does 'livestock' access necessarily mean 'male' access. Only women in the study area felt that livestock have priority over women (i.e. water for household use) at shared water sources. And even then, what determines access is timing rather than being male or female. A point made clearer from the findings from key informants where they talk about women with livestock having priority as put across in the quote below:

> *"If they reach the water source first, they are given priority whilst 'other' women have to wait until all the livestock are watered"* ***(KII#2 WUA Official).***

In light of the above findings, findings from key informants indicated that several measures have been adopted to control access to water sources between competing livestock/women water users. The first is restricting access to water sources that are located close to human settlements either through use of agreed rules or physical control such as fencing – these are reserved for domestic use; second, there is staggering access at shared water sources which ensures that livestock is watered every two alternate days. In situations where livestock and women both need access to a shared water source at the same time, women are given priority.

The results of this study agree with those of Wilk and Jonsson (2013) who recorded that in the ASALs, occupied mostly by pastoralists, water is mainly used for livestock and household or domestic use. Also, Lusuva (2009) in his study, observed that sedentary pastoralists practice small scale crop farming and this forms another water need in addition to the domestic circles, where water is mainly used for cooking, cooling, promoting hygiene through laundry and washing the household item.

4.5.2 Water access challenges

The study respondents were asked to indicate the challenges they experience in accessing water in the study area. The results are presented in the table below.

Table 4. 6: Water access challenges

Challenges	***N***	***Mean***	***S. D***
Increased distance	96	4.7292	1.11936
High cost of water	96	4.4482	.85278
Dirty water	96	4.1289	1.12632
Conflict at water points	96	3.8647	1.09463
Scarcity of water	96	3.7724	1.29468

From the findings above, the majority of the respondents indicated that the main challenge that they experience with water access is an increase in distance to water sources especially during the dry season (mean=4.7292). The study respondents indicated that the high cost of purchasing water is a key challenge to them in accessing clean and quality water in both dry and wet season with prices being very high during periods of drought (mean=4.4482). Also, the respondents indicated that dirty water (mean=4.1289) is a major challenge of the water sources and thus mediating on access. Respondents noted that wet seasons are characterized by floods with affects unprotected sources of water. Further, the respondents for this study also indicated that conflict at water points (mean=3.8647) to be a major problem, especially among women as a result of long queues and varying priorities of water needs. For instance, women with livestock and those that are pregnant would be given priority to fetch water fast. Besides, the respondents also indicated that water scarcity (mean=3.7724) in itself was a challenge. Respondents noted that the other challenges would only occur where there is a water source.

Findings from the focus groups discussions also support the above quantitative findings. Participants noted that during the dry season, many springs, seasonal streams, shallow wells, water pans, sand/earth dam and even boreholes tend to dry up and households are forced to

look for alternative sources which involve a lot of walking for long distances. Some of the participants noted the following:

> *"Here we have the challenge of crossing this valley to go and get water from Burat which has good boreholes and its like 10 kilometres from here"* ***(FGD#2 Female 30 years old).***
>
> *"We walk for long distances to get water when there is drought but those with motorbikes are better off"* ***(FGD# 1 Male 42 years old).***

During periods of drought, water shortage severity increases and women must walk long distances to find water. In addition, where communities depend on hand-dug traditional wells it is only possible to obtain water by increasing the good depth considerably.

> "*The water shortage becomes severe and to get water from the wells three people [mostly men] have to get inside to bring water to the earth surface"* ***(FGD# 4 Male 56 years old****).*
>
> *"During the rainy season, we don't struggle to get water from a far distance whereas during the drought season we go far to collect water for the household and our small livestock* ***(FGD# 2 Female 39 years old).***

Further, as indicated in the previous section, the role of children in supporting women in water collection is reduced during drought periods. This is due to increased distances to fetch water and children are not able to travel in search of water for long hours. Men and women face various constraints related to water access during both normal and shock periods. These concern access to water sources, the workload on water-related tasks, increased reliance on cash and donkeys or motorbikes to obtain water and reduced support from children on water collection duties. In certain instances, when there is water scarcity in the household, there is an increased incidence of domestic violence. Men also suffer from similar constraints albeit to a different degree. Poor access to water is closely tied to an increase in women's workload related to caring for livestock:

