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INDIGENOUS KNOWLEDGE AND CLIMATE CHANGE ADAPTATION AMONG HERDSMEN IN KPONGU COMMUNITY, WA MUNICIPALITY, GHANA

LAMBERT ABATANIE NAPOGBONG

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BY

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THESIS SUBMITTED TO THE DEPARTMENT OF GOVERNANCE AND DEVELOPMENT MANAGEMENT, FACULTY OF PLANNING AND LAND MANAGEMENT, UNIVERSITY FOR DEVELOPMENT STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY DEGREE IN DEVELOPMENT MANAGEMENT

MARCH, 2019

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DECLARATION

Student

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this University or elsewhere:

Candidate's Signature: ……...…… Date: ……..……

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Supervisor

I hereby declare that the preparation and presentation of the thesis was supervised in accordance with the guidelines on supervision of thesis laid down by the University for Development Studies.

Supervisor's Signature: …… Date: ……..……

Name: Prof. Emmanuel Kanchebe Derbile

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ABSTRACT

Climate change and climate variability have adversely impacted cattle production and the livelihoods of herdsmen. The multiple sources and scales of exposures create a process of vulnerability that constrain adaptive capacity. However, much of the climate change research in Sub-Saharan Africa rarely address how climate change has impacted herder communities and how they are dealing with its effects in tending cattle. Hence, this study explored the role of indigenous knowledge in the adaptation of cattle production to climate change among herdsmen of the Kpongu community in the Wa Municipality, Ghana. A case study research design was adopted and this facilitated an in-depth understanding of how the herder community of Kpongu is affected by climate change and how they are adapting through their indigenous knowledge systems. The primary methods of data collection included key informant interviews, focused group discussions and direct observation. The study revealed that herdsmen describe climate change and climate variability using multiple indicators. These include longer dry seasons and frequent dry spells, shrinking water bodies, formation of iron pans, stunted growth of grasses, smaller stalk sizes and less concentration of grasses. The results further revealed that indigenous adaptation strategies included stress management in herds, mobility of men and herds for feeding and watering, diversification of feed sources and division of labour for meeting differentiated need of cattle. The study also found out that the Municipal Development Planning does not address the climate change adaptation needs of herdsmen and their herds. To enhance adaptive capacity, the study recommends that climate change adaptation needs of herder communities should be institutionalised through Municipal Development Planning and implementation of community based measures such as dredging of water bodies, prevention of bush fires and planting early maturing leguminous crops for shade-drying and feeding to the cattle.

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DEDICATION

To the herdsmen of Kpongu, for the custody of deep generational indigenous knowledge and the application of same to the climate so as to keep with the times.

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LIST OF ACRONYMS

- APDADP - Afram Plains District Agricultural Development Project
- AR4 - Fourth Assessment Report (of the IPCC issued in Nov., 2007)
- ASAL - Arid and Semi-Arid Lands
- CBO - Community Based Organisation
- CBRDP - Community Based Rural Development Project
- CEFIKS - Centre for Indigenous Knowledge Systems
- CIKOD - Centre for Indigenous Knowledge and Organisational Dev.
- DAAD - Deutscher Akademischer Austauschdienst (German)
- EPA - Environmental Protection Agency
- EU - European Union
- FBO - Faith Based Organisation
- FGD - Focus Group Discussion
- GDI - Global Drylands Initiative
- GEF - Global Environment Facility
- GHG - Green House Gas
- GPRS - Ghana Poverty Reduction Strategy
- GSGDA - Ghana Shared Growth and Development Agenda
- IK - Indigenous Knowledge
- ILO - International Labour Organisation
- IPCC - Intergovernmental Panel on Climate Change
- ITCZ - Inter-Tropical Convergence Zone
- KII - Key Informant Interview
- MCD - Municipal Co-ordinating Director
- MCE - Municipal Chief Executive
- MDGs - Millennium Development Goals

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- MMDAs - Metropolitan/Municipal/District Assemblies
- MoFA - Ministry of Food and Agriculture
- MP - Member of Parliament
- MPO - Municipal Planning Officer
- MTDP - Medium Term Development Plan
- NDPC - National Development Planning Commission
- NGO - Non-Governmental Organisation
- NRGP - Northern Rural Growth Project
- POCC - Potentials, Opportunities, Constraints and Challenges
- SADA - Savannah Accelerated Development Authority
- SDCDS - Starting Date of Critical Dry Spells
- SES - Social-Ecological Systems
- SME - Small and Medium Enterprise
- SSSA - Soil Science Society of America
- TLIK - Traditional, Local and Indigenous Knowledge
- UNEP - United Nations Environment Programme
- UNFCCC - United Nations Framework Convention on Climate Change
- UNHSP - United Nations Human Security Programme
- UNICEF - United Nations International Children Emergency Fund
- WMO - World Meteorological Organisation

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CHAPTER ONE

BACKGROUND AND PROBLEM STATEMENT

1.1 Introduction

It is widely known that the global climate is currently changing. The last decade of the 20th Century and the beginning of the 21st Century have been the warmest period in the entire global temperature record, starting in the mid-19th Century (Howden et al. 2007). Climate change is a normal part of the earth's natural variability, which is related to interactions among the atmosphere, ocean, and land, as well as changes in the amount of solar radiation reaching the earth. The Intergovernmental Panel on Climate Change (IPCC) observed that in the 20th Century when the earth was seen from space for the first time, there have been consistent patterns indicative of climate change. For example, since the 1950s, average global temperature rose by about 0.1ºC per decade, winter snow covers declined by 10%, ice thickness fell by 40%, the frequencies and intensities of droughts, storms, and warm periods rose, glaciers retreated, and the sea level rose by 20cm (IPCC, 2007). The Panel attributed these changes to increased carbon emissions from fossil fuel burning. Assuming business as usual, these problems are expected to intensify.

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To satisfy his survival needs, mankind has attained many accomplishments that have largely been done without much recourse to what happens to the clouds, oceans, greenery and soils. Humanity's inability to fit its activities into that stable design is changing planetary systems and fundamentally altering global climate over the decades. Many such changes are accompanied by life-threatening hazards, resulting directly from climate change. This new reality, from which there is no escape, must be recognised and managed (Morelli, 2011). The time that humans have to salvage what is left of the environment and work towards regeneration is shorter because of the effects of climate change. This throws a whole new ball into the game

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with humanity grabbling with how to mitigate it, cope where we cannot and innovate adaptations when we can. Nations are meeting and leaders are urged to spearhead the drive of climate change adaptations. At the community level, people are using whatever assets they can mobilise and combining them with indigenous knowledge systems to create their own suitable adaptation strategies.

Preparing for climate-related changes will not only mean preparing for the worst; in some it may also mean preparing to take advantage of new conditions (Fenton et al. 2007). Thus climate change and climate variability will also bring opportunities. Positive changes are likely to occur somewhere at some time, but flexibility and responsiveness will be needed to realise potential benefits. For example, in some regions, climate change experts are predicting that higher rainfall can be expected, which could open up new and profitable agricultural opportunities. Community involvement and local initiatives are crucial not only for development but also for the protection of the environment and the fight against climate change. Case studies in different countries have shown that making local inhabitants incentive partners rather than simply collateral beneficiaries has increased local appreciation of climate change, the benefits of preserving natural resources and an interest to work towards climate change adaptation.

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Africa is the most vulnerable region to climate change, due to the extreme poverty of many indigenes, frequent natural disasters such as droughts and floods, and agricultural systems heavily depend on rainfall (Watson et al, 2001). A paper presented by Apata et al, (2009) reveal that there are strong indications and already evidence that the agricultural and food systems as well as the rural areas across Africa are experiencing major change. This change has drastically reduced livestock and agricultural outputs particularly in Sub-Saharan Africa. According to the

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IPCC predictions, areas suitable for livestock rearing particularly along the coastal margins, semi-arid and arid regions are expected to decrease including the length of forage and yield potentials. In some African countries, yields from rain-fed agriculture could reduce by close to 50% by 2020 (IPCC, 2007).

Traditionally, African farmers and herdsmen have used indigenous knowledge to understand weather and climate patterns and make decisions about crops, irrigation cycles and livestock movement. These have helped them to develop traditional and indigenous technologies to cope with climate change. Farmers in Africa are acknowledged to have been very highly adaptable to climate change and climate variability in both short and long terms while at the same time have the ability to develop effective indigenous means of handling variability in climate (Apata et al, 2009).

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Herdsmen in the Sudan-Sahel region have complained of drastic reductions in soil fertility and forage and that they can no longer predict the rainfalls. The soils are becoming drier and is harder to manage cattle, and the changes are causing very serious threats. In the coastal areas of Africa, there are evidences of the intrusion of salt water along communities where people live and keep cattle along the coast (Apata et al, 2009). This has led to increased salinity in soils, and the encroaching salt water that sweeps through the land has made it impossible for food crops and grasses to grow. While excessive flooding during the past decade has hurt cattle rearing in coastal communities, desertification is ravaging the Sudan-Sahel region (Tarhule & Woo, 1997).

Desertification in the Sahel regions had earlier been blamed on overgrazing practices of the local herdsmen, but recent studies have discovered that the real problem is climate change. The

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change in climate is predicted to worsen the incidence of drought and desertification. This is already evident in the steady declining rainfall in the Sahel region since the 1960's (Medugu, 2009). The result has been the loss of farmlands and conflicts between crop farmers and herdsmen over the ever decreasing suitable lands. Many different communities, including fishermen, farmers and herdsmen, are now confronted with difficulties arising from climatic changes. Peoples' livelihoods are being affected, and poor people are becoming more impoverished. Climate refugees are being created, as the changes make some land inhabitable and affect water supplies (Parry et al., 2004).

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Changes in temperature and the amount and distribution of rainfall have already been observed by residents of several communities across Ghana, and are anticipated to continue. The processes of vulnerability have several implications for efforts and activities designed to promote successful adaptations to future changes in climate. Ghana's Environmental Protection Agency (EPA) has indicated that over the period of 1961–1990, the country experienced an increase in temperature by 1°C and a reduction in precipitation by 20% (EPA, 2001). Estimates of future temperature increases forecast an additional increase of 0.2°C - 0.5°C per decade, with a 2°C - 3°C increase overall by the year 2100 (Christensen et al. 2007). While estimates of the amount and distribution of precipitation remain uncertain, inter-annual variability is expected to increase, with an increase in the intensity of high-rainfall events but an overall decrease in the number of rain days (Hulme et al. 2001).

In the Accra Plains, there is the growth of herbage for cattle, which is only possible and characteristic of the bimodal rainfall pattern (Fianu, Atta-Krah and Koram, 1972). Although grasses are endowed with unlimited growth potential, actual growth is regulated by the rhythmic variations of the seasons, modified by the supply of plant nutrients or food available

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to the plant. The period of growth begins with the first rains and continues, often with fluctuations due to erratic rainfall, to the end of the rainy season. The plant then enters a resting period similar to dormancy, which lasts until the beginning of the next cycle (Rose Innes, 1977). Animal growth rates are therefore seasonal and follow a stop-fall-start growth pattern in a cycle corresponding with the available herbage as influenced by rainfall. Thus cattle usually do not reach marketable size (250 kg) until they are six (6) years old or more (Rose Innes, 1977). Milk production in the dry season is low or non-existent and herdsmen may sometimes not milk their cows at all. Cows may not calve more than once in three (3) years and calf mortality is extremely high. Twenty percent of calves may not survive the first six (6) months and another 20% may fail to reach maturity (Webster and Wilson, 1980). During the dry season, cattle are unable to meet their requirements for maintenance and production. Animals are often in negative energy and undesirable nitrogen balance and as a result mobilise body reserves in a bid to survive. This is reflected in low growth rates, weight loss and reduced milk yield during the dry season, which ultimately affect the total output by the animals. Cattle may lose up to 30% of their body weight in a very severe dry season (Sada, 1968). Average daily partial milk yield may fall to 0.3 kg in the dry season and rise to 1.5 kg in the wet season (Okantah et *al.,* 1995).

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The response to climate change and climate variability reveals that indigenous knowledge has become a strategic resource for adapting cattle production and agriculture in general to climate change. Indigenous knowledge is emerging as a tool of response to climate change and climate variability (Scoones and Thompson 1994, Roggero et al, 1996, Nyong et al, 2007). Within the years 1982 – 1983, drought cycle was worse in terms of precipitation in Nigeria and southern Niger than that of the earlier 1969 - 1974 drought (Mortimore, 1989). Yet responses, many of them positive, could be identified at the scale of the village and that of the household.

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As part of the response to climate change and climate variability there were changes to the livestock management system, labour management, land holdings, grazing systems and local technologies, as well as changes in sources of capital (Mortimore, 1989). However, changes had different impact from house to house, depending on a complex array of differentiating factors, and one person's strategy could be another's act of desperation.

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Livestock management and breeding in Africa incorporates local expertise, indigenous knowledge and goes well beyond risk reduction. The Wodaabe herdsmen in Niger, for example, have a production strategy and it is informed by studying cattle in their environment, controlling their stress and facilitating the regeneration and transmission of desired functional behaviour. Matrilineal genealogies are carefully memorised by the herdsmen. Reproduction is strictly controlled, less than 3 percent of the bulls being systematically used (Kratli, 2008). Animal variability is fostered. Selected male cattle are intensively circulated within the breeding network. Cows are rarely sired twice by the same bull. Culling of females focuses on reproductive capacity, and marketing of poorly performing animals.

In Ghana, Fulani are generally the herdsmen who are engaged by cattle owners to tend to their cattle. They are perceived to be confident in handling and control of cattle. Their wages are generally paid in kind and the milk from the herd usually forms their major reward (Okantah, 1974). The herdsman usually lives just by the kraal and takes care of the cattle as their primary livelihood. They may also cultivate food crops such as maize around the homestead. Farming is subsistence in nature. Most herdsmen also keep a few poultry and a few sheep and/or goats to supply meat (Okantah *et al.*, 1995). Their way of life and livelihood around tending cattle is adversely affected by climate change and climate variability (Medugu et al, 2014; Orindi,

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Nyong and Herrero, 2007) and how they are adopting to this phenomenon is crucial for the sustainability of the industry and agriculture as a whole. Thus the interest of this study is to explore how herdsmen are employing their indigenous knowledge for dealing with climate change and climate variability in tending their cattle. This is in the face of greater attention being paid by various institutions to the needs of food crop farmers to the neglect of herdsmen in climate change adaptation.

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1.2 Research problem

Changes in the climate and the physical environment clearly present exposures and significant constraints in cattle production among herdsmen. The multiple sources and scales of exposures create a process of vulnerability with various forces acting to constrain adaptive capacity at the local level. It is those at the local level who are mostly in touch with the environment and the realities of climate change. They are the ones that are constantly innovating and using local resources and their indigenous knowledge in climate change adaptation. The indigenous knowledge of pastoralists informs the nature and effectiveness of their indigenous climate change adaptation strategies. Agro-pastoralists in drylands rely on indigenous indicators of rainfall and other atmospheric changes, using them as a framework within which to position and interpret climatic trends and forecasts (Rao et al., 2011). At the same time, few are able to adapt their practices predominantly because of a general lack of adaptive capacity (Speranza et al., 2010).

It is often too easy to devalue the importance of indigenous strategies employed by the herdsmen and the capacities of poor households, and accede to a conventional wisdom that emphasises their limitations: i.e., herders have low or weak adaptive capacity (Nkomo et al, 2006). This apparently plausible rationale for ‘low capacity’ which is stated explicitly and

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sometimes implied in the IPCC 4th Assessment of 2007, needs to be challenged in the light of the Sahel experience. The local herdsman is often thought to be adamant in his opposition to change. It would be more reasonable to admire his shrewdness and practicality. He may well be opposed, and rightly so, to new techniques which have not been proven to him. The fact of his existence is in itself proof of some abilities of his indigenous adaptive capacity and general survival practices which have been successfully used in hostile environments over the course of many centuries. He will not relinquish these practices unless better methods are clearly demonstrated on his own ground (Rose-Innes, 1977).

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The literature is full of praise for the ingenuity and originality of local communities as documented in the view of many researchers who study the locals from afar (Medugu et al, 2014; Crawhall, 2014; Macchi 2008). The recognition not notwithstanding, the literature on climate change adaptations and the use of indigenous knowledge in the process has not adequately dealt with the perspectives of herdsmen in climate change adaptation. Climate change research rarely address the subject of climate change adaptation among herdsmen in cattle production. Much of the literature rounds up conclusions for and on behalf of herdsmen based on the stories of climate change impacts and adaptations told by food crop farmers (Charles, 2017; Ismail., et al, 2014; Thornton, 2010). Hence, the problem that concerns the study is the role of indigenous knowledge in the adaptation of cattle production to climate change among herdsmen of the Kpongu community.

1.3 Research questions

Main question

The main question of the study is set out, thus, what is the role of indigenous knowledge systems for adapting cattle production to climate change and climate variability among herdsmen in the Kpongu community?

Sub-questions

1. How do herdsmen narrate climate change and climate change impacts from their perspectives and experiences as part of their world view?
2. What indigenous adaptation strategies are used by herdsmen for adapting cattle production to climate change?
3. How is District Development Planning addressing the climate change adaptation needs of herdsmen in cattle production?

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1.4 Research objectives

Main objective

The main objective of this study is to analyse the role of indigenous knowledge systems for adapting cattle production to climate change and climate variability among herdsmen in the Kpongu community.