> *"The wife collects water but the workload increases because you have small animals that need water so you have to collect more water compared to normal times"* ***(FGD# 1 Male 45 years old).***

Further, it was established from the findings that during the periods of water stress force men to support the women in ensuring that the household can access water to meet their basic requirements. This view was dominant in a men group discussion but was also expressed by one woman:

> *"We must support our wives during such periods because they have a lot of work"* ***(FGD# 1 Male 40 years old).***

> *"During a good period, women are responsible for who fetches water and when it is drought period the workload of water is a lot and men come in to help in fetching water and still take care of livestock"* ***(FGD# 2 Female 32 years old).***

Contrary to what the men mentioned about supporting their women on water-related roles during drought, the women's views contradicted those of the men. Some of the women mentioned that they are solely responsible for ensuring water security for their households during drought periods: Consider the quote below:

> *"It is only me who fetches water during the drought period because they (children) are not at home at all times of the year. They go to school. During a good year, we all fetch water because it is near. I go to other tasks and children go to fetch water"* ***(FGD# 3 Female 37 years old).***

Thus, the challenges that women and men experience vary depending on water needs and use. Access to water is dependent on multiple sources with different profiles in terms of convenience, quality, reliability, cost and access rights, across different seasons of the year. The pressure that comes with livelihood choice, wealth status, access to labour, transport and storage facilities, household composition, and intra-household relations all come into play in determining which sources to use, and how much water to use and for which purposes.

These findings echo those by Isiolo County Integrated Smart Survey (2017) which recorded that the water demands in the households however exceed water supply and availability, especially in the ASALs. Unreliable water supply and the subsequent water shortage are the overarching water challenges that persons especially in the ASALs have to contend with. The report recorded that the quality and safety of water is another challenge. Although there may be a supply of water the quality might be compromised through contamination. Also, it was observed that open and surface water sources and the risk of contamination during trucking contribute to the challenge of poor water quality (Cook et al., 2016). Similarly, Galaty (2013) also recorded that conflicting interests in water and land use in the catchment areas of community water supply systems also have an increasingly negative impact on the availability and quality of drinking water.

Knapman and Sutz (2015) and Cleaver (2000) conclude that the way in which environmental resources such as water are managed is shaped by social and structural expectations and formal and informal institutions. Hence, men and women have different access to, control over, and rights and responsibilities in relation to land and water for agricultural production as well as assets and opportunities that support adaptive capacity by acting as buffers in times of crisis.

4.6 Water insecurity coping mechanisms for sedentarized pastoralists in Isiolo County

The third objective of this study investigated the strategies that sedentarized pastoralist adopted to cope with water insecurity in Isiolo County. From the study, community men and women adopted a myriad of strategies to cope with water scarcity. Re-using of water, rainwater harvesting, water trucking, reducing water usage and diversification of water sources were identified in the study as the main strategies adopted by respondents to cope with water insecurity in the study area. The study respondents were asked to indicate the

strategies they employed to cope with water insecurity and the findings are presented in the table below.

Table 4. 7: Water insecurity coping mechanisms

Coping mechanisms	***N***	***Mean***	***S. D***
Building water harvesting structures	96	4.4292	1.11936
Reduced water usage	96	4.8482	1.25278
Reducing the livestock number	96	4.3289	1.12632
Fetching water from dams	96	4.5267	,83576
Recycling water	96	3.8647	1.09463
Increasing storage capacity	96	3.7724	1.29468

From the findings in the table above, the majority of the respondents indicated that reducing the use of water is one of the main strategies that they adopt as a mechanism of coping with water insecurity (mean=4.8482). The study respondents indicated that fetching water from dams which are located many kilometres from their locality is a strategy for coping with water insecurity and the means used here could donkeys, motorbikes and sometimes human beings (mean=4.5267). Respondents indicated that during times of water scarcity such as during extended drought periods, the only choice they are left with is to buy water from water kiosks which many indicated that to be charging very high-water tariffs depending on the season (mean=4.4682). From the study respondents, the building of water harvesting structures (mean=4.4292) is a key coping mechanism that respondents employ to harvest rainwater during long and short rains and store it for use during the dry season and especially being used a drinking water.

Further, it was shown in the findings that being sedentarized pastoralists still keep small herds of livestock such as goats, sheep, cattle, camels and donkeys. In times of water shortages, respondents noted that they destock their livestock (mean=4.3289) through selling and giving to relatives in wet places during the dry period and restock when the rainy seasons return. Resulting from the study, the respondents indicated that recycling of water is one strategy that

employs to cope with water insecurity (mean=3.8647). This involves using the same water for multiple purposes where water that has been used to water wash utensils is stored and used again for the same purpose or other purposes. Also, the respondents indicated that storage capacity (mean=3.7724) is one method that people are using and investing in as a key mechanism to cushion them from water insecurity. Having huge storage facilities for water helps in storing during drought and rain season which can last the household for a long period.

The above quantitative findings have been supported by findings from the qualitative methods. Focus group participants explained that in previous years they had received emergency water trucked into the area which helped in times of extended drought but that at the time of the research visit no water trucking had taken place. The following quotes provide a picture of the situation:

> *"Yes, it depends on the facilities and storage capacity that someone has because with big tanks you can harvest rainwater and store it for later use when there is drought"* ***(FGD#1 Male 47 years old).***
>
> *"…we have problems with getting water during the dry season. We have to walk to the dam which is like 20 km from here and you can't carry more than one jerrycan…those who have donkeys are better off because the animals carry more containers and can do more trips"* ***(FGD#3 Female 34 years old).***
>
> *"My husband bought a motorbike that we use to fetch water during the dry season from the water kiosks or dam when the kiosks don't have water"* ***(FGD#2 Female 30 years old).***
>
> *"Sometimes we also see the county government try to help us by bringing water using the trucks to our community and this is when there is severe drought"* ***(FGD#4 Male 45 years old).***

In corroborating the above findings one of the key informants said the following:

> *"When there is drought all these surface water will dry up leaving people options of buying water from the Kiosks or the dam. For us we normally give our people information on when drought is likely to start so that they can plan accordingly……you will see some people selling off their small livestock and*

others would even sell cows to buy donkeys and camels" ***(KII#4 Community Leader).***

Thus, the findings show that rainwater harvesting and management is one of the strategies that water insecure communities have adopted to cope with water stress in ASALs. Prolonged rainfall shortage contributes significantly to a water security risk, especially in the drylands. However, in the short and long rains water can be harvested and stored for future use. Also, although rainwater harvesting can be simple, effective harvesting demands resources including water storage spaces such as drums, tanks and other containers. The strategy is also not reliable because of not only being rainfall-dependent but also lack regular replenishing of water, meaning that households can use the stored water for only a short period. Nevertheless, the method remains a useful water security risk coping strategy. However, the strategy may pose another risk: hygiene and sanitation. The desired optimum and reduced use of water are associated with a risk of deteriorating hygiene and sanitation. In the pastoral communities, water-borne diseases including acute diarrhoea have been reported.

The study also found from the focus group discussions that access to wealth through occupation or business enabled a household to cope better during water stress. Livelihood diversification was also cited as a means to remain resilient to water insecurity. Access to social and financial capital according to the study had a profound effect on a household's resilience to water stresses. Borrowing, sharing and loaning of water and transport assets provide a social buffer for households who may have difficulties in accessing water. Households which had access to social capital such as friendly neighbours, relatives or in groups, were able to access water and financial resources easily. These social associations also played a key role in addressing the water needs of the vulnerable groups in the study area.

The findings of this study corroborate those by Aroka (2010) who found that rainwater harvesting involves the diversion, collecting, storage, usage, and management of runoff through various schemes and as sustainably as possible which allows future use of the collected water. Similarly, Cook et al. (2016) observed that households also post-pone or reschedule certain water-consuming chores including laundry and reducing the number of meals cooked per day and reserving drinking. They concluded that all these practices aim at reducing water use. Water trucking and pricing is another strategy for coping adopted by water-stressed communities. Households purchase water from tracking services offered by vendors and other private sources (Nganganyuka et al. 2014).