Sub objectives

1. To analyse the narratives of climate change and climate change impacts from the perspectives and experiences of herdsmen as part of their world view.
2. To identify and analyse indigenous adaptation strategies herdsmen employ for adapting cattle production to climate change.
3. To assess how District Development Planning and Management is addressing the climate change adaptation needs of herdsmen in cattle production.

1.5 Significance of the study

This study is not a full account of indigenous innovations and climate change adaptations in cattle production. Rather the intention is to provide a layman's understanding of the widely used indigenous climate change adaptation strategies and how these are impacting on

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livelihoods of individuals and households. The study contributes empirical data to the emerging body of research on climate change adaptations in Sub-Saharan Africa. The research is to contribute knowledge in the area of indigenous climate change adaptation strategies and their proper usage.

The study also finds significance in the fact that it is not only appropriate but also timely to integrate indigenous climate change adaptation strategies with the modern scientific system, represented by the formal decentralised planning structures. This is one of the objectives that the research explores and will thus be contributing to the body of literature.

The research is also significant on the grounds that it could set the stage for local policy and legislative action by the appropriate government department/institution, particularly the Wa Municipal Assembly. The research seeks to help development planners make informed decisions towards improving individual and communal adaptive capacities and maintaining the livelihood options that are opened to individuals and households.

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1.6 Limitations of the study

A cursory look at the objectives of the study shows that the main unit of analysis would be the herdsmen. These are members of the Kpongu community who keep cattle and engage in pasturing activities. This means that, all other persons who keep grazing animals that are not cattle are not included in the sample population of this study.

In terms of geographical coverage too, the study is limited to only peri-urban herdsmen. The choice of delineating a peri-urban study area is because the herdsmen are those being faced head-on by the challenges of climate change. Herdsmen of forest regions are merely being brushed by the impact of climate change and climate variability since cattle feeding is barely

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disturbed. In like manner, this study will not include herdsmen in urban areas because the cattle that are being kept in such areas are on temporal basis and eventually to satisfy the demand for meat.

Also this study did not encompass any form of environmental modelling, involving climatic warning systems that combine simulation and remote sensing using climatic variables. This is because the purpose of the study is not to develop a map of the vulnerable land surface which could direct the movement of herdsmen.

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1.7 Organisation of the study

The study is organised in five (5) chapters. Chapter one is a general introduction which include a background to the study, the problem statement, research questions and objectives. The chapter also captures the justifications and limitations of the study. The theories, concepts and already existing discourse that are pertinent to the climate change adaptations of herdsmen form the second chapter. The chapter is also devoted to the critical issues of the study by way of reviewing relevant literature. It ends with a conceptual framework that serves as a model to guide the research process.

Chapter three presents the research methodology that was adopted for the study. The chapter covers the research design, various research approaches, including methods and techniques of data collection as well as tools for analysing and presenting the data. This chapter also deals with the profile of the study area, the study population, sample size and sampling techniques as well as instrumentation and instrument validity. The details of the research findings and the discussion of these outcomes constitutes the fourth chapter. Findings of the research are

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presented and discussed. Tables, figures and other illustrations are employed to make data analysis and presentation simpler for easy understanding.

Chapter five is the final chapter and it presents the summary of research findings and conclusions. Also a linkage is established between and among variables, beginning with the problem statement, the research objectives, research questions and then the findings. This link would then invariably give ample basis for the recommendations that are made to improve policy and practice.

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CHAPTER TWO

REVIEW OF LITERATURE AND THEORETICAL FRAMEWORK

2.1 Introduction

This chapter presents a critical review of literature that is relevant to the study. The review covers the concepts of climate change and climate variability, climate change adaptation, indigenous knowledge and the relationship between indigenous knowledge and climate change adaptation. Based on the review, a theoretical and conceptual framework is presented for guiding the empirical analysis.

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2.2 Climate change and climate variability

Even though scientists have no doubt that global climate is warming, natural climate variability will always occur in different regions of the world. There will be ups and downs even if we are in the middle of a warming trend. Understanding the difference between climate variability and climate change and how scientists study both allows us to interpret information on weather and climate and to make sense of our environment. An understanding of the difference also makes it possible to situate the study and discussion of indigenous knowledge and adaptations in the proper context.

2.2.1 Climate change

Climate change is a long-term continuous change, either an increase or decrease, in the average weather conditions (e.g. average temperature) or the range of weather such as more frequent and severe storms. Both changes can also happen simultaneously in the long term, that is, a change in the average conditions as well as a change in the frequency or intensity. Long-term means at least three decades. Climate change is slow and gradual, and unlike year-to-year variability, it is difficult to perceive without scientific records.

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Although climate change is not a new phenomenon, its recent usage, especially in the context of environmental policy, refers to changes in prevailing climate, particularly since the 20th Century. Climate change generally refers to changes in the statistical distribution of weather parameters over periods of time, ranging from decades to millions of years (Bello, 2010). Okoruwa (2010) referred to climate change as identifiable variability in climate that has brought about negative consequences to human survival. This understanding of climate change embodies the central theme of this research. The definition captures the fact that climate change brings some negative effects and thus becomes appropriate since herdsmen adaptations are informed by threat to their livelihood and survival needs.

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Some scientists are beginning to conclude that the anthropogenic effect of increased greenhouse gas concentrations on global climate is already evident (Thomson, 1995). Increasing surface temperature has been linked with lengthening the growing season in temperate regions while shortening the season in tropical environments with very high chances of drought (Okoruwa, 2010). According to Lehodey et al. (2006), the extent to which preferred patterns of variability can be considered true modes of the climate system is debatable, but certainly these patterns are useful in explaining physical and biological variabilities.

Climate change in Africa

The climate of Africa is warmer than it was 100 years ago and model-based predictions of future Green House Gas (GHG) induced climate change for the continent clearly suggest that this warming will continue and, in most scenarios, accelerate (Hulme et al. 2001; Christensen et al. 2007). Observational records show that during the 20th century the continent of Africa has been warming at a rate of about 0.05°C per decade with slightly larger warming in the June - November seasons than in December - May (Hulme et al. 2001). Before the year 2000, the

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five warmest years in Africa had all occurred, with 1988 and 1995 being the two warmest years. This rate of warming is not dissimilar to that experienced globally, and the periods of most rapid warming, that is, the 1910s to 1930s and the post-1970s, occur simultaneously in Africa and the rest of the world (IPCC 2001).

In East Africa large water bodies and varied topography give rise to a range of climatic conditions, from a humid tropical climate along the coastal areas to arid low-lying inland elevated plateau regions across Ethiopia, Kenya, Somalia and Tanzania. The presence of the Indian Ocean to the east, and Lake Victoria and Lake Tanganyika, as well as high mountains such as Kilimanjaro and Kenya induce localized climatic patterns in this region (KNMI 2006). Mean temperature varies with elevation.

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Kenya's climatic conditions vary from a humid tropical climate along the coast to arid areas inlands. While mean temperature varies with elevation, the more remarkable climatic variation is with respect to precipitation. Kenya experiences a bimodal seasonal pattern as it lies astride the equator. The long rains season starts around March and runs through to June, with the peak centred on March to May; the short rains run from September and taper off in November or December, coinciding with the shifting of the Inter-Tropical Convergence Zone (ITCZ).

The arid and semi-arid regions are intensifying, and changing from rangeland to mixed systems. This transition from pastoralism to agro-pastoralism is ongoing in many places throughout Africa (Reid et al. 2004, 2008). This is also demonstrated by the reductions in land area in the rangeland based systems towards increases in areas of mixed systems, and the substantial increases in the livestock populations in the mixed systems leading to more intensive types of production systems (Herrero et al. 2008). In Kenya, changes from pastoral

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to mixed systems are projected to occur at rates of 1.2 - 2% per year in terms of area (Herrero et al. 2008).

2.2.2 Climate variability

Climate varies over seasons and years instead of day-to-day like weather. Some rainy seasons are colder than others and some dry seasons are accompanied by higher temperatures. Some years have more overall precipitation than others and some dry seasons are longer than others. These seasonal fluctuations are the evidence of climate variability. Even though people are fairly perceptive of climate variability, it is not as noticeable as weather variability because it happens over seasons and years.

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Scientists think of climate variability as the way climate fluctuates yearly above or below a long-term average value. One can think of it as a story with two parts: average and range. These parts complement each other. Understanding the range gives context to the average and vice versa. There will always be natural climate variability at many scales: decadal, yearly and short-term extreme events. This means that over the long-term record, there will be ups and downs with the yearly and 30-year averages, even if overall climate is getting warmer.

Climate change and livestock rearing in Asia

More than half of the population of Asia live in rural areas, with many being pastoralists depending on livestock and rangelands for their livelihood. Rangelands occupy over 4.3 billion acres on the continent, almost 38% of the total land area (Okayasu et al, 2007).

The IPCC 4th Assessment Report provided a synthesis of outputs from twenty-one (21) climate models for Asia. With a focus on the Mongolian rangelands, the projections of a majority of

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these models is for increased annual temperatures in this region. Rangeland productivity in grazing enclosures in Mongolia has decreased 20 - 30% during the last 40 years (Adger et al 2009). This productivity decline has been attributed to recent changes in climate, mainly higher temperatures and lower summer precipitation.

Drought frequency and intensity are projected to increase over the continent of Asia. These events could lead to crop failures and food shortages that, in turn, could lead to reduced availability of supplemental feeds for livestock during drought periods. Air temperature increase can increase the evaporation of soil moisture, but in regions that experience precipitation increases, evaporation losses might be offset. Overall, water use efficiency could increase under climate change predictions in the Inner Mongolia regions if both increased temperatures and seasonal precipitation are realised, especially in conjunction with higher atmospheric carbon dioxide levels (Morgan et al., 2009). Given projected population increases and continued increases in livestock numbers, the potential exists for continued degradation of the rangeland resources. Climate change projections could have significant impacts across this region, noticeably causing further decreases in net primary production of livestock. Therefore, any strategies for mitigating these impacts need to address classic rangeland management. Adaption strategies also need to target concerns of limited forage production and allow for detection of trends in the vegetation and soil resource, thus providing necessary information for adaptive management.

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Climate variability in Africa

The projections and actual records for rainfall are less uniform in Africa. Hulme et al. (2001) illustrated the large regional differences that exist in rainfall variability. East Africa appears to have a relatively stable rainfall regime, although there is some evidence of long-term wetting,

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giving rise to the likelihood of increase in annual mean precipitation over East Africa (Christensen et al. 2007). Recent studies have shown that there has been precipitation decreases of between 10% - 25% per decade in the humid regions of West Africa since the beginning of the century. In the Sudan-Sahel regions, there have also been records of decrease in rainfall in the range of about 3% - 4% per decade (Apata et al, 2009). These areas are recording seasonal and inter-annual climatic variabilities, resulting in droughts and desertification processes that propel indigenous adaptations by herdsmen and small holder farmers. In fact, since 1968, the start of rains has been getting progressively delayed over the Sudan-Sahel regions as corroborated by the significant decline in April rainfall (Apata et al; 2009). These have resulted in low and variable rainfall, shorter growing periods, scarcities of soil nutrients to support plants growth and deep water tables (Mortimore and Adams, 2000). These inconsistencies in rainfall have made it generally difficult for various farmers, herdsmen (Macchi, 2008) and scientists (IPCC, 2001) to predict precipitation patterns. This difficulty in predictions leaves the herdsmen with little room to manoeuvre. All they can do is to anticipate the changes in climate, cope with those that are minimal and adapt quickly whenever their scope of indigenous knowledge and local resources makes it possible.

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Most economic livestock species have comfort zones of between 10 and 30°C. At temperatures below this, maintenance requirements for food may increase by up to 50%, and at temperatures above this, animals reduce their feed intake by 3 - 5% per additional degree of temperature (NRC, 1981). In many livestock systems, changes in temperature and rainfall variability affect feed quantity most directly. Droughts and extreme rainfall variability can trigger periods of severe feed scarcity, especially in dryland areas, which can have devastating effects on livestock populations. In the recent past, the pastoral lands of East Africa have experienced droughts about one in every five years, and even under these conditions it is generally possible

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to maintain relatively constant herd sizes, but increases in drought frequency to one in every three years would set herd sizes on a rapid and unrecoverable decline (Thornton & Herrero, 2009). In Kenya, some 1.8 million extra cattle could be lost by 2030 because of increased drought frequency, the value of the lost animals and production foregone amounting to US $630 million (Ericksen et al., 2012).

For the purpose of this study, both climate change and climate variability are suitable concepts. Climate change opens up the human mind and experience to have long term perspectives. On the other hand, climate variability results in short term changes in the frequency, intensity, spatial extent, duration, and timing of weather events (IPCC, 2012). The fluctuations in climate variability present some conditions that are very conducive for pastoralism in the short term and therefore would not necessitate any form of adaptation in that time frame. Meanwhile, in the long term, usually over three decades, the climatic conditions change slowly in a manner that is not readily noticeable but requires adjustments to be made, thus the need for mitigation and adaptation.

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Admittedly, rainfall seasonality affects agricultural production, pastoralism and the livelihoods of rural folks especially in the arid and semi-arid regions (van de Steeg, et al. 2009). Pastoralists have devised ways to maintain livestock production in-between seasons and also require strategies to adapt to the climate in the long run. Even though extreme isolated events occur, such as floods and heat waves, these do not prompt households in arid and semi-arid regions to make any significant adaptation to their environment (Meze-Hausken 2004; Cooper et al. 2008). The need for climate change adaptation intensifies as the frequency, intensity and timing of various weather events culminates in a significant shift and a relative permanency in the nature of the physical environment in the long term.

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2.3 Climate change adaptation

In the 1990s and early 2000s the debate on climate change was mostly focused on how to mitigate it. In recent years growing attention has been paid to adaptation (Adger et al., 2009; Dodman and Mitlin 2011). The aim of adaptation is to reduce vulnerability and to increase resilience and involve changing processes or practices in social and ecological systems through reducing potential damages or engaging in new opportunities (Adger et al., 2007). Climate change adaptation rarely only focuses on factors related to climate change. Adaptation may incorporate any practices or initiatives that increase resilience to elements constituting threats to communities that may aggravate through climate change.

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Adaptation is an adjustment made to a human, ecological or physical system in response to a perceived vulnerability. Specifically, the IPCC described adaptation to climate change as adjustment in natural or human systems in response to "actual or expected climatic stimuli and their effects" which moderates harm or exploits beneficial opportunities (IPCC, 2001). Adaptation is an important component of climate change impact and vulnerability assessment and is one of the policy options in response to climate change impacts (Smith and Lenhont, 1996; Fankhauser, 1996). Adaptation to climate change is therefore critical and of concern in developing countries, particularly in Africa where vulnerability is high because ability to adapt is low (Hassan and Nkemechena, 2008).

Adaptation methods are those strategies that enable the individual or the community to cope with or adjust to the impacts of the climate in the local areas. Such strategies will include the adoption of efficient environmental resources management practices that guarantee the goal of effectively adapting to the changing climate with the least effect on the environment.

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According to Brussel (2009), adaptive measures to climate change and climate variability in agriculture range from technological solutions to adjustments in farm management and to political changes such as adaptation plans and policy. Continuing, the author categorised agricultural adaptation options into technological development, government programmes, insurance, farm production practices and farm financial management. The first three options are principally the responsibility of public agencies and agri-business and adaptation here could be thought of as system-wide or macro scale. The last two mainly involve farm level decision making by farmers and herders. In the short run, autonomous farm level adaptation may be sufficient but in the longer run, adaptation in the form of technological and structural changes will be necessary. This will require planned strategies based on analysis of local and regional conditions (Brussel, 2009).

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There is a great variety of possible adaptive responses available to deal with climate change. These include technological options (such as more drought-tolerant crops), behavioural responses (such as changes in dietary choice), managerial changes (such as different livestock feeding practices), and policy options such as planning regulations and infrastructural development (Thornton et al. 2009). For example, in the arid and semi-arid regions, livestock herders migrate with their animals in search of pasture and water, with the average distances trekked tripling in drought years. Herding communities typically reserve some pastures back at their homesteads for grazing by vulnerable animals left under the care of women during migration seasons. The herders also ensure that the composition, size and diversity of their animal herds (e.g. a mix of browsers and grazers) suit their variable feed resources and serve to protect them against droughts that could otherwise wipe out their animal stock.

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2.3.1 The practice of climate change adaptation

The current wave of climate change adaptation activities started at the first meeting of the Conference of the Parties to the Framework Convention (COP-1, Berlin, 1995), where a decision was taken (Decision 11/CP.1) to approach adaptation in three stages. These stages were defined as follows:

Stage I – Planning, which includes studies of possible impacts of climate change, to identify particularly vulnerable countries or regions and policy options for adaptation and appropriate capacity building.

Stage II – Measures, including further capacity building, which may be taken to prepare for adaptation.

Stage III – Measures to facilitate adequate adaptation, including insurance and other adaptation measures.

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Under these provisions, the Global Environment Facility (GEF), which is the financial mechanism for the Convention, has met the agreed full costs for the preparation of First National Communications under the Convention. In addition to impact studies, a number of vulnerability and adaptation studies have been carried out including studies supported by the World Bank in Bangladesh, the Caribbean and the Pacific Islands. Studies of adaptations have also been carried out in many countries as part of the United Nations Environment Programme (UNEP's) country studies, and in the study programs sponsored by the Netherlands and the U.S. It is appropriate at this point to review some of these country specific adaptations particularly adaptation practices in Africa.