5.0 CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents a summary of the study findings based on the objectives of the study. It also provides the conclusion and the recommendations for policy action. The chapter ends with suggested areas for further research.

5.2 Summary of the findings

The overall goal of this study was to investigate water security risk and coping mechanisms among sedentarized pastoralists in the Wabera Ward of Isiolo County. Specifically, the study

sought to: describe water security dynamics among sedentarized pastoralists; identify water needs and challenges for sedentarized pastoralists; and to establish water insecurity coping mechanisms among sedentarized pastoralists in Isiolo County. In determining the foregoing, questionnaires were administered to the respondents who constituted pastoral men and women who were living in the study area. From the 100 questionnaires that were administered in the field, the study achieved a response rate of 96%. From the findings, whereas the majority of the respondents were women (57.3%), about half (49%) of the respondents were aged between 31-40 years. An overwhelming majority (62.5%) of the respondents were married, 53.8% had a primary level of education and 34.4% were engaged in livestock keeping as their source of livelihood. Since the study location is primarily dominated by the Borana pastoral community, the majority of the study respondents belonged to the Borana ethnicity.

From the study findings, water insecurity dynamics manifest in terms of water access, quantity, quality and cultural implications including conflicts and distress for women and children. In this regard, climate change leads to changing seasons in the study area which were characterized by varying access and availability of water. It was observed that there were four seasons in the study area which included seasons of short rains, long rains, dry and extended dry season. With the changing seasons, there were different protected and unprotected sources of water in the study site with some being preferred in some seasons and by a specific gender. The communities in the study area discern which water sources to use for household and livestock needs and at which times of the year. However, each season had its challenges related to water access but generally, during short and long rains, water access challenges are tremendously reduced compared to dry and extended dry seasons. The results indicated that the main source of water in both dry and wet seasons for sedentarized pastoralists in the study area were the boreholes and then following by water kiosks.

While there many sources of water depending on the season, the findings show that water access was highly insecure and the vulnerability is exacerbated depending on the most available source of water. Water collection and management was shown to be the sole responsibility of women which would come to some and power over how household water is used. Children provide support to women on duties related to water while men participate minimally and especially during drought. Thus, from the study, women and girls are generally responsible for water collection and therefore bear the greatest burden including other household chores. But the gender aspect of water security extends beyond this. This means that women not only bear a high workload when water access is good but when collection times are high, they may be forced to extend their working hours and trend-off with other competing needs.

The water needs and use for men and women vary depending on the season and the sources of livelihood. The common uses of water at the household level are mainly for drinking, cooking, birthing, washing, livestock, business and farming. However, the needs change with a season where priorities are introduced in times of scarcity. Also, women were found to have more uses and needs for water than men. However, access to these sources of water was controlled by men who then prioritize their water needs to that of women and thus to some extent, males control female access to water sources regardless of the need. Access to shared water sources was observed to a matter of competition between female and male users. The study findings show that during drought, women and children walk for long distances to search for water, whose quality is not guaranteed. The women's gender role of supplying households with water has a gender connotation and has resulted in the women and girls facing long queues waiting to get water during water rationing days. Girls and boys also spend a lot of time fetching water and their participation reduces during dry seasons.

In terms of coping with water insecurity, community men and women adopted a myriad of strategies to cope with water scarcity. The main strategies that pastoral men and women adopted in the study area to Re-using of water, rainwater harvesting, water trucking, reducing water usage and diversification of water sources were identified in the study as main strategies adopted by respondents to cope with water insecurity in the study area. Further, access to wealth through occupation or business enabled a household to cope better during water stress. Access to social and financial capital according to the study had a profound effect on a household's resilience to water stresses.

5.3 Conclusion

The study concludes that sedentarized pastoral communities still experience water security challenges such as poor quality of water, high water tariffs, long queues at water points and long trekking distances despite the continuous investment by the government and its partners in ensuring water access is achieved for all populations including those in the ASALs in Kenya. Water-related stress and coping mechanisms are highly gendered, and this study revealed that this extends not only to the demands placed on women and children by water collection but also to domestic disputes and unequal divisions of labour within the household. In as much as water stress affects both men and women, the study concludes that the burden of fetching water when left to women alone limits the time available for other activities including education and income generation with a consequence is heightened vulnerability to climate variability. Many pastoral communities lack access to safe and quality water limits meaningful participation in income-generating activities that require the use of safe water.