2.3.2 Adaptation practices in Developing Countries

The UNEP together with other partners in Kenya, South Africa, Swaziland and Tanzania conducted a study from 2004 – 2006 to provide information on the use of indigenous

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knowledge in climate change adaptations in the four countries. The agro-pastoral communities in the areas studied practice controlled grazing to conserve vegetation and they practice grazing rotation to avoid overexploitation of the vegetation.

Among the Lake Victoria communities, for example, this rotational grazing was practiced as a form of transhumance where animals were grazed in the higher areas during the wet season and brought back to the river banks and lake shores during the dry seasons. In the drier areas of Makueni and Kwale districts of Kenya, livestock was moved from pasture to pasture in order to maintain the ecological balance. In Kitumbeini division of Arusha region in Tanzania the Maasai pastoralist practiced the *ronjo* system, a traditional method of dividing the village into pasture zones to conserve their pasturelands and prevent drought-borne disasters. However, pure pastoralism was the most common practice of the Maasai, who seasonally moved their herds to take advantage of the rangeland.

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The Sukuma people who inhabit Mwanza and Shinyanga regions near Lake Victoria in north western Tanzania practice an indigenous pastoral system known as *ngitiri* or enclosure, which evolved out of the need to cope with scarcity of grazing areas particularly during dry seasons between June and October. It is almost like a zoning system. It involves the conservation of grazing and fodder lands by retaining an area of standing hay as reserve and encouraging vegetation regeneration (Kamwenda, 1999). Supplemented with tree planting, *ngitiri* has proved to be effective in protecting the environment and improving the livelihoods of the communities in the region. The *ngitiri* system was effective in conserving and protecting the soils and for reclaiming degraded lands (Kilahama, 1994). In the *ngitiri* system species are selected on their suitability for conservation measures, such as soil conservation. Once selected, degraded areas are closed off to protect them from animals for a period of about five years to

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allow regeneration. Tree planting is also done in the degraded areas to add socio-economic and environmental value. In the wet season, the areas are closed off to animals in order to allow vegetation to regenerate. During the dry season, once grazing areas are depleted, the *ngitiri* is opened bit by bit to allow animals graze.

The baobab (*Adansonia digitata*) or the monkey bread or *kiamba* in the local language Kikamba is one of the most important plants used by herdsmen as indigenous early warning indicators of rainfall and drought in Makueni District of Kenya. Other trees include *muaa* (*Acacia tortilis*) or umbrella tree, *muthiia* (*Acia Mellifera*), and *itaa mwaka*. The tree sheds all leaves at the end of the long rains (March-May) and remains leafless during the long dry season. Near the onset of the short rains (October-November), tender new leaves start appearing on the tree. The herdsmen and community in general also use the fruiting pattern of the tree to divine the likely performance of the season, especially rainfall failure and drought. Prolific fruiting seems to indicate a likely poor season ahead.

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The study of the four project countries shows clear evidence that when the best practices in indigenous knowledge are disregarded, when there is environmental degradation and poor natural disaster management, poverty sets in and grows. Maasai pastoralism, an indigenous knowledge skill acquired over centuries, illustrates this point. The Maasai move their herds throughout the year to optimize utilisation of rangeland resources for maximum meat and milk production. As a result of well-organised livestock movement, the herds stay healthy and produce a reliable supply of milk and meat that meets the demands of pastoral households. This is possible because of the application of indigenous knowledge in rangeland utilisation. In rangeland utilisation, Maasai warriors supervise grazing techniques and provide instruction on animal grazing behaviour, while elders order warriors to conduct ecological skirting, which

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includes identifying and classifying plants and accurately assessing the water-holding capacity of distant pastures. They then draw up movement itineraries on the basis of the warriors' reports.

Other measures included diversifying livestock to ensure that some livestock species survived even under severe environmental conditions (Thomas, 1945). "Herd splitting" is used to reduce or spread the risk of livestock loss, if all the animals are kept together, particularly during dry or drought periods, the risk would be greater. Female animals used for milk production were kept near the homestead where the majority of the members of the pastoral families, particularly women, children and the elderly, were living. The herd-splitting also reduced grazing pressure on forage near the homestead and improved foraging conditions for animals producing milk for the most vulnerable members of the family.

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To help cope with the negative impacts of anthropogenic climate change, communities in many East African countries employ Traditional, Local and Indigenous Knowledge (TLIK) - based practices. TLIK includes the use of early warning systems to predict short, medium and long term climate changes; transhumance to avoid drought and risk of livestock loss; herd accumulation; use of supplementary feed for livestock; reserving pasture for use by young, sick and lactating animals in case of drought; disease control in livestock and grain preservation; use of indigenous techniques in the management of pests and diseases; culling of weak livestock for food; and multi-species composition of herds to help survive climate extremes (Elasha and Downing, 2007). This knowledge, or parts of it, has ensured survival of thousands of starving pastoralists, but not the loss of their animals, which more often than not have succumbed to shortage of water and pasture.

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Kenya is already experiencing negative impacts from a changing climate. Some of the indicators of climate change and climate variability are recurring weather events, floods, droughts and temperature changes (Kenya Metrological Department, 2009). The droughts of 2008/2009 and 2010/2011 have been described by the elderly as "the worst in living memory" (Agrawal, 2008). Such climatic shocks and related losses come at a heavy price to affected communities as livestock is the mainstay of the local economy in the Arid and Semi-Arid Lands (ASAL) of Kenya (Agrawal, 2008).

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The ASAL constitute about 80% of Kenya's land mass and approximately 70% of the national livestock herd. The *Maasai, Samburu, Rendille, Pokot, Pokomo* and *Borana* people occupy large parts of the ASAL. These pastoralists/agro-pastoralists own about 50% of the national cattle and small ruminant herd and 100% of the camel population (Thorne, 2008). Over time, these communities developed complex human (language, indigenous technical knowledge, culture), natural (uniquely adapted breeds), and social (networks) capital, which has undergirded adaptation to their environment. This knowledge system, as referred to traditional, local and indigenous, has been used by the pastoralists as a safeguard for adaptation and mitigation against the effects of a changing and increasingly changing climate. The Pokot, for example, have a lively and informed understanding of their environment and the possibilities it provides for living (Nyong *et al*., 2007).

Local farmers in sub-Saharan Africa have developed several adaptation measures that have enabled them to reduce vulnerability to climate change and extremes. One important step in reducing the vulnerability of a climatic hazard is the development of an early warning system for the prediction or forecast of the event (Ajibade and Shokemi, 2003). There is a wealth of local knowledge based on predicting weather and climate. Studies of weather knowledge in

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various parts of sub-Saharan Africa reveals the wealth of knowledge that herdsmen possess. The pastoralists have developed intricate systems of gathering, prediction, interpretation and decision-making in relation to climate. These systems of climate forecasts have been very helpful to the herdsmen in managing their vulnerability to a very great extent.

2.3.3 Climate change adaptation in Ghana

Ghana is experiencing changing climatic patterns; already experiencing an increase in extreme weather conditions such as higher incidences of flooding and longer periods of drought. This is manifest in high temperatures, intense erratic rainfall and rise in sea level all along the Ghanaian coast line. Forty years observed data (1960-2000) shows that temperatures in all zones within the country are rising, rainfall in all agro-ecological zones of the country has also decreased and rainfall is becoming increasingly erratic. The frequency and intensity of rainfall, floods and landslides have been inconsistent. Extended periods of drought and intense heat have been linked to changing climatic patterns. The impact of climate change and climate variability is being felt in all regions but the impact is not uniform (Arku, 2013). Currently the east coast of Ghana, (Keta area) is experiencing an annual coastal erosion rate of 3 meters (Ghana Meteorological Agency, 2014). Some communities (Totope, Gleefe) have almost disappeared.

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To overcome the challenge of finding suitable grazing fields, several attempts have been made to provide year round quality feed in Ghana. The use of improved pasture has been suggested by Montsma (1960) and Rose-Innes (1960). However, the overall cost involved in the development and establishment of pasture has made the realisation of this suggestion difficult. The conservation of forage as either hay (Grieve, 1976) or silage (Owusu-Sarfo, 1972; Larsen, 1975) has been tried in the country. Though successful, these efforts have remained "on-

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station" and are yet to be utilised by cattle farmers. Difficulties posed by uneven and unstumped grassland, lack of mowing implements, impossibility of cutting and transporting heavy bulky material by human labour alone combine to place this approach beyond the grasp of village herdsmen at this present time.

Gyampoh et al. (2009) studied five regions in Ghana (Upper East, Upper West, Northern, Western and Volta Regions) and analysed the use of indigenous knowledge in coping with climate change and climate variability in those areas. The findings in this study are consistent with studies conducted in many rural communities. It concluded that people's understanding of what constitutes climate change is similar within local communities, that is, change in the rainfall amount and distribution. Results of the various studies indicated that herdsmen are vulnerable to shocks such as flooding, seasonal rainfall variations and increases in temperature. Findings from the studies also indicated that adaptation to climate change and climate variability occurs at multiple levels, from the smallholder to the community and then the national level. Coping strategies in these regions are usually adopted to reduce vulnerability to these shocks and the strategies adopted included traditional water conservation where available water is managed in the watering of cattle.

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From the literature it is evident the various Indigenous Knowledge (IK) based strategies have not been adequately documented. Even though IK is being used by local people the local strategies have also not been validated for use. Use appears therefore to be limited to the communities that use them. The government has expressed the desire to harness Indigenous Knowledge for national development. To this end, there are two NGO's in Ghana working on Indigenous Knowledge. They are Centre for Indigenous Knowledge Systems (CEFIKS) and

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Centre for Indigenous Knowledge and Organisational Development (CIKOD). There is the necessity therefore to investigate indigenous knowledge systems further.

2.4 Indigenous knowledge systems

The term "indigenous" has prevailed as a generic term for many years. Some occupational and geographical terms like hunter-gatherers, nomads, peasants, hill people, etc., also exist and for all practical purposes can be used interchangeably with "indigenous peoples". *Indigenous knowledge* refers to what indigenous people know and do, and what they have known and done for generations, that is, practices that evolved through trial and error and proved flexible enough to cope with change (Melchias, 2001).

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All around the World, indigenous populations have lived in perfect harmony with nature. Over long periods of time, these populations have acquired knowledge about the inner workings of their immediate surroundings or environment. Accordingly, these populations have developed intimate knowledge on a wide array of topics ranging from environmental, biophysical, economic and social issues to spiritual knowledge (Sand, 2002), so much so that many authors refer to this type of knowledge as traditional knowledge systems. In these systems, knowledge is being continuously acquired by men, women and children in a given society or community.

Indigenous Knowledge (IK) is the local knowledge that is unique to a given culture or society. IK contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local-level decision making in agriculture, health care, food preparation, education, natural-resource management, and a host of other activities in rural communities (Warren 1991). IK is the information base for a society, which facilitates communication and decision-making. Indigenous information systems are dynamic,

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and are continually influenced by internal creativity and experimentation as well as by contact with external systems (Flavier, et al. 1995).

Indigenous technologies, practices and knowledge systems have been studied extensively by sector specialists and even more so by social anthropologists. However, most studies are descriptive. They concentrate primarily on the social or ethnological aspects of knowledge rather than on the technical ones. The literature contains limited information regarding the systematic transfer of local knowledge across communities and cultures. Yet, there is considerable evidence of IK transfer from traditional societies to industrial countries (e.g., acupuncture, herbal medicine, rehydration salts, etc.).

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Early keynote contributions to the understanding of indigenous knowledge appeared a little later and include a collection of papers in the IDS Bulletin in 1979 (especially contributions by Barker, Chambers and Howes, all 1979), and landmark seminal work by Brokensha and Warren (1980), by Richards (1985), and subsequently by Scoones and Thompson (1994). From much of this work, indigenous knowledge becomes central to later debates about sustainable development because of the way in which such knowledge has apparently allowed people to live in harmony with nature for generations. Such a privileging of indigenous knowledge in development is, therefore, apparently to be welcomed, as it represents

> "*a shift from the preoccupation with the centralised, technically oriented solutions of the past decades that failed to alter life prospects for a majority of the peasants and small farmers of the world*" (Agrawal, 1995, pg. 414).

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From the body of literature, indigenous knowledge embodies many diverse phenomenon as summarised and illustrated in figure 1, and therefore often referred to as a system. The system becomes the basis of coping practices that have helped vibrant communities survive natural calamities and unpredictable climatic changes over centuries. This is partly the reason why the Global Knowledge Conference (Toronto, June 1997) emphasised the urgent need to learn, preserve, and exchange indigenous knowledge (Wolfensohn, 1998).

Figure 1: Illustration of an indigenous knowledge system

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Source: Author's construct

For this study, an Indigenous Knowledge System refers to the set of interactions between the ecological, social and environmental arenas within a group with a strong identity, drawing existence from local resources through patterned behaviours that are transmitted from generation to generation to cope with change. These patterns are sustained by micro level institutional arrangements vested with differentiated responsibilities that ensure the group's

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continuous survival. Unfortunately, these systems are fast eroding due to colonialism, commercialisation, globalisation and modernisation, lack of efficient codification, breakdown of the traditional family structure and function (the institution that helps in the socialisation of tacit knowledge), developmentally induced human displacements, the decline in the practitioner base and many other reasons.

The limits of indigenous knowledge

It seems that, all too often, we have conceptualised indigenous knowledge in unproblematic, and even naïve ways, and therefore it has turned out to be less helpful than has been supposed or hoped for as a development tool. Indeed, the term 'indigenous knowledge' by itself reflects this, conceptualised as some separate, self-contained folk knowledge. In reality, few farmers and herdsmen compartmentalise knowledge into such separate, self-contained entities, but rather develop knowledge as something that is hybridised, mediated and local.

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Herdsmen are nothing if not pragmatic and utilitarian in how they assess and use knowledge. If a particular piece of knowledge works, and it makes economic and socio-cultural sense, then it will be used, regardless of whether it is drawn from western science, a repertoire of local knowledge or some other source. There is a need, therefore, to recognise the limits of indigenous knowledge, as it is frequently conceptualised in the literature. Whilst indigenous knowledge may indeed be represented as a valid and relevant alternative to western science, realistically it needs to be seen as something rather more pragmatic and flexible, perhaps even provisional, highly negotiable and dynamic.

Indeed, rather than resisting western science, indigenous knowledge appears to be becoming ever more complicit as it becomes appropriated by 'development', a process which will only

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harden as indigenous knowledge becomes increasingly institutionalised. The challenge will then be for proponents of indigenous knowledge to make the difficult choice between arguing for promoting indigenous knowledge as a radical alternative to western science and knowledge, or instead negotiating a way into mainstream development practice.

The application of indigenous knowledge from one context to another clearly carries serious risks of failure, and indeed, there is little merit in trying to develop indigenous knowledge as a generic development planning tool. Because knowledge is developed by local people through a real understanding of the environment in a particular place, knowledge is not easily transferred into other locations, raising doubts about how applicable indigenous knowledge is out of its immediate geographical context (Leach and Mearns, 1996). If so, this raises serious questions about how useful indigenous knowledge can really be in a wider development context.

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Indeed, it can be argued that indigenous knowledge should not be packaged, generalised or 'scientised', because such an approach misses the point of the special character of local needs, as well as ignoring the reality of "the socio-economic and historical situation of the local community in which the technology is applied" (Sikana and Mwambazi, 1996). This view is echoed by Eyzaguirre (2001), who argues that a global recognition of indigenous knowledge as a planning tool may be at a price. That price is the detachment of indigenous knowledge from its cultural, livelihood and community contexts, the very things which helped to create indigenous knowledge in the first place, and hence such a disembodied indigenous knowledge may end up undermining the system itself.

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2.4.1 Indigenous knowledge in climate change adaptation

Since the first Rio 'Earth Summit' in 1992 the United Nations system has recognised the connections between indigenous knowledge, climate change and environmental sustainability and has variously promoted the global recognition for indigenous knowledge systems in achieving various environmental goals. This support has taken the form of intergovernmental guidance for the use of traditional knowledge, including its protection, access and benefits sharing; and promotion of traditional knowledge systems as necessary complement to science and on-the-ground support to ensuring the continued propagation and vitality of indigenous knowledge systems (UN-IASG, 2014). Integrating indigenous knowledge into climate change and climate variability policies leads to the development of effective adaptation strategies that are cost-effective, participatory and sustainable (Hunn, 1993).

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The increased awareness of the links between indigenous or local knowledge and climate change and climate variability is reflected in recent and evolving international discussions on policies related to resource and environmental challenges and genetic resources, including in the scientific assessments that seek to inform these policies (Robinson and Herbert, 2001). Understandings from these distinct forums, including best practices on ensuring participation and engagement of indigenous knowledge-holders, is being considered. In considering issues related to the protection and promotion of indigenous knowledge, it is equally important to consider its inter-linkages with ensuring intergenerational transmission and continued access to and sustainable use of the lands and natural resources on which this knowledge is based (Cohen, et al, 1998).