The study concludes that water security must be understood concerning livelihoods and the wider human security context in often 'hard' rural development environments. The achievement of water security in terms of access to quantities necessary for survival and basic domestic use is, in pastoral communities, inextricably linked to the role of social relations in

binding households and communities together. From the foregoing, the better-off tend to have better water access under normal conditions and are more able to cope under a shortage. This may be through mobilizing a range of assets that poor households may not be able to obtain, to create a wider range of access choices and reduce the time and drudgery involved in water collection.

5.4 Recommendations

Based on the aforementioned, the study makes the following recommendations:

i. Since women are responsible for ensuring households are water secure, interventions designed to address water insecurity such as those from the county government and other local development partners should ensure that women and men are engaged and represented fairly in the design process to ensure their unique needs, challenges and coping mechanism are reflected in the entire initiative in a gender transformative manner.

ii. Non-governmental organizations working on gender and water related interventions in the county need to approach water security from the lenses of the most affected, women. There is a need to empower women to actively participate in all process of water resources management such as supervision of implementation and management of operations and maintenance of water sources and supply and decision-making in water management committees.

iii. Since boreholes come out as the most reliable source of water across the various seasons, the county governments need to invest in and construct more boreholes and water reservoirs while at the same time improving local water storage facilities to ensure that sedentarized pastoral communities in the study area have access to enough quantity of water.

iv. The fact that women are primarily responsible for collecting and managing domestic and livestock water as well as water storage for the household means that initiatives geared towards improving water security should be directly addressed to women both individually and collectively instead of the male-dominated channels such the water user associations and committees.

v. Sedentarization as a form of coping strategy among pastoral community which increases their vulnerability to water stress. Thus, there is need for the county government and its partners to invest in water supply for sedentarized pastoralists in peri-urban centers to increase access to good quality and quantity of water for these group while at the same time providing subsidies.

5.5 Areas for further studies

In terms of research, a study looking at social capital and networks as a form of coping with water security among sedentarized pastoralists in Isiolo County should be conducted.

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APPENDICES

Appendix I: Consent Form

Investigator: Elsa Ouma

Introduction

I am Elsa Ouma from the Institute of Anthropology, Gender and African Studies, University of Nairobi. I am conducting a study on**:**

WATER SECURITY RISK AND COPING MACHANISMS AMONG SEDENTARIZED PASTORALISTS IN ISIOLO COUNTY, KENYA

Purpose

The study seeks to investigate water security and coping mechanisms among sedentarized pastoralists in Isiolo County, Kenya.

Procedure

If you agree to participate in the study, you will be asked various questions related to the study. Although you will be asked certain specific questions, you will be free to provide more information that is relevant to the themes being addressed.

Risks/Discomfort

There are no risks in participating in this study.

Benefits

Although there will be no direct or immediate benefit for participating in the study, the investigator will assist in answering questions that you may have. Further, the study aims at exploring the factors relating to water security risk and coping mechanisms. The findings might inform policy for improved water security practices and sustainable coping strategies.

Confidentiality and Anonymity

Your confidentiality will be maintained at all times during the study. The information provided will not be used for any other purpose than the one stated. The names or identifiers of participants will not be used in the report or publications which may arise from the study. True identification of participants will be concealed at all times.

Compensation

There will be no direct compensation for your participation in the study although you will be reimbursed your transport expenses.

Voluntariness

Participation in the study is voluntary. You will be free to withdraw at any stage of the study and doing so will not attract any penalties or discrimination whatsoever. However, I humbly request for your cooperation, which will be highly appreciated.

Persons to contact

If you have any questions regarding the study, you can contact Elsa Ouma through telephone number 0722313564 or email through elsa@uonbi.ac.ke. You may also contact Dr. Dalmas Omia on email addressdalmas.ocheing@uonbi.ac.ke

I would like to know whether you have a question to ask now. If no, would you like to participate in the study? If yes, please sign the space below.