As such, recognition of the links between indigenous knowledge, sustainable customary use of biological resources as well as its wider potential benefits has led to international work on indigenous knowledge in many areas so as to ensure its recognition, continued vitality and

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protection from misappropriation. Indigenous knowledge issues cut across many domains in relation to global environmental issues, from biodiversity conservation and natural resource management, to use of genetic resources and to climate change observations, mitigation and adaptation. Work on indigenous knowledge provides support to understanding the role of customary livelihoods within sustainable development and the links between environmental management, science and well-being.

UNIVERSITY FOR DEVELOPMENT STUDIES

The IPCC 4th Assessment Report (AR4) noted that indigenous knowledge is an invaluable basis for developing climate change adaptations and natural resource management strategies in response to environmental and other forms of change. This was reaffirmed at the 32nd Session of the IPCC in 2010, that '*indigenous or traditional knowledge may prove useful for understanding the potential of certain adaptation strategies that are cost-effective, participatory and sustainable*' (IPCC, 2010).

Indigenous peoples, particularly those in small islands, high-altitude, desert and the Arctic, are already experiencing the impacts of climate change. While global inaction to reduce greenhouse gas emissions erodes their ability to remain resilient in an increasingly unpredictable and unstable climate, ill-informed climate mitigation and adaptation policies also stand to increase their vulnerability. Despite this high exposure to the impacts of climate change, the knowledge of indigenous peoples offers valuable insights to observations of climate change. In-depth, site-specific knowledge can be linked up with broader scientific data and forecasts to provide enhanced understanding of already-occurring changes and predicted impacts upon men and women on the frontlines of climate change (UN-IASG, 2014).

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2.4.2 Indigenous knowledge and adaptive capacity

Assessing Adaptive Capacities

While exposure and sensitivity determine the potential impact of a climate-induced change, adaptive capacity can be a major influence on what impact actually eventuates. Adaptive capacity is also the component of vulnerability most amenable to influence for social systems, and therefore is an obvious focus for adaptation planning.

Adaptive capacity can be assessed at a range of scales, from the individual (Marshall and Marshall 2007), household (Adger and Vincent 2005) and community levels of organisation (Adger 2000, Berkes and Seixas 2006, Cinner et al. 2009c) to national assessments (Adger and Vincent 2005; Nelson et al. 2009a, b). Some approaches are inductive and use community-driven measures to assess capacity, whereas others are deductive (Nelson et al. 2008).

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Some measures of adaptive capacity are best for comparing across scales (e.g. McClanahan and Cinner 2009), whereas others are more suitable for stand-alone assessments of specific communities or sectors. The technique most appropriate for a given area will depend on the expertise available, goals and budget. Selection of the most appropriate approach for adaptation planning requires consideration of the constraints and opportunities relating to the individuals within communities and industries, as well as at larger scales.

The capacity of herdsmen to cope and adapt will be determined in part by their characteristics and circumstances and their capacity to take advantage of other opportunities (Marshall 2009). Some key characteristics can be used to evaluate the adaptive capacity of herdsmen.

1. The perception of risk: How herdsmen perceive the risks associated with change is fundamental in determining their ability to cope and adapt. How risk is managed reflects individual and cultural differences in experiences, knowledge, beliefs, values, attitudes and

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judgements as well as differences in abilities to plan and execute plans (Ritchie et al. 2004; Taylor 2003).

2. The level of interest in change: This dimension of adaptive capacity corresponds with the degree to which the system is capable of 'self-organisation'. Individuals that have a higher level of interest in adapting to the requirements of the future usually have a higher financial, social and/or emotional flexibility. The level of interest in climate change adaptation can also be influenced by climate education and access to climate technology, expertise and information (Steinfeld, 2001). An interest in adapting is necessary for herdsmen to identify consequences, impacts and possible responses ("adaptation options") to climate change and climate variability (Howden et al. 2007).

3. The ability to plan, learn and reorganise: This component reflects the capacity to anticipate the future. The capacity to plan, learn and reorganise in the face of change is dependent on novelty, creativity, experimentation, learning and planning (Harris et al. 1998, Colding et al. 2004, Olsson et al. 2004). Without it, any response to climate change and climate variability by herdsmen and individuals in general will be reactive and there will be less opportunity for input from others.

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4. Family characteristics: Herdsmen and general resource users with dependents may be especially sensitive to climatic changes and have a lower adaptive capacity since they will be less able to experiment with their options for the future and are consequently less flexible in their approach to change (Bennett 2001; Sorenson and Kaye 1999).

5. Local environmental knowledge: Some herdsmen have over time invested substantially into developing local environmental knowledge and are able to detect subtle changes in resource condition. However, this investment usually means that the herdsmen are less likely to move and develop it again elsewhere (Carroll and Lee 1990; Cinner 2005). While herdsmen with

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high levels of local knowledge are often well adapted to current conditions, they are likely to possess a lower capacity to effectively respond to climatic changes.

2.5 Theoretical framework

There is a broad body of theoretical literature that conceptualises climate change adaptation and reflects on the relation to vulnerability, adaptive capacity, resilience, improved measures and adaptation assessments. These are the concepts that are central to this study. For instance, Kelly and Adger (2000, drawing on Blaikie 1994) differentiate between biophysical and social conceptions of vulnerability. This also holds for Brooks (2003) who is careful to distinguish between actual adaptation and adaptive capacity. This distinction underlies much of the literature on vulnerability. In a similar vein, O'Brien et al. (2007) distinguished outcome vulnerability from contextual vulnerability. The former refers to the likely residual effect of climate change on an exposure unit after adaptive measures have been taken. Contextual vulnerability focuses on the characteristics of the exposure unit itself. Turner et al. (2003) tried to integrate social and biophysical vulnerability by adopting the perspective of coupled Social-Ecological Systems (SES).

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Burton et al. (2002) and Lim & Spanger-Siegfried (2004) considered the design of adaptation assessments, where the vulnerability concept is seen as instrumental or "subordinate". Instead, adaptation moves more to the centre because there have always been adaptations to climatic conditions that offer a starting point for identifying specific adaptations to deal with climate change and climate variability. Nelson et al. (2007) also linked adaptation to the resilience discourse. They defined adaptation as decision-making processes and actions that enhance adaptive capacity. Conversely, they also claim that adaptive capacity encompasses the enabling conditions for adaptation, and is one component of resilience. Last but not least, Ionescu et al.

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(2008) expended some effort in order to obtain a very precise definition of vulnerability. This approach specifies adaptation as the values of control variables that prevent a system from becoming vulnerable. Adaptive capacity is then the set of possible values that can be selected as adaptations.

Even though all the theoretical works mentioned above could be suitable in constituting the theoretical underpinning for this study, it is the *Action Theory of Adaptation* advanced by Klaus Eisenack and Rebecca Stecker (2011) that this study adopts.

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2.5.1 Action Theory of Adaptation

Espoused by Klaus Eisenack and Rebecca Stecker in 2011, the theory recognises that adaptation is a set of actions that requires actors and an intention, and specifically refers only to individuals and collective actors. The intention is directed towards an impact of climate change. It describes a core configuration that is meant to be as simple as possible and serve as a basic unit of analysis. Furthermore, adaptations require the use of resources as means to achieve the intended ends. When complex real-world adaptations are to be analysed with the theory, separate concepts need to be recombined in different ways to consider multiple interrelated actors. This leads to an outline of the action theory that can partially be built around established concepts (Figure 2).

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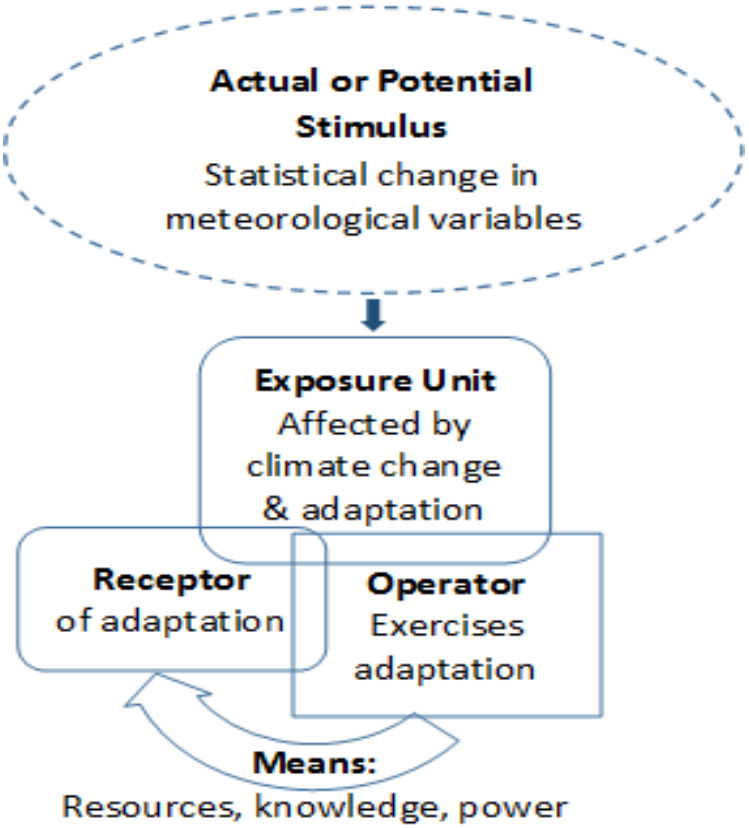
Figure 2: Illustration of the action theory of adaptation



Source: Klaus Eisenack and Rebecca Stecker, (2011:7)

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The schematic representation above captures some core concepts of the action theory of adaptation. The boxes with rounded corners can either be actors or biophysical units, while operators are always actors. Operator, receptor and exposure unit are not necessarily identical and are indicated by overlapping boxes.

Proponents of the theory, defined a *stimulus* as a change in biophysical variables, particularly meteorological variables, associated with climate change. In a very precise meaning, this has to be distinguished from weather events. Stimuli can refer to changed values of statistical parameters such as average intensity, frequency, or higher statistical momenta (e.g. variance). Within the context of this study, a stimulus could be excessive heat, extreme atmospheric humidity and floods that would require some action on the part of the herdsmen.

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A stimulus is only relevant for adaptation when it influences an *exposure unit*. The latter term broadly refers to all those actors, social, technical or non-human systems that depend on climatic conditions, and are therefore exposed to stimuli (Eisenack and Stecker, 2011). The abstract term is necessary to encompass the broad diversity of affected entities or systems that may be considered in an adaptation assessment. In relation to this study, an exposure unit would be the herds, grazing fields, water bodies and the herdsmen themselves.

According to the action theory of adaptation, the individual or collective actor that exercises the response is called the *operator*. This distinct term is needed since actors also play other roles in the theory. An operator can be, for example, a private pastoral household, cattle owners or a government institution. But in all cases it is a social entity, so that machines, artefacts' and natural systems are ruled out as operators (Eisenack and Stecker, 2011).

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The actor that is the target of an adaptation (the purpose) is called the *receptor*. Receptors can be both biophysical entities (e.g. the cattle of a herdsman) and social systems (e.g. the pastoral household), depending on the objective of analysis. It is further not required that the receptor of an adaptation is an exposure unit at the same time.

The action theory of adaptation is most suitable in guiding this study because it recognises that to implement the adaptation, the operator needs resources that are referred to as *means*. These could be access to natural resources, financial support, other material/logistical resources, legal power, social networks, knowledge, and/or available information. Action is further shaped by constraints and resources that cannot be controlled by the operator. These are called the conditions. In the context of this study, the means would include the natural resource base,

pastoral social networks, the indigenous knowledge of the herdsmen and available and timely information regarding climate change and weather events.

2.5.2 Conceptual Framework

The main aim of developing a conceptual framework for this study is to contribute to the clarification of the concept of climate change adaptation within the context of indigenous knowledge, other adaptation options and the pastoral system, in a way that enables it to be applied in the design of adaptation assessments and improving adaptive capacity. This opens a new view on adaptation that also sheds light on other concepts often used in adaptation research. Secondly, the conceptual framework that has been developed for this study (Figure 3) provides a foundation upon which to analyse development planning decisions and the role of governance structures in climate change adaptations. This allows for the systematic deduction of successes and postulate meaningful premises about barriers to climate change adaptation.

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Drawing on the action theory of adaptation (Eisenack and Stecker, 2011) and the work of Smit et al. (2000) some core questions are posed. Answers to these questions set the appropriate tone for advancing a suitable model for this study. The questions include: "adaptation to what?", which refers to climate-related stimuli that affect an "exposure unit". The question inquires about the purpose of an adaptation in terms of an impact, i.e. a stimulus that affects a considered exposure unit. The exposure unit and its characteristics become specific by answering "who or what adapts?" An exposure unit can both be a biophysical or social entity. It is acknowledged that 'who' and 'what' are not necessarily synonymous. This question asks for the operator, receptor, and their relation to the exposure unit. The third question is "how does/should adaptation occur?" and refers to aspects such as the intent, timing, localisation and type of

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measures that are taken. This question is answered by providing description of how means and purpose are interlinked, and whether just processes, or even actions are considered. The evaluation of these measures provides the answer to the final question: "how good is the adaptation?" in mitigating against the impacts of climate change. These questions provide a sound basis for understanding climate change adaptation while proposing some crucial variables for proposing a suitable climate change adaptation model for guiding this study.

In proposing a model, concentration is on the basic ingredients of this discourse: indigenous knowledge, adaptation options, singular and collective adaptive capacities of actors and climate change impacts. The resultant model is more prescriptive in the climate change adaptation effort rather than analytical. It is purpose and process oriented rather than being static at a tier. It is from its intended nature of progressive movement from one echelon to the next that the name ***echelon adaptation model*** is proposed. This is illustrated in Figure 3.

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The model has some basic assumptions: (i) that climate change and climate variability are phenomena that would continue to confront mankind and that human ingenuity would be used to always adapt to the climate; (ii) that indigenous knowledge would continuously be transferred over time from one generation to the next; (iii) that indigenous knowledge and modern technological/scientific systems can be integrated and (iv) that adaptations are made by only human actors, in contrast to adaptations by natural eco-systems.

The *echelon adaptation model* recognises a variety of adaptations (such as infrastructural, organisational, regulatory, financial, research and development, market mechanism, legal, administrative and legislative) but emphasises the importance of indigenous knowledge-based adaptation, institutional led adaptation and technological adaptations.

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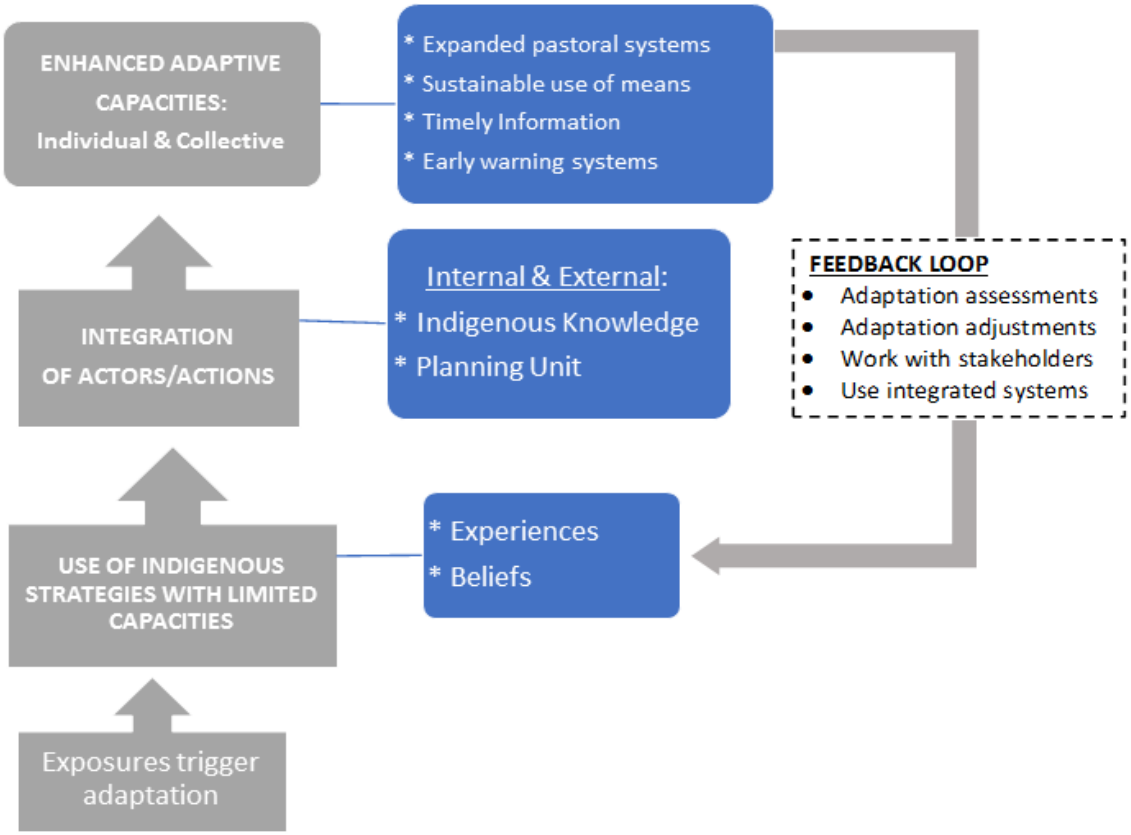
Figure 3: Conceptual framework: Echelon adaptation model



Source: Author's construct, 2018; Adapted from Eisenack and Stecker, 2011

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As illustrated above, the echelon adaptation model prescribes a bottom-up approach towards achieving enhanced adaptive capacities for efficient climate change adaptations. It begins at the community level where exposures to various climatic elements trigger the need for adaptation by the herdsmen. The herdsmen recognise and tap into their indigenous knowledge, perspectives, beliefs and experiences. This is the first echelon of the model. At this level indigenous adaptation strategies and adaptive capacities of individuals and the community are limited.

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It is then advocated that the experience of the herdsmen be integrated with the benefits that modern technological and scientific systems of the external actors have. The point of integration forms the second echelon. The integration of internal and external actors leads to a fusion and synergy of "means", which are the resources that each actor brings on board. The resources could be access to natural resources, financial support, material/logistical assets, legal power, social networks, knowledge, and/or available information. Consultation and information sharing is expected to lead to an agreed process towards a common purpose. The fusion of "means" is not intended to be a radical departure from what is known in the practice of adaptation, but rather an alignment of resources for optimum use.

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Once a good synergy is reached, the model progresses to the third echelon that should see an enhancement of individual and collective/communal adaptive capacities. Enhanced adaptive capacities would embody among other things the ability of actors to better target "receptors", synthesise and share information timely, initiate accurate early warning systems and be more sensitive to extreme climatic events. An enhancement of adaptive capacities would also reduce vulnerability and improve resilience.

The penultimate echelon paves way for improvement and sustainability in climate change adaptation strategies that are informed by the agreed processes and the common purpose of the actors. The model expects that the adaptation strategies would be effective even though they might not be sustainable and also accommodative of the processes of natural biological eco-systems. Some of the benefits that would be realised by embracing and using integrated adaptation strategies include an improved natural resource base, expanded agro-pastoral systems and the sustainable use of means (resources).

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Intended to be self-sustaining, the echelon adaptation model incorporates a feedback loop that carries various information to the internal and external actors for remedy. Regular assessments should be carried out in a participatory manner. Where interventions are necessary, they should be carried out with all stakeholders using the integrated knowledge system. Any adjustments to the adaptation strategies should also be mindful of local situations while learning from global best practices.

The usefulness of the echelon adaptation model is attained by the appropriate insights it provides to the questions that have been raised as guiding precepts in its development. The model advances answers to these questions that are inspired by the work of Smit et al. (2000). (i) adaptation to what: The model underscores the singular role of a stimulus that occurs in the form of extreme and continuous climatic events. (ii) Who or what adapts: According to the model, it is the internal actors, such as farmers and herdsmen, as well as the external actors, such as government and scientific research institutions that play the role of adaptation. (iii) How should adaptation occur: In a progressive manner that should first integrate the actors, seek a merger of their resources, enhance adaptive capacities and devise strategies. (iv) How good is the adaptation: In the view of this model, the adaptation should be so good that it is sustainable, improving the natural resource base, driving the expansion of agro-pastoral systems and fostering the sustainable use of resources.

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There is the urgent need to learn, preserve, and exchange indigenous knowledge. To this end, the model recommends and highly accommodates support in the form of governmental guidance (UN-IASG, 2014) for the use of indigenous knowledge, including its protection, access and benefits sharing; and promotion of indigenous knowledge systems as necessary complements to science and on-the-ground support to ensuring the continued propagation and vitality of indigenous knowledge systems.

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2.7 Summary

Scientists think of climate variability as the way climate fluctuates yearly above or below a long-term average value. Although climate change is not a new phenomenon, its recent usage, especially in the context of environmental policy, refers to changes in prevailing climate, particularly since the 20th Century. Seasonal fluctuations are the evidence of climate variability. Even though people are fairly perceptive of climate variability, it is not as noticeable as weather variability because it happens over seasons and years (Bello, 2010). For the purpose of this study, both climate change and climate variability are suitable concepts. Climate change opens up the human mind and experience to have long term perspectives. On the other hand, climate variability results in short term changes in the frequency, intensity, spatial extent, duration, and timing of weather events (IPCC, 2012).

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Studies have shown that there has been precipitation decreases of between 10% - 25% per decade in the humid regions of West Africa since the beginning of the century. In the Sudan-Sahel regions, there have also been records of decrease in rainfall in the range of about 3% - 4% per decade (Apata et al, 2009). These areas are recording seasonal and inter-annual climatic variability, resulting in droughts and desertification processes that propel indigenous adaptations by herdsmen. In the 1990s and early 2000s the debate on climate change was mostly focused on how to mitigate it. In recent years growing attention has been paid to adaptation (Adger et al., 2009; Dodman and Mitlin 2011). The aim of adaptation is to reduce vulnerability and to increase resilience and involve changing processes or practices in social and ecological systems through reducing potential damages or engaging in new opportunities (Adger et al., 2007). According to Brussel (2009), adaptive measures to climate change in agriculture range from technological solutions to adjustments in farm management and to political changes such as adaptation plans and policy.

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Indigenous Knowledge is the main factor that spearheads indigenous adaptations to climate change and climate variability and refers to the set of interactions between the ecological, social and environmental arenas within a group with a strong identity, drawing existence from local resources through patterned behaviours that are transmitted from generation to generation to cope with change

To help cope with the negative impacts of anthropogenic climate change, communities in many East African countries employ Traditional, Local and Indigenous Knowledge (TLIK) - based practices. TLIK includes the use of early warning systems to predict short, medium and long term climate changes; transhumance to avoid drought and risk of livestock loss; herd accumulation; use of supplementary feed for livestock; reserving pasture for use by young, sick and lactating animals in case of drought; disease control in livestock and grain preservation; use of indigenous techniques in the management of pests and diseases; culling of weak livestock for food; and multi-species composition of herds to help survive climate extremes (Elasha and Downing, 2007).

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Drawing on the action theory of adaptation (Klaus Eisenack and Rebecca Stecker, 2011) and the work of Smit et al. (2000) some core questions are posed. Answers to these questions set the appropriate tone for advancing a suitable model for this study. As a conceptual framework to guide the study therefore, the echelon adaptation model is developed and is more prescriptive in the climate change adaptation effort rather than being analytical.

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CHAPTER THREE

CASE COMMUNITY AND RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research design and the methods and techniques of data collection and analysis employed in the research. The profile of the case community is presented first to provide a better understanding of the context and the methodology.

3.2 Study Community

The community that was sampled for this study is Kpongu. It is located in the south-western part of the Wa Municipality in the Upper West Region of Ghana. Kpongu is one of the five Zonal Councils (Wa, Busa, Kperisi, Kpongu and Boli) that are in the Municipality. The Wa Municipal Assembly is one of the eleven District/Municipal Assemblies that make up the Upper West Region of Ghana. Kpongu occupies a small landmass of the Municipality's surface area of approximately 234.74 km^2 and has existing functional relationships with other settlements throughout the Municipality. In terms of distance, Kpongu is about seven (7) kilometres south of the Wa, the Central Business District. It lies approximately on latitude 2º35'N and longitude 10º00'W. (Figure 4).

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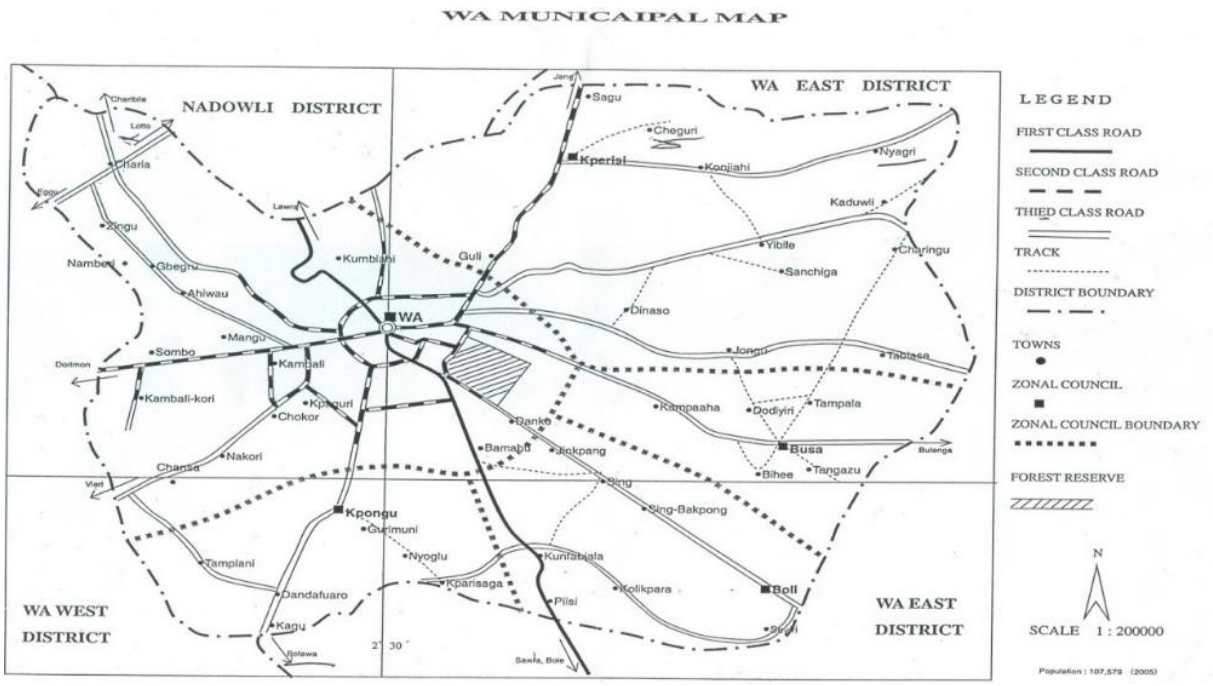
Figure 4: Map of Wa Municipality showing the Kpongu community



Source: Development Planning Unit, Wa Municipal Assembly, 2017

The community has a land nature that slopes towards its middle section where there is a seasonal dam that holds water for domestic use and for use by herdsmen and others in watering their livestock. In terms of geology, rocks are mainly those of the middle Voltaian formation. That is, it is dominantly igneous rocks with sedimentary rocks which includes sandstone and dolomite, containing primary and secondary minerals like quarts and calcite ($CaCO_3$). The dominant soil types are gravel and sandy-loam with few patches of clayey loam in the north western fringes (Planning Unit, Wa Municipal Assembly).

The community experiences a unimodal rainfall pattern, usually from May to October, with an annual rainfall of between 1000mm and 1400mm. The peak of the rains is from July to September (Meteorological Office, Wa – 2017). It also experiences the north-east trade winds that leave the harmattan conditions in its trail from November to March. The average sunshine

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is about 7.5 hours per day from July to September and much longer during the harmattan, with average prevailing wind speed of less than 10km/hr. Temperature is generally high all year round with the hottest occurring in March. The average monthly temperature ranges between 25.5ºC and 35.0ºC (Meteorological Office, Wa - 2017).

The vegetation is that of the Guinea Savannah (EPA/MES Country Profile, 2004) which is made up of grasses interspersed with short drought resistant trees and shrubs. The grasses are short, stocky and sparsely spaced. The dominant trees are dawadawa (*Parkia biglobosa*), shea (Vitellaria *paradoxa*), and neem trees (*Azadriachta indica*). Other trees are Kapok (*Ceiba pentandra*) and Baobab (*Adansonia digitata*). Cashew (*Anacardium occidentale*) and Mango (*Mangifera indica*) are exotic species growing well in the area. Pasture grass is mainly guinea grass (*Panicum maximum*). The grass serves as nutritious diet for free-range livestock, herded cattle and as well as raw materials for making thatch roofing.

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Issues of environmental concern in Kpongu include bush fires during the dry season, improper waste disposal and indiscriminate defecation. The ever increasing exploitation of natural resources is leading to the reduction in vegetation sources and biological diversity. The cutting of some tree species is significant and this manifest itself in the sale for firewood and charcoal. By occupational distribution, most households are agrarian. They cultivate farm produce, keep livestock and occasionally engage in communal hunting. The keeping of livestock, particularly cattle, by herdsmen in the community is the focus of this research.

It is believed that good research sites should have an entrance procedure for the research, an element of trust and possibilities for gathering credible or quality and suitable evidence (Swartz, 1998). In the choice of the study area, these concerns are guaranteed because the

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researcher is already familiar with the community and has a system of linkages and a network of support.

3.3 Study population

The overall study population for this research include the individuals who first and foremost reside in the community or have substantial economic interest in the areas. Using the rural population growth rate (2.7%) and the population of Kpongu in 2000 (Wa Municipal Assembly, MTDP, 2006) as the base population, the population of the study community has been projected over four (4) years intervals (See Table 1)

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Table 1: Population of Kpongu

NO.	Settlement	**Population Size**				
		2000	2006	2010	2014	2018
1.	Kpongu	1,911	2,242	2,494	2,774	3,086

Source: Wa Municipal Assembly, MTDP, 2014

The study population is further trimmed down to those who by virtue of their direct or indirect involvement in cattle herding, face the challenges of pasturing that is associated with climate change. The study population thus include cattle owners who engage mainly Fulani migrants, to carter for their cattle. The owners are direct beneficiaries of the growth in the number of cattle, have enormous stake in the nature of pasturing activities and the overall wellbeing of the cattle. However, they are not directly involved in the cattle day-to-day feeding and tendering, except their occasional inspections. The main respondents included in the study population are the herdsmen (young and old). They tend to the needs of the cattle and thus have to engineer local and indigenous ways of surmounting the challenges of climate change.

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3.3.1 Socio-economic characteristics of respondents

A total of eighty-two (82) respondents were interviewed during the course of this research. These people, young and old, have their own independent, identifiable and, so often, collective socio-economic and cultural characteristics. Their characteristics include but not limited to their ethnic background, educational background, economic activities and age distribution.

Ethnic background of respondents

On the basis that the research is centred on a way of livelihood that is most engaged in by people of a particular ethnic grouping, it is not out of place to report that a vast majority (84%) of the respondents are of the Fulani extraction. A third of global Fulani population are pastoralist, the largest nomadic community in the world (Levinson, 1996). The Fulani people form a large ethnic group in the Sahel and widely dispersed across the West African sub region, mostly in Nigeria and Guinea. Ghana ranks 10th in the list of countries that has significant Fulani populations (Stanley, 2011). The Fulanis in the study community are originally a migrant group and are now a number of generations down their lineage. They have settled there and in fact many among the current generation being were born and raised there. The remaining 16% of the respondents for this research belong to many other ethnic groups such as the Waala and Dagaaba. The chief of the community, the assemblyman and some officers of the Wa Municipal Assembly are of the Waala ethnic group.

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Educational background

All the institutional leaders and representations that were enlisted for interviews during the course of this research have had some appreciable form of formal education. They include the officials of the planning unit at the Municipal Assembly, officers at the regional meteorological office, the veterinary officers and the extension/animal production officers at the regional office

of MoFA. These are all officers who are well educated in their fields of endeavour and have risen through the ranks over the years. The implication is that they have the requisite knowledge and experience that reflected positively during interview sessions. Information obtained is therefore most reliable and accurate as the case may be.

At the community level, only the assemblyman had some formal education. The rest of the community-level respondents did not have any formal education. These are largely the herdsmen, (young and old) and their wives. The lack of formal education among this category of respondents did not hamper the resourcefulness and exactitude of their responses. This is because the responses that were sought from them bordered on their indigenous knowledge that have been passed down over generations and their general experiences as pastoralist. They demonstrated a blend of their indigenous knowledge and conventional wisdom. The herdsmen responded to issues and questions in a manner that did not reflect a lack of understanding of pastoralism resulting from the absence of formal education in their lives.

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Economic activities

The means of livelihood for the key respondents of this study is pastoralism. Historically, they are nomads that are always on the move with their families and cattle. In recent times, they are becoming sedentary and settle depending on the dictates of the climate. They depend on the returns that they obtain from their stockbreeding practices, such as cattle for the animals market and cow milk for sale and in some cases for barter trade.

The herdsmen in Kpongu have become more sedentary than nomadic, relative to their historical antecedents. Their sedentary nature enables some of them to add another economic activity, which is seasonal farming, thus becoming ‘agro-pastoralists’. During the rainy season they

combine their stockbreeding responsibilities with the cultivation of various crops to meet the consumption needs of their families.

3.4 Research design – Case Study Approach

The case study research approach was used for this study. The choice of this research design is appropriate because it allowed for an up-close and detailed examination of the phenomenon of climate change adaptations as well as its related contextual issues, and the 'case' being the herdsmen in the Kpongu community. As a research strategy, the case study approach facilitated an "in-depth of understanding and corroboration" (Johnson et al, 2007: 123) on climate change adaptations within the real-life context of herdsmen. Also the case study approach was appropriate because it allowed for a wide range of qualitative data and relied on multiple sources of evidence.

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Furthermore, the case study approach allowed for the discussions that are needed to assess and develop effective linkages between climate change, adaptations needs and indigenous adaptation strategies as well as individual and communal adaptive capacities. The use of the case study approach is also due to the fact that the study population is dynamic and as such follow-ups might be difficult due to their nomadic way of life. When completed, the findings can lead to new and advanced research that wouldn't have been possible without a case study. Using this case study information, new studies can be organised to learn better ways to help herdsmen who are adapting to climate change and climate variability with indigenous knowledge as their most important resource.