I_____ hereby voluntarily consent to participate in the study. I acknowledge that a thorough explanation of the nature of the study has been given to me by Mr./Ms._____. I clearly understand that my participation is voluntary.

Signature_____Date_____

Signature of Reseacher/Assistant_____Date_____

Appendix II: Survey Questionnaire

Introduction to survey questions

My name is Elsa Ouma, a masters' student in Gender and Development at the University of Nairobi. I am conducting a study on water security risks and coping mechanisms among sedentarized pastoralists in Wabera Ward in Isiolo Sub-County. I would therefore want to find out the water security dynamics, water uses and needs as well as water insecurity coping strategies for sedentarized pastoralist in this area. All the information given in this study will be kept in the strict confidence and will only be used for academic purposes. Please answer honestly where choices are given and tick the options which match your answers. Otherwise, write out the information asked for in the blank space after the question. Thank you in advance for your cooperation.

Date of the interview	
Location of the interview	
Questionnaire number	
Time of the interview	

Part One: Respondents demographic

characteristics 1. Please record respondents' gender

[a] Man [b] Woman

2. How old are you?

_____ Years

3. What is your marital Status?

[a] Single/Never married [b] Married [c] Divorced/Separated [d] Widowed [e] Other_____

4. What is your highest level of education attained?

[a] Never attended/No school

[b] Primary incomplete

[c] Primary complete

[d] Secondary incomplete

[e] Secondary complete

[f] College (e.g Technical Institutes, KMTC e.t.c) [e] University

[99] No response

5. What is your main occupation/source of income?

[a] Crop farming
[b] Livestock and poultry keeping (including sales)
[c] Trading in livestock and livestock products
[d] Trading in agricultural products (excluding livestock) Not own produce.
[e] Formal salaried employee (e.g. civil servant, domestic work)
[f] Business - trade/ services (non-agricultural)
[g] Not working - unemployed
[h] Other (specify)_____
[99] No response

6. What is your ethnic group?

[a] Borana [b] Somali [c] Turkana [d] Meru [e] Other (Specify)_____

Part Two: Water security dynamics

10. What are the major changes in the weather that you have experienced in this area?

_____

11. How have the changes affected your access to water for your household?

_____

12. What are the main sources of water available for members of your household?

[a] Piped water into household
[b] Piped water into compound
[c] Public tap/standpipe
[d] Water kiosks
[e] Boreholes
[f] Protected shallow well (covered)
[g] Protected spring
[h] Unprotected dug well
[i] Unprotected spring
[j] Tanker-truck (Water booster)
[k] Seasonal rivers (laga)
[l] Dams
[m] Water pan (Silango)
[n] Lakes
[o] Ponds
[p] Irrigation channels
[q] Canals
[r] Permanent rivers
[s] Rainwater collection
[t] Other (specify)_____

10. Who is in charge of ensuring your household is water secure and why/why not?

_____

11. In the scale of 1 to 5 how difficult has been for your household to get water domestic and other uses.

[1] Very difficult
[2] Moderately difficult
[3] Difficult
[4] Moderately less difficult
[5] Less difficult

12. How is your household affected when you don't have water for use?

_____

13. Who are the most affected among men, women and children and why?

_____

14. How long does it take to get water for your household in dry and wet season?

_____

15. How long do you take to cue and wait for water?

_____

16. Do you pay for water and if yes how much per 20 liters container in dry and wet season?

_____

Part Three: Water needs and uses

17. What are the main uses of water in your household?
    1. Domestic
    2. Livestock
    3. Crop production
    4. Other (specify)_____

18. Who is involved in fetching/collecting and transporting water for your household?

[a] In the rainy season

1. Men only
2. Women only
3. Both men and women
4. Children

99. No response

[b] In the dry/extended drought season

1. Men only
2. Women only
3. Both men and women
4. Children

99. No response

19. What are the different water needs for men, women and children in this area?

_____

20. Who uses more water in your household among men, women and children and why?

_____

21. Where do you store water for drinking and other uses?

_____

22. What do you to your water before drinking and using in other area?

_____

23. How do vulnerable members of the community meet their water needs?

_____

Part Three: Coping mechanisms to water security risk 24.