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3.5 Methods and sources of data collection

This study employed various data collection tools mainly for gathering primary data from the Kpongu community. These tools were used to principally collect qualitative data, and include the following methods:

Key informant interviews:

This data collection technique was employed to meet and interview the respondents on a face-to-face basis. The method provided for a guided interview and an exploratory discussion on the topic. This method of data collection was applied mainly on the institutional respondents: animal production officers and veterinary officers at MoFA, meteorological officers and Municipal development planning officers. At the community level, this method was applied on the chief of Kpongu and the assemblyman for the area. Purposive sampling was used for all of these respondents at the institutional and community levels. This sampling method is appropriate because each category of persons have the relevant information that was needed for this study. One interview was conducted for each key informant and data collected centered on observed climatic changes and indigenous adaptation strategies. The data was analysed by way of narrations and discussions.

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Focus group discussion

In order to receive many diverse views and opinions about a phenomenon such as climate change adaptations, this method was used. Focus group discussions were deep interactions with the groups of herdsmen. It was helpful in digging into the historical aspects of the climate change phenomenon and a greater insight into the issues of adaptations. This approach also provided direct evidence about similarities and differences in the participants' opinions and experiences as opposed to reaching such conclusion from post hoc analyses of separate statements from each interview. These focus groups produced useful information and insights

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that would be less accessible in the absence of the interactions found in a group setting. The focus group discussions in this study were conducted with the youth and the aged, separated into different groups using a pre-arranged focus group questionnaire to guide the discussions. For the youth, the age group of 15 to 35 years was preferable, taken as working age group, and that they were participating fully in livestock keeping activities. The decision to include youth in the focus groups was driven by the fact that many elders within the community blamed the youth for being reluctant to learn and use indigenous knowledge in livestock activities. Thus, youth involvement was of great significance in getting their opinion regarding these allegations over the use of indigenous knowledge. Both youthful and aged herdsmen in the Kpongu community were included as respondents by way of a complete enumeration (census). This sampling method gave every herdsman in the community a chance to voice out what they have learnt and how same is being applied to climate change adaptations in their cattle production. Two focused group discussions were organised for and with the youthful herdsmen and same for the aged herdsmen. The data collected through the focused group discussions centred on the year-on-year climatic variations, indicators as well as the impacts of climate change. The focus group discussions also concentrated on the indigenous knowledge-based adaptations that are being employed by the herdsmen in their cattle production. The data collected was analysed by way of narrations, descriptions and ranking of responses regarding climate change adaptations.

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Direct observation:

This method was employed to have a first-hand knowledge regarding the ways in which climate change and climate variability is affecting the pasturing activities of herdsmen, the indigenous ways they are responding and adapting to the change. A visit to the Kpongu community

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provided the opportunity to observe how the herdsmen were sourcing diverse feed and managing the stress of their cattle.

Content analysis

Secondary data was accessed mainly through desk studies in the course of this research. The secondary sources of data employed for this study included were the Municipal Assembly's Medium Term Development Plans (MTDPs), and internet sources. Information gathered from these sources were used to variously complement the data that was collected from primary sources.

Two Medium Term Development Plans (MTDPs) of the Wa Municipal Assembly were reviewed to first determine the methodologies that are used, whether the herdsmen are engaged in consultation processes leading to the preparation of plans and whether there is participatory design and implementation. The second leg of the review focused on the content of the plans, in terms of whether policies, strategies and development interventions are being proposed to appropriately respond to the climate change adaptation needs of these herdsmen.

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3.6 Data analysis and presentation

Before analysing the data from the field, all completed interviews, notes and other structured recordings were firstly checked for completeness. Thus data cleaning and processing was done to identify errors in data prior to the analysis phase. For the qualitative data collected, the notes and recordings were categorised into themes, in line with the research questions and objectives, to give elaborate discussions and explanation of phenomena and description of events. With the help of a computer software, data presentation is be done using graphs, charts and tables where appropriate.

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CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents an analysis and discussion of the results from the study. In the first part, I present the results around thematic areas that address the research questions and objectives. The result is an analysis of their experiences, views and understanding of climate change and climate variability, how they are adapting the tending of cattle to climate variability through indigenous knowledge systems, and the extent to which district development planning is addressing climate change adaptation needs for tending cattle among herdsmen. The second part discusses the results around same thematic areas.

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4.2 Data analysis and presentation

4.2.1 Narratives of climate change from the perspectives and experiences of herdsmen

The herdsmen of Kpongu have made various observations that have become a part of their own understanding, measurement and experience of climate change. These observations have been done over so many years and the information have been transferred from one generation to the next. The result is an accumulation of experiences that inform how they view and understand different aspects of climate change and climate variability as well as how they go about measuring the changes in their environment that have been brought about by climate change.

The narratives of the herdsmen reveal that there is some physical evidence in their environment that point to the fact that the climate around them has changed over the years, or that it has become variable. Their narratives show that their understanding of climate change and climate variability is deep and is interlinked with the experiences they share and the impacts they live with, showing a contrast between the climate in the past and now. Herdsmen do not distinguish between experiences and impacts of climate change. The impacts of climate change and climate

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variability hamper their efforts at sustainable pastoralism. Their battles to deal with the climate forms the rich and holistic experiences that they hold about climate change and their livelihood.

The experiences and narratives of climate change and climate change impacts among the herder community point to the following themes: the lengthening of the dry season, increased frequency and longer dry spells, shrinking sizes of water bodies, formation of iron pans on top soils, stunted growth and less concentration of grass species. I shall now describe these in turns.

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Lengthening of the duration of dry seasons and dry spells

The herdsmen narrated that there is change in the climate, which, according to them is evident in variation in the duration of the dry seasons. The variation has mainly been an increase in the length of the dry season. The dry season is the time of the year that is not favourable for pastoralism. Thus the herdsmen are keen about when the dry season starts, what happens during the period and when the season ends.

Mentioning the names of the months in the Fulani language, the herdsmen were unanimous in saying that the conditions that mark the dry season used to start in the month of *Sewtoranu* (November) and end in *Gaanii* (March), a total of five (5) months. However, they now notice that the duration has increased to seven (7) months, starting earlier than before in the month of *Juldanu* (October) and stretching further to *Nii Gaanii* (April). For the herdsmen, conditions that mark the dry season include strong winds from the east, the leaves of trees shedding their leaves, lower temperatures at dawn, drying up of grasses (that facilitate bush fires) and diminished water sources for their cattle.

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Recounting some youthful experiences, in relation to the length of the duration of the dry season one elderly herdsman mentioned during a focus group discussion that the rains used to start earlier than they do now. This means that the dry season has extended. In his own words, he said:

> *I remember that when I was learning pastoralism, the duration of the dry season was shorter than now. The rains usually started early with less intense winds and the dry season was about five (5) months each year. (Participant, FGD, 14/11/2017, Kpongu)*

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Speaking on this phenomenon during a focus group discussion, one herdsman made a very profound statement that relates to the implication of this phenomenon for their pastoral activities and their general livelihoods. He said that:

> *Now we observe that the dry season is becoming longer than before, meanwhile the number of months in the year are still the same. This means that the rainy days have become fewer and we have to endure a lot more hardships in taking care of our herds. (Participant, FGD, 14/11/2017, Kpongu)*

Furthermore, there is an increase in the frequency and duration of dry spells during the rainy season. Each year, the rainy season is known to be punctuated by a number of days without rainfall. Such a prolonged period during the rainy season without rainfall is referred to as a dry spell. The herdsmen narrated how the number of dry spells used to be few, occurred between longer intervals and lasted for a maximum of one week in the past. According to them, the situation is no longer the same. The herdsmen narrated that it has changed for the worse. They mentioned that the dry spells during the rainy season are now more frequent and that they also last longer than they used to. From the narratives of the herdsmen, there are some signs that characterise the occurrence of dry spells. The herdsmen mentioned that they experience little or no cloud cover, higher temperatures, the leaves of trees begin to coil and twist and various grasses lose their freshness.

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The frequent occurrence of dry spells during the rainy season is a common denominator among the herdsmen of Kpongu. Apart from the more frequent occurrence of the dry spells, the herdsmen were also apprehensive about the length of the dry spells. During a focus group interaction, they agreed that they are experiencing longer dry spells during the rainy season as compared to what used to be the case some years past. Increasing from a maximum of one week continuous period of dry spell, the herdsmen mentioned that they now experience dry spells that can last for as long as two weeks. The experiences shared in their narratives reveal that frequent dry spells cause some distortion in the amount and quality of feed that become available for their cattle to feed on. In the course of a key informant interview, one herdsman underscores this and other impacts when he said that:

> *Dry spells are accompanied by a lot of heat and that causes distress in the animals. The grasses in grazing fields always start to lose their freshness when a dry spell sets in. Leaves would begin coiling up and twisting in the heat and the animals are unable to feed well. (Key Informant, 08/10/2017, Kpongu)*

The narratives of the herdsmen are corroborated by data on the number of rainy days that was obtained from the Wa Station of the Meteorological Agency. The data covers several years, from 2006 – 2017 and is shown in the table below. It reveals the non-occurrence of rains during the months that make up the dry season and also reveals by inference, the length of dry spells that occurred during the rainy seasons of those years.

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Table 2: Records of Rainy days for Wa Municipal, 2006 – 2017

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2006	1	1	2	6	11	12	12	11	16	10	0	0	82
2007	0	0	2	10	9	5	10	19	20	8	3	0	86
2008	0	0	3	6	7	9	19	20	17	8	0	0	89
2009	0	2	4	7	13	12	11	20	19	12	1	0	101
2010	0	1	0	6	11	6	12	15	14	11	1	0	77
2011	0	1	4	3	11	10	10	19	15	7	1	0	81
2012	0	1	3	8	11	11	17	13	15	15	1	0	95
2013	0	1	7	6	10	7	11	14	21	10	2	0	89
2014	0	0	2	8	5	8	9	11	14	9	7	0	73
2015	0	1	1	2	6	8	12	17	18	9	0	0	74
2016	0	0	7	2	14	6	12	13	14	4	0	0	72
2017	0	0	3	6	9	15	11	10	6	4	0	0	64

Source: Wa Meteorological Agency, 2017

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A cursory glance at the record of rainy days (Table 2) shows that there are usually no rains in the months of December, January and February for the years that have been recorded. This is because those three months mark the peak of the dry season with severe harmattan conditions that do not help in the formation of any rainfall. In fact, from 2006 – 2017, there has been no rainfall in the month of December and almost the same for the month of January except for one rainfall in January of 2006. Similarly, the month of February usually gets only one or no rainfall at all except for February of 2009 when there were only two rainy days.

An analysis of the months that constitute the rainy season reveal that the number of rainy days are decreasing. This means that there were more frequent dry spells. For instance, a look at the data for the months of August, September and October reveal this fact. These months usually record the most rains every year. From a record high of 20 rainy days in 2008 and 2009, the number has been decreasing over the years with 2017 recording the lowest of 10 rainy days for the month of August. For the month of September, the highest record of rainy days was in 2013, with a record of 21 days. In subsequent years, the number of rainy days for the month of September started decreasing to its lowest record of 6 rainy days in 2017. The situation is not

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any different for the month of October which recorded its highest number of 15 rainy days in 2012 and has since seen a decline over the years to its lowest of 4 rainy days in 2017.

The narratives of the herdsmen regarding the lengthening of the dry seasons is equally corroborated by the data of rainy days when viewed in terms of the totals across the various years. Table 2 also shows in its totals that the number of rainy days per year is declining and that could have implications for the length of the dry season in each year. As a result of how the number of rainy days are declining during the months that ought to bring the most rains, the total number of rainy days in each year have also been declining. From the year 2006 to 2008, the total was not less than 80 rainy days. The number peaked in 2009 and then started reducing from a high of 101 rainy days to 95 in 2012, 89 rainy days in 2013, below 80 rainy days from 2014 – 2016 and further down to 64 rainy days in 2017.

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The implication of fewer rainy days during the months that are expected to produce the most rains in a year is that the occurrence of dry spells would be more frequent and prolonged. This is because, as the number of rainy days are decreasing, the average rainy days per month would also be decreasing since the number of days in a month is a constant. Thus a lot more days in those rainy months would pass without any rainfall.

Shrinking sizes of water bodies

One of the most critical need for cattle, apart from forage, is a source of water. This is a very significant resource in the practice of pastoralism and an essential element in balancing the survival needs of cattle. Unfortunately, it has been observed by many herdsmen, particularly the aged, that their water bodies are reducing in size over the years. This phenomenon forms another experience and a way by which the herdsmen recognise and measure climate change.

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From the narratives of the herdsmen, the water bodies are not only shrinking in overall size but also lose significant amounts of water during dry spells and often completely dry up in the dry season.

Recounting his experience regarding the water bodies in the Kpongu community that their animals drink from, and then comparing that with the present day situation, one herdsman mentioned that:

> *Growing up, we used to swim in that pond, even in the dry season. We often left the animals on the river side and go for a swim. But now the water in the pond cannot even reach my knee level during the dry season, let alone enough for swimming. (Participant, FGD, 14/11/2017, Kpongu*)

From this narrative, the herdsman had seen and experienced that the volume of water used to fill up the said pond and the fact that there used to be enough water throughout the dry season until the rains of the next season set in. Their cattle used to stay at the banks of the pond to graze and drink because the pond was so big and deep that the cattle would not risk going into the water. The narratives of the herdsmen show that, now the cattle can easily wade through the water and cross over to the other side. In some extreme cases, during the dry season, the pond is reduced to a murky mass of suspended particles and the cattle can hardly drink from it. One of such ponds in the community that has shrunk in size is captured below (Figure 5).

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Figure 5: Water body that has shrunk in size

Source: Field work, Kpongu - October, 2017

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This is one of the water bodies that the herdsmen depend on as a source of water for their animals. The picture above shows a valley that contains the muddy remains of a pond. This remnants is mainly mud. Meanwhile, the valley is quite a large one that and the depth of it shows that it used to hold large volumes of water. The area around the pond still has some traces of grass, the survival of which is made possible by the presence of the water. However the pond has lost most of its water to the heat and the fact that the rains are few and far between. During a focus group discussion with the herdsmen, the issue of shrinking water bodies was probed further so as to estimate the extent to which the water in the pond has reduced. In response, one of the herdsmen cited an example. He said that:

> *It is now possible for some community members to comfortably mould bricks and leave them at the edge of the water, without any fears that they would be washed away. Some years past, nobody could mould bricks there since that space was filled with water. (Participant, FGD, 14/11/2017, Kpongu)*

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The fact that water bodies in the community are shrinking, and the fact that they easily dry up in the dry season, it presents some implications for pastoralism and the livelihoods of the herdsmen as a whole. According to the herdsmen, they have to plan and reroute their movements in the dry season. Very often they take the option of trekking in the direction of other communities where they are assured of water for their animals. This implies that herds and men would have to endure longer trekking distance and the probability of no feed in the direction of that water source.

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Another implication is that, the animals are sometimes compelled to drink water of very poor quality. This situation was confirmed by the regional veterinary officer during a key informant interview. This is what he said regarding the kind of water that the animals drink:

> *When I go round on inspection and treatment, it is clear that some illnesses that attack the animals are due to the kind of water that they drink. Sometimes I ask questions and in response the herdsmen would say that their options of water sources are limited (Key Informant, 19/10/2017, Kpongu)*

The herdsmen admit they know that the water quality is poor in the dry season but conceded that they allow the cattle to drink. This is because they have to weigh that option as against the option of covering several kilometres into distant territories for water, with the risk of exposing the animals to severe heat and stress.

Formation of iron pans on top soils

One of the experiences recounted by herdsmen in Kpongu which reflects their understanding and experience of climate change and its impacts is the spread of what is known as iron pans. An iron pan on the surface of a piece of land is a form of clay that is rich in iron but very poor in humus, resulting in the hardening of top soils. This kind of hardened top soils are unable to support the growth of grasses that herdsmen require to feed their herds. The increasing

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formation of these iron pans on hitherto humus land surfaces is one measure of climate change for the herdsmen.

The herdsmen are well aware that several factors contribute to the exposure of top soils to heat, aridity and eventually the formation of iron pans. These include erratic and fewer rains, higher temperatures, deforestation through charcoal burning and bush burning (wild fires) that scotch the land surface. This in-depth understanding of the climate by the herdsmen is corroborated by the responses of the senior veterinary officer, Mr Stephen Ang-Numbaala, at the Regional Veterinary Unit of the MoFA in Wa. He revealed that through his interactions with herdsmen, there is an appreciable understanding amongst them that temperatures are now higher and intolerable, the weather patterns are unpredictable and that rainfall is now more erratic than ever and the distribution across the landscape too is intermittent and unreliable.

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During a key informant interview, one herdsman noted with concern the numerous locations that iron pans can be found when they go away from their homestead with their herds. This is what he had to say:

> *Some years ago, we only saw iron pans in rocky or stony areas. This situation has changed now. We see them in any direction that we move. Some places that used to have grasses are now over taken by the iron pans. The way it is now, grasses cannot grow there again. (Key Informant, 20/10/2017, Kpongu)*

According to the herdsmen, their frequent encounters with the iron pans in vegetative plains that once had grasses is only one aspect of the impacts. They also narrated some experiences that show that the as the years go by, the sizes of the iron pans are not fixed. Their observations reveal that the iron pans are increasing in size, expanding further to affect the surrounding forage. This is the apprehension of another key informant. Expressing this uneasiness, he mentioned that:

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The iron pans are growing and are taking over our grazing fields, spreading into many areas. The rate of the spread might be gradual but they are becoming bigger as compared to when we first saw them. Now we are afraid of how big and how far they would grow. (Key Informant, 13/10/2017, Kpongu)

During a focused group discussion with the herdsmen, many of them who spoke on the issue of the formation of iron pans, conceded that their appearance and rate of growth happens gradually. This picture (Figure 6) was captured in the course of this study showing the nature of an iron pan.

Figure 6: Grazing field that has lost its grasses

Source: Field work, Kpongu – October, 2017

The iron pan that is captured above is located in the northern extremes of the study community, next to a stretch of green field. The herdsmen narrated that this area was previously a grassland that is losing its green forage. This is evidenced by the fact that the area still has some patches of grass as the iron pan is expanding. The few patches of grass that remain would be lost in the coming years as the iron pan is expected to expand over a wider area.

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Some of the narratives expressed by the herdsmen brought to light their understanding of the causative linkage between the occurrence of drought and frequent dry spells on the one hand and the formation of iron pans on the other hand. Their narratives are indicative of the fact that periods of prolonged droughts and dry spells influence the occurrence of iron pans in such a way that make the iron pans become more visible and the top soils become more hardened. Speaking on this linkage, a key informant mentioned that:

> *When we experience continuous rains, the iron pans are not able to form or expand easily. In the rainy season when we spot the iron pans, they become partially covered by creeping plants. So if the rains are continuous, we might not even be able to locate the iron pans again. (Key Informant, 13/10/2017, Kpongu)*

Droughts and dry spells results in increased aridity of the top soils within iron pans. The opposite is true for periods of continuous rains, when the ground become waterlogged and thus prevent the formation or expansion of iron pans.

The herdsmen narrated the impacts of the iron pan formation on their pastoral activities and by extension their livelihood. The first and obvious impact for them is that their graze lands are being lost to the iron pans. Places that were green with grasses and served as graze lands for their herds are now without grass even in the wet season. This is because in places where the iron pans are formed, the conditions of the top soils are such that they cannot support the growth of grasses anymore. Following from this, another impact is that, the trekking distances of the men and their herds would increase. The herdsmen narrated that they are compelled by the situation to move further and cover longer distances in search of feed.

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Stunted growth, smaller stalk sizes and less concentration of grasses

The herdsmen in Kpongu have made another observation that has become a part of their own understanding, measurement and experience of climate change. Apart from the fact that the availability of forage for cattle is cyclical (rainy and dry seasons) and influenced by the amount of rains, there is also the issue of the length or height of the grasses. They narrated that another way in which they have experienced climate change and its impacts is by gauging the growth of various grass species.

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During various interactive sessions with the herdsmen, they were unanimous in their indication that the grasses their herds depended on have experienced diminutive growth over the years. On a lighter note, some of the herdsmen believe that their animals are equally becoming stunted because they do not have to stretch to reach for tall grasses and weeds. Describing how short the species of grasses have become, this is what one herdsman had to say during a focus group discussion:

> *So many years ago, when we go into the bush, the grasses were so tall that they would prevent us from seeing far ahead. Grasses that hitherto could shield and match up to the height of a fully grown man have now shrunk to about half that size. The grasses have become so short even when we are experiencing heavy rains. (Discussant, FGD, 14/11/2017, Kpongu)*

To measure the actual height of the grasses, the best period would be at the peak of the rains when the grasses would have grown to their tallest possible height. The herdsmen added that, at this time the grasses would not be heavy at the top as a result of the formation of pods (for some species) and haven't reached the point where they begin to bend downwards.

Similarly, the size of the stalks of grasses, in terms of their width, has also been observed by the herdsmen. They narrated that stalk sizes have become smaller over the years. According to

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the narratives of the herdsmen, they are able to determine this because they harvest some of the grasses for weaving and use for thatch roofing. The stalks are cut from their base at the time that they begin to show signs of drying up. This is usually done between the months of *Juldanu* (October) and *Sewtoranu* (November), early enough before the grasses are destroyed by the blaze of wild fires.

Regarding the smaller size of stalks as they are harvested for thatch roofing, one key informant spoke about the weight of a bundle of stalks. The herdsman recounted his experiences regarding the weight of a bundle of wet or freshly cut stalks which, as children, they had to bear when they were tasked to carry from the bush to their homestead. He mentioned that:

> *One bundle of grass stalks is often held together by a single twine of fibre. Some years ago such a bundle was so heavy that, as children, we could not carry the load home. Nowadays, we have to cut a lot more grass stalks to make up a bundle of the same weight. (Key Informant, 20/10/2017, Kpongu)*

In the estimation of this herdsman, it will take about twice the number of freshly cut stalks in present day to match the weight of the quantity that he used to carry several years ago.

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Also, the narratives of the herdsmen show that they have experienced less concentration of grasses as compared with what it used to be several years ago. They say that the grasses are now generally sparse in the main grazing fields, only a bit more dense at the edge of water bodies and in swampy regions. The accounts of the herdsmen are that, the grasses used to be so dense that walking through them was troubling, and that, one grass sprout could easily develop other off shots all around that made them impenetrable.

In explaining how dense grasses used to be, one key informant narrated the reason why, as herdsmen, they are used to shouting out to one another. He attributed their yelling in the bushes

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to the way the grasses were so long and concentrated that a fully grown adult would be obstructed from view. He stated that:

> *The bushes used to be so long and thick that we had to call out to each other in high pitch voices so as to be able to locate each other. We learnt how to listen to the whirling of the wind, the rustling of the bushes and are able to differentiate various sounds. Through this, we were able to easily determine the direction of a shout from another herdsman as well as other sounds in the bush. (Key Informant, 13/10/2017, Kpongu)*

In the present day, the grasses are shorter, the stalk sizes are smaller and the bushes are not as dense as they used to be. Grass concentration per unit area has diminished. All of these factors and experiences have some implications for the pastoral activities of the herdsmen, particularly as it relates to the amount of feed that they can now source from fresh grasses. Instead of staying within a small parcel of graze land and being able to get enough feed, the herdsmen would be compelled to keep moving around due to the less concentration of the grasses. This kind of movement and continuous search for feed brings stress and fatigue upon herds and men. If grasses were to be more concentrated, the herdsmen would have been less mobile and their movement would be restricted to just shorter distances, probably around their homestead.

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It became clear from the narratives of the herdsmen that the health and general growth of their herds are affected by the nature of grass species, which is caused by the impact of climate change. Having noted that climate change has caused grasses to be stunted with smaller stock sizes and less concentrated per unit area, the herdsmen expressed concerns about the health of their herds relative to the kind of grasses they are fed on in recent years. To start with, stunted and smaller stalks of grasses means that the animals are not able to gain enough roughage that should facilitate their growth and overall health. During a focus group discussion, a herdsman underscored the importance of good forage with large stalks and leaves, saying that they usually

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observe the cow dung to determine if the cattle are getting enough fibre from the grass. Demonstrating his understanding and experience, he narrated that:

> *Our animals need regular and sufficient fibre, especially young ones that have just started feeding on grass. As the grasses are becoming smaller and less concentrated, we observe that the cattle excreta is lighter and sometimes watery. Good grasses with lots of fibre make the dung to appear dark, solid and compact. (Discussant, FGD, 14/11/2017, Kpongu)*

The discussant also narrated that, the period when calves start to feed on grass is the most critical time that determines how well they would grow and how their health would be impacted. Calves that are weaned at the start of the dry season are the ones that mostly affected in terms of their growth. This is the time when grasses are not fresh and even the dried ones are mostly scorched by bushes fires. According to the participants of the focus group discussion, the situation is not any better in the rainy season due to the impact that climate change have on the grass species.

A synthesis of the narratives and results reveal five (5) key pointers of climate change and climate variability based on the world view of herdsmen (See Figure 7). From the analysis, the key indicators of climate change and climate variability include the following: longer dry seasons and frequent dry spells, shrinking size of water bodies, formation of iron pans on top soils, stunted growth of various grass species and then smaller stalk sizes and less concentration of grasses.

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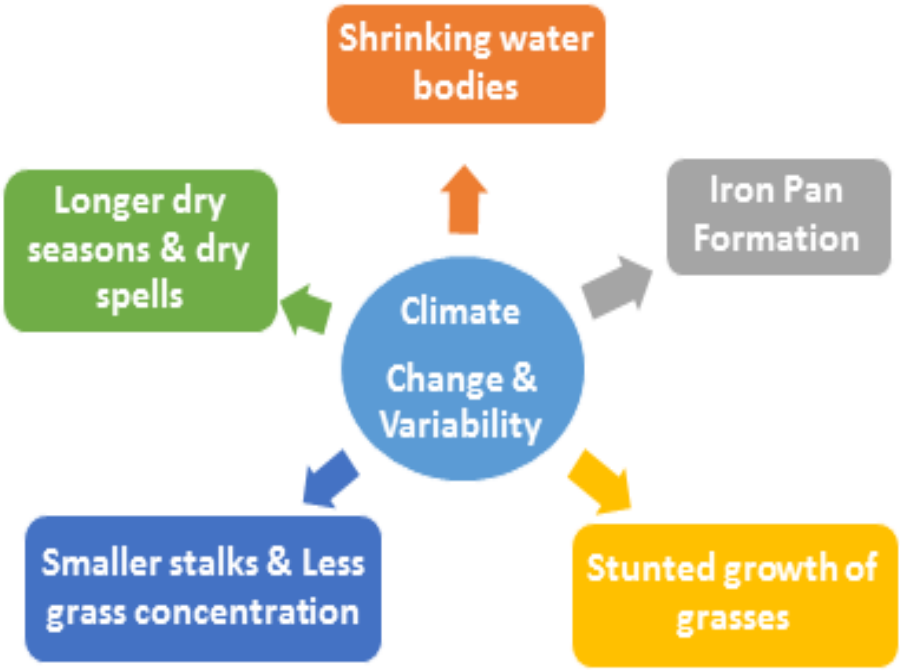
Figure 7: Narratives of impacts of climate change and climate variability



Source: Author's construct, 2018

The figure shows that climate change is central to all others. These two related and yet distinct phenomena are fundamental causes of the experiences that have been narrated by the herdsmen. Climate variability begins with rather subtle deviations in the nature of the weather parameters of a given region. Such parameters are measurable indicators that can be felt by herds and men. Temperature and humidity tend to be moving towards extreme records. Rainfall becomes erratic with changes in its distribution over a landscape. Cloud cover is reduced, causing the direct sun's rays to reach the earth's surface. Increased solar radiation also tend to speed up evaporation and transpiration processes. When viewed as a collective and over many years, there would be a clear awareness that the climate has changed. The impacts of climate change are then felt as a chain of cascading effects are set in motion such that a preceding effect becomes a cause of another impact.

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The various climate change impacts as experienced and narrated by the herdsmen are interconnected by a cause-effect relationship. To begin with, longer dry seasons and more frequent dry spells have implications for water bodies. This is because water bodies in the study community get water from rainfall and a shorter rainy season reduces the volumes of water. It is water run-offs from rainfall that are naturally channelled down slope into dams and dugouts that serve as places for watering cattle. Similarly, frequent and longer dry spells in the rainy season would equally cause a reduction in the volumes of water that reach the various water bodies in the community.

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Furthermore, the shrinking of water bodies reduce vegetation which in turn trigger the formation of iron pans. The fields that surround water bodies are the rallying points for herdsmen to graze their cattle in the dry season. Moist and humid conditions in these places make them conducive for the sprouting and growth of grasses. However, as the water bodies are shrinking in size, the vegetation in the surrounding areas of the water bodies would begin to dry up. As the volumes of water diminish, the muddy and saturated banks begin to lose moisture and deteriorate to the disadvantage of the greenery that are surviving there. In a similar way, as the surrounding vegetation start to wither, coupled with the effects of the dry seasons and dry spells, the top soils become exposed and susceptible to the formation of iron pans.

Longer dry seasons and frequent dry spells in the rainy season also have implications for the formation of iron pans and the growth of various grass species. Dry seasons bring winds with little moisture content. Intense temperatures and solar radiation also leaves the top soils very parched and cracked. These become the perfect conditions for the formation of iron pans. As the iron pans spread out with such harsh conditions, grasses easily fizzle out, leaving the ground bare. Any surviving grasses in such an area would most likely suffer stunted growth and develop a smaller stalk size.

4.2.2 Indigenous adaptation strategies to climate change and climate variability

The study reveals that the herdsmen employ various indigenous adaptation strategies. These indigenous adaptation strategies that they practice are derived from their repository of indigenous knowledge, even though some of their adaptations are laced with conventional wisdom, which are handed down over generations by word of mouth and by observation. Their very livelihood and survival manoeuvres stem from indigenous knowledge that is deep rooted and has helped them evolve variously to the vagaries of the climate.

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During a focus-group discussion, a discussant was able to put their indigenous adaptation strategies into perspective by attempting to group them. He mentioned that:

> *We adapt to the effects of climate change in terms of how we move with the cattle, the feed we give them, the method by which we share workload among ourselves and also the ways in which we reduce stress levels in the animals. (Discussant, FGD, 14/11/2017, Kpongu)*

This statement was accepted by the herdsmen who were present to be true and a proper way of grouping their indigenous adaptation strategies. From the statement of this discussant, four broad categories of indigenous adaptation strategies can be defined as (i) mobility of herds and men (ii) diversifying sources of feed (iii) division of labour for differential needs of herdsmen and (v) stress management. Explaining further, an elderly discussant stated that:

> *The indigenous knowledge-based adaptation strategies are shaped by our physical landscape and socio-cultural orientation towards the immediate environment and also informed by the regulatory regimes of our territory. (Discussant, FGD, 14/11/2017, Kpongu)*

Mobility of men and herds

Among all the indigenous adaptation strategies that the herdsmen of Kpongu use to adapt to the constraints brought about by climate change, mobility of herd and men constitute the central strategic element. On the basis that each mobility style is linked to a precise and distinct

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ecological landscape, some mobility strategies can be distinguished. Of the forty-one (41) herdsmen that were contacted during the survey for this study, fifteen (15) of them mentioned three forms of mobility. These are: linear movement, non-linear or irregular movement and circular movement. In addition to these three, a fourth mobility strategy was mentioned by twenty-six (26) herdsmen as migratory movement.

(i) Linear movement

This means that the herdsmen abandon the zone of their habitual attachment for lack of feed and then depart in search of more favourable zones. This withdrawal from their typical grazing zone is done by following a route that stretches out in a somewhat straight line, regardless of the direction. It is a kind of pendular movement of comings and goings between two geographical points that are distant. A different direction is taken the next day or at a later time. It is common knowledge among the herdsmen that the availability of feed has a direct correlation with the distance covered, as depicted in figure 8 below. Thus, the objective is usually to cover as much linear distance as possible before returning.

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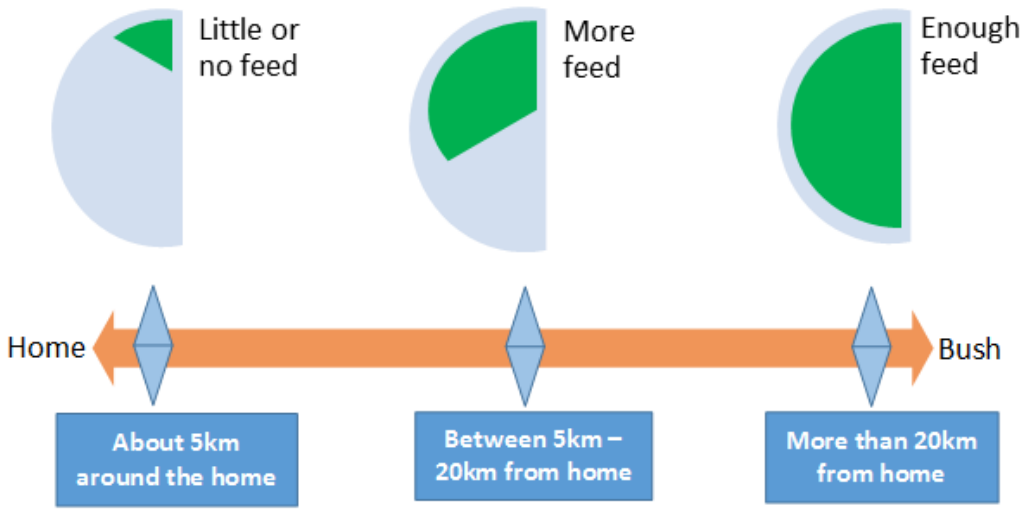
Figure 8: Linear movement of men and herd



Source: Author's construct, 2018

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During interactions with various key informants, varied accounts were given by the herdsmen with regards to the length of distance (in kilometres) that they cover. These diverse narrations were collated and approximations as well as averaging of the distances were done as depicted in figure 8. The illustration shows that feed availability improves with increasing distance from the home. This is because, anywhere around their homestead, other competing land uses and cumulative demand by other herds in the community makes forage almost non-existent. However, moving beyond 5km to about 20km from the community, more feed may be found to increase the level of satisfaction of the animals. The advantages associated with this strategy, according to the herdsmen, come to them in the form of luck. This is because one's choice of direction of movement could be unfamiliar. Speaking on the benefits of taking a linear route, one middle-aged herdsman narrated during a key informant interview that it is just the occurrence of luck that can come their way. This is what he had to say:

> *When we go far into the bush, sometimes we are lucky to discover a niche of unexploited forage that is supported by some fertile and moisture retaining soils. Other times we are fortunate to come across a parcel of some drought resistant grass species. Eventually we are able to make a mental map of the immediate and distant terrains. (Key Informant, 13/10/2017, Kpongu)*

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Listening to key informant, he was indicative of the fact that the mental map and knowledge of the landscape around them go a long way to form an invaluable resource that they rely on in successive years. This knowledge is then disseminated to young herdsmen who also depend on such information and familiarity with the terrain. Embarking on a linear route, the herdsmen are often targeting a suitable rangeland that has been separated from the main land by a swamp or a creek. Such an isolated field is often not scotched by wild fires. They explained that depending on the origin of bush fires, some grasses remain unscratched, being limited in the distant by a creek, bare land or some other phenomenon in the territory. The linear movement

and the resultant accidental discoveries of rangelands thus become an adaptation strategy to the adverse effects of climate change.

This strategy has its associated drawbacks, such as the fact that discovery of a suitable grazing field is open to chance. One could move a herd of cattle very far into the bush and just hassle in vain. Another drawback of this strategy is that the remoter a herd is taken out, there will be a corresponding increase in stress levels among both men and herd. Commenting on the difficulties with this strategy, the key informant who earlier spoke on the benefits, emphasised that the distance one covers is not as important as the choice of direction. He stated that if one goes in a direction where there is no water source close by, the herdsman may enjoy the forage of unexploited fields but the animals suffer dehydration and exhaustion and thus become susceptible to illnesses.

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A further probe into the implications of such movements across distant lands revealed that, there are often confrontations between the herdsmen and members of other communities when the latter feels that their territory has been invaded. Instances of such confrontations have been corroborated by Naa Braima Seidu, the chief of Kpongu, and Mr. Rashid Ibrahim, who is the Animals Production Officer at the regional office of MoFA. Speaking as a traditional ruler, the chief of Kpongu mentioned that:

> *Such cases of confrontations usually come to my attention, even though it is not a frequent phenomenon. The triggers of confrontations occur when herds of cattle are led into/or through cultivated fields or the vicinity of sacred grooves and shrine encampments that belong to some of our neighbouring communities. (Chief, 23/11/2017, Kpongu)*

As a whole, a linear strategy has the characteristic of an elongated elliptical movement that is motivated essentially by a quest to source suitable feed and also sometimes driven by the need

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to distance animals from cultivated fields. Apart from linear movement, the other mobility strategies involves an initial search for a suitable grazing field and then an appropriate style of movement is selected so as to make optimal use of that field.

(ii) Non-linear/irregular movement

An irregular mobility strategy is an array of unpredictable movements within the limits of a given region, mostly during the dry season. Located within a low lying and undulating landscape, the herdsmen mentioned that such a field usually involves a pre-identified wetland, valley, or river basin that has the possibility of holding some moisture to support plant growth even during the dry season. Apart from that, the field could also be one that is surrounded by trees so as to help retain moisture and humidity that are necessary for plant growth. Describing this mobility strategy and the nature of manoeuvre, one aged herdsman, who said he started herding at the age of nine (9), submitted that:

> *A zone of suitable grass that has been identified in a valley or river basin becomes a true zone of sentimental attachment for every herdsman that wish to frequent there. The tactic is that the herd has be to taken out early to prevent stress and dehydration and also to know how to negotiate between the portions that do not hold any grass. (Key Informant, 14/10/2017, Kpongu)*

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Once a suitable turf is identified and the herd of cattle are taken out, there is no specific or defined style of movement. This is because, the whole area could be covered with forage but interspersed with some patches of either stones, rocks or mud that can impede free linear movement. The objective will then be to move around and avoid such patches of mud, swamp or rocks. The spatial dispersion and frequent fluctuations in the availability of common pool resources such as rangelands, wetlands, river banks and fallow fields make them less reliable for livestock production.

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As intimated by the herdsmen, this strategy is helpful in the fight against the negative effects of climate change to the extent that it provides a wide area of grass species that are able to quickly rejuvenate due to the presence of muddy and swampy conditions that retain humidity.

The challenge with this adaptation strategy is that, it is often difficult to locate such rare grazing fields and that they are usually found very far from home. Also, notwithstanding the damp and humid conditions, the herdsmen alluded that there might not be any water source for the animals, thus dehydration and stress levels in the animals can be high. Another downside of this strategy according to the herdsmen is that, the moist conditions that characterise such rare ecological niches facilitate the breeding of pests and insects that are inimical to the health of the cattle.

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(iii) Circular movement

A circular movement is an adaptation that is typical to the dry season as well as periods of drought and dry spells, and is always done in relation to a given source of water. The water source is the central feature. The landscape that is situated around a water source is noted to always have some appreciable levels of reserves of green grass during drought and dry spells. The space that surrounds the water source is therefore exploited by making continuous circular movements. From the narrations of the herdsmen, some of the movements around a water source are done in such a way that it can be described as centrifugal, that is, receding and expanding from the base and then back to the base, which in this case is the water source.

Speaking during a focus-group interaction, one herdsman made markings on the ground with his finger, to demonstrate the circular movement around a source of water. His drawings informed the illustration of this kind of movement as shown in figure 9 below.

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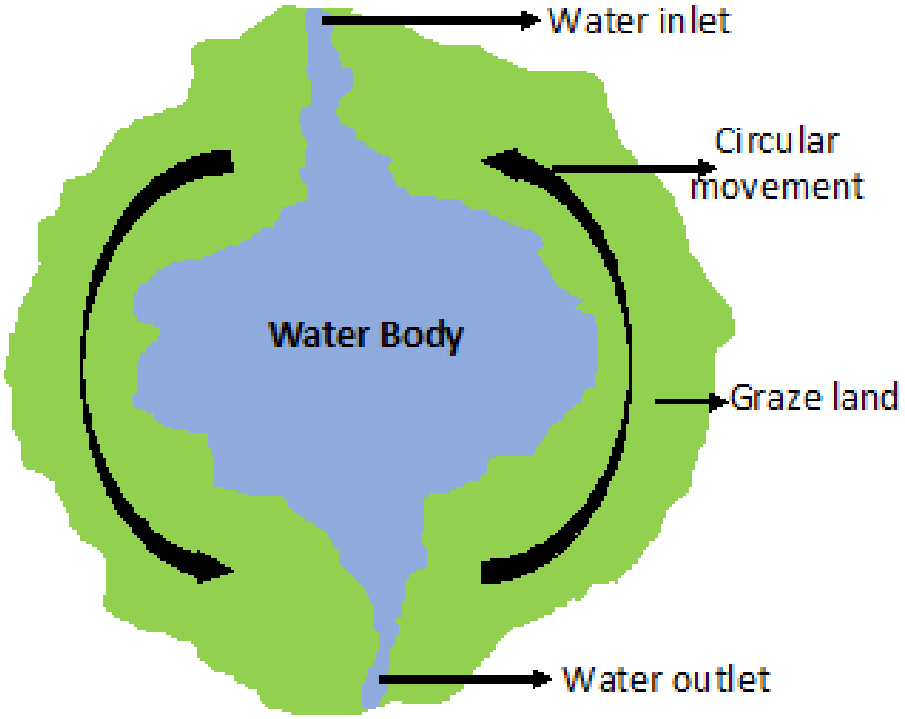
Figure 9: Illustration of a circular movement around a water body



Source: Author's construct, 2018

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A further probe on this mobility strategy revealed more explanation and clarification from the herdsmen. For instance, the cyclic movement would be slightly different, i.e., being complete or incomplete, depending on whether the water body is a stagnant one such as a pond or a moving/flowing one such as a river. An incomplete cyclic movement means that, the herd and men are being blocked by the in-let and/or out-let of the said water body (See Figure 9). Explaining this sort of movement further, a herdsmen stated that:

> *If it is a stagnant water body, we can move all the way around it, but if it is a river, we keep to about half of the area because the animals may not be able to cross. We just keep the cattle around the banks because that place would be better than any other field. When we are going around the water body, it does not matter whether you are moving clockwise or anticlockwise. (Key Informant, 20/10/2017, Kpongu)*

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During a focus-group discussion with the herdsmen, it became evident from the narration of their experiences that their favourite choice of adaptation to climate change, relative to feeding their animals, is grazing around a water source. This is because, on the one hand, there is green vegetation and continuous sprouting of forage and on the other hand, the proximity of water for the animals makes it most desirable. The herdsmen in Kpongu indicated that they considered themselves fortunate, in comparison with some neighbouring communities. This is because, there are two water bodies in Kpongu that have become their rally points. The implication of this mobility strategy is that, the landscape around a water body would be under pressure due to over grazing. Since the herdsmen frequent such places and make them their rally points, the vegetative cover would be over stretched since there is no time for the grasses to rejuvenate. This could make the landscape susceptible to erosion with its associated consequences for environmental sustainability.

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(iv) Migratory movement

Migratory movement occurs when men and herds travel very far from home in search of feed and water for their cattle and then decide to make temporal camps in which they would stay for a couple of days. The decision to camp at a distant location is often made based on:

- the size of the graze land found there
- nearness to a water source
- suitability of the location for camping and
- the extent of stress that repetitive trips would cause the animals

A migratory movement occurs as an avenue of last resort, when a recourse to other alternatives would not yield enough feed for the animals. According to the experiences of the herdsmen, during periods of drought and/or dry spells, brought about by climate change, the animals are still able to survive on dry grass. But even the dry grass may not be readily available within their homestead, prompting a migratory movement. Narrating his experience during an

interview, a key informant stated that, migratory movement is now a way of life for them. He went on to say that:

> *Every year we have to migrate at least once. This is often the case when the whole neighbourhood is devoid of even dry grass, as a result of bush burning. When dry grass is available the animals are able to live on that while we wait on the rains. (Key Informant, 08/10/2017, Kpongu)*

Responding to the issue of risk, the key informant agreed that it is quite a dangerous endeavour, posing risk to both herdsmen and their herd. As a result, no herdsman goes out alone. They would rather migrate in a group, leaving their households behind for a couple of days. There is however a caveat to this adaptation strategy, which is permission from the cattle owners (if all the cattle are not solely owned by the herdsmen) to allow them to take such a risk and embark on a trip with their cattle. An interview session with Mr. Mahamoud, who is chairman of the cattle owners association in the Wa Municipality, corroborates this assertion. Be that as it may, a recourse to temporal migration out of one's locality may prove to be a very valuable undertaking in the climate change adaptation process. This is because, a trip of that sort is prompted by the unavailability of sufficient feed within a return distance. A migratory movement becomes particularly useful as a mobility adaptation strategy when bush fires have burnt all dry grasses that could have been an option for survival.

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Diversifying sources of feed

The field work in Kpongu has revealed that the herdsmen are committed to giving their cattle appropriate and sufficient food all through the seasons and in the face of climate change. This is paramount to the herdsmen as they endeavour to prevent stuntedness of the herd and also improve fertility and milk production by mostly relying on common pool resources. As a result, the herdsmen are diversifying the sources of feed for their cattle. Some of these diversified sources of feed are: (i) pruning of tree branches and leaves (ii) use of crop residue and (iii)

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reliance on grass sprouts in valleys resulting from dew fall. These diversified sources of feed are discussed into detail in the succeeding sections, showing how these sources are relevant in the lives of the herdsmen, relative to their climate change adaptation strategies.

(i) Pruning of tree branches/leaves

This strategy was the singular thing that ignited the researcher's curiosity. Observing this diversified source of feed, it generated the interest to investigate indigenous adaptations of herdsmen and their respective implications for environmental sustainability. Pruning trees for animals to feed on the leaves is distinctive to the extent that the animals' heads are not bend towards the ground, but are rather raised in the air as they look to the skies for leaves to fall. Pruning requires one to climb a tree and then use a sharp edge, usually a machete, to cut branches to the ground. These branches would have leaves, pods, flowers and any edible parts. Pruning is probably the only adaptation strategy whereby the resourcefulness of young herdsmen become a principal element. This is in terms of their agility, speed and light weight that are essential in harvesting a good measure of leaves from a tree. Some of the trees whose leaves have become feed for cattle were mentioned in the Waale dialect as *bornea* and *kakala.* The picture beneath was captured during observation as a young man climbed a *kakala* tree close to the homestead and then started cutting leaves from a tree that had already even lost most of its branches.

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Figure 10: Pruning of tree leaves to feed cattle

Source: Field work, Kpongu - November, 2017

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As evident in the image above, the ground that has been captured in the picture is without any green vegetation. There are only a couple of scattered trees in the distant. Also the image shows some houses, indicating that this adaptation strategy can be practised within or very close to the community. Based on the initial observations of pruning in the field, the Animals Production Officer at the regional office of MoFA was engaged later in a key informant interview. He noted during the interview that there could be associated risk of indigestion, illness and even death. The officer also stated that:

> *The animals are also changing their taste buds. Now they do not eat only grass. Different leaves are harvested and served to the cattle. They might eat because of starvation. If the cattle respond by eating, then it is included in the list of options and gradually the animals adapt to those leaves. (Key Informant, 24/09/2017, Wa)*

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Akin to the cutting of leaves, is the practice where the cattle are led to some of the trees with low branches and are then allowed to pick the leaves off the tree by themselves. This even goes for some economic trees such as mangoes. The herdsmen admit that the cattle eat mango leaves and when there are fruits, they eat those as well. This source of feed for cattle has adverse implications for environmental sustainability. In the wake of climate change, cutting of tree branches could worsen rainfall patterns. This is because continuous use of this adaptation strategy would facilitate the pace of deforestation, drawing the desert closer home.

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(ii) Use of crop residue

In the immediate aftermath of the harvesting of farm produce, one of the herdsmen's diversified source of feed as an adaptation strategy is to rely on crop residue. Crop residue is a dry straw based feed. These include the residue of groundnuts, beans, sorghum, stocks and dried leaves of maize, guinea corn and millet plants. The herd of cattle is often led to a heap of residue and are allowed to stay there and feed (Figure 11).

Figure 11: Herd of cattle feeding on corn residue

Source: Field work, Kpongu - November, 2017

The herdsmen do this by going through farms in their immediate neighbourhood and continue searching across farms with increasing distance from their homestead.

(iii) Grass sprouts resulting from dew fall

The herdsmen also tap into the benefits of dew at the end of the rainy season to feed their cattle. Dew is formed when atmospheric moisture condenses and falls to the ground as little droplets of water. There is the benefit of relative humidity in the soil. These partially humid soils support the early sprouting of vegetation, giving cattle green grass even after the rains. This invariably allows the herdsmen to artificially prolong the benefits of the rainy season, by cutting back as much as possible on dry, straw-based feed.

Division of labour for differential needs of herdsmen and herds

Climate change has had a toll on not only the cattle and their fight to survive, but also on the men, women and children who are available and form the domestic labour force for tending to the needs of the animals. One burden of climate change and climate variability on herdsmen is the increased workload that has to be done daily and/or seasonally. The workload simply becomes too much for one herdsman when animals have to be taken out into distant fields, kraals have to be built or repaired, vulnerable animals such as the sick, wounded and calves need attention and lactating cows have to be milked daily. The division of the work load among members of the domestic household thus becomes an adaptation strategy for the benefit of not only the herdsmen themselves but also the herds.

Unless help is sought from neighbours or relations, all of the pastoral responsibilities are taken care of by the members of a domestic household unit, comprising parents and children. The head of the household unit is responsible for overall herd management, defining each one's

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role and sharing tasks. The family herd is managed collectively as one herd. However, each member of the household is responsible for a certain kind of cattle, be they sick, wounded, calves, pregnant cows or lactating cows. The different activities are divided according to the sex and the age of the household members. Generally the men take care of guarding and watering the animals, searching for grazing field, repairing and building new kraals and the sale of animals if need be, while the women take care of milking the cows, sale and bartering of milk and then guarding and watering wounded and sick animals. More specifically, the young herdsmen take care of lactating cows and their calves. These do not go far from the homestead because the calves may not yet be old enough to move around. In fact, most situations require that the lactating cows be secured to a tree or stump nearby. The middle-aged herdsmen are responsible for finding logs of wood and conveying them home to repair or build new kraals. When such a job has been dealt with, they take over from the elderly herdsmen who would by then be tending to the feeding and watering of the cattle.

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Narrating his experience regarding the practice of division of labour as an indigenous adaptation strategy, one herdsman had this to say during a key informant interview:

> *When there was always enough feed around the home, I used to allow the cattle to graze nearby such that I can watch, while I work through the day and attend to the other duties. This time, things are different. One person cannot do everything. Anytime I move very far in search of grazing fields, my children cut some leaves near the home for the weak, wounded and pregnant cows. These animals cannot travel far. (Key Informant, 19/10/2017, Kpongu)*

The division of labour for differential needs of herdsmen as an indigenous adaptation strategy to climate change has a number of benefits for the herdsmen. During a focused-group discussion, the herdsmen enumerated the following as some of the benefits of having to share their pastoral duties.

a) They become available to attend to social events

b) Getting enough rest
c) Having energy to go farther into distant fields in search of feed
d) Serves as an avenue for the youth to learn in the process
e) Fosters familial unity and communication

Attesting to the benefits of dividing the pastoral duties among members of his household, an elderly herdsman mentioned that "peace of mind" is what he gains by assigning the other duties to some household members. Precisely, this is what he had this to say:

> *Usually we have to wake up at dawn and prepare for journeying into the bush. While am away from home I always have peace of mind