How often do you face water shortage in your household?

[a] Always [b] Sometimes [c] Rarely [d] Never

25. Are there situations you had to change your plans or schedules due to water challenges?

_____

26. What local knowledge do you use to cope with water problems in this area?

_____

27. What support do men and women and well as other vulnerable groups get to cope with challenges of water in this area?

_____

28 Do you have any other comment(s) to add or question(s) to ask?

_____

We have come to end of our interview.

Thank You

Appendix III: Focus Group Discussion (FGD) guide

My name is Elsa Ouma, a masters' student of Gender and Development at the University of Nairobi. I am conducting a study on water security risks and coping mechanisms among sedentarized pastoral communities in Wabera Ward. I am therefore interested in finding out your views as a community on water security dynamics, water uses and needs as well as water insecurity coping strategies for sedentarized pastoralist in this area. All the information that you will share in this study will be kept in the strict confidence and will only be used for academic purposes and that no identifies will be used even in reporting the findings. Feel free to contribute. Thank you

Section A: Demographic Characteristics

Age range:_____
Education:_____
Gender of the group:_____
Occupation:_____
Ethnic background:_____
Location/settlement:_____

Section B: Water security dynamics

How would describe water availability in this area? What are the sources of water in this community across wet and dry seasons? How is the quality and quantity of the sources like? When do you consider yourselves do be water secure? What roles do men and women play in relation to water security in this community?

Section C: Water needs

What are the different water needs for men and women in this community? How does the water uses and needs changes across the seasons? What are the problems experienced by community members when there is water scarcity?

Section D: Coping mechanisms

What do people in this community do to address water scarcity challenges individually and collectively as a community? What do people do differently to better their water situation in times of water scarcity? What kinds of support do community members receive to address the water scarcity challenges? How would respond to water scarcity challenge better if you had all that you need? Do you have any questions or comments since we have come to the end of our discussion.

Thank You for Participating

Appendix IV: Key Informant Interview (KII) guide

Background Characteristics

Age: _____
Sex: _____
Name of the organization/association: _____
Position in the organization/association: _____
Years of Service: _____ Years

1. In your opinion, how would describe water insecurity patterns in this area?
2. What are the drivers/pressures of water scarcity in this community?
3. What is your role in ensuring that households in this community are water secure? (Probe: area of coverage and population; availability, access, quality)
4. What water related difficulties do different groups experience in this community? How do the difficulties vary over the seasons (specify intensity wet/dry)?

5. What are the main economic activities that households depend on in this community? How does the kind of economic activity that you engage in affect your water needs?
6. What income generating activities do people in this community engage in? What is the effect of these income generating activities on water scarcity?
7. How do people in this community respond to water scarcity?
8. How do people adapt their livelihood activities when there is water scarcity?
9. What do people do differently to better their water situation in times of water scarcity?
10. What recommendation you give to support communities living in this area to address water scarcity challenges?
11. What policies exist to address the plight of sedentarized pastoralists in meeting their water needs?
12. Do you have comments or thoughts you would like to add? Do you have any questions for me before we end our interview?

Thank You for Participating

Appendix V: Research budget

ITEMS	QUANTITY	UNIT PRICE	TOTAL COST
Project Proposal			10,000
Study Tools			5,000
Research Permits (NACOSTI)	1	2,000	2,000
Note Books	12	100	1,200
Research Assistants	2	5000	10,000

Refreshments for FGDs	72 pax.	100	7,200
Accommodation	14 days	1,500	21,000
Transportation			15,000
Grand Total			**71,400**

Appendix VI: Work plan

Period	**Year 2019**					**Year 2020**				**Year 2021**	
Activities	**Jan 2019**	**Feb 2019**	**Mar 2019**	**Apr 2019**	**May 2019**	**Feb 2020**	**Mar 2020**	**Oct 2020**	**Nov 2020**	**Feb 2021**	**Apr 2021**
Proposal writing and literature review											
Proposal defense and corrections											
Data collection											
Data processing and analysis											
Project presentation											
Project correction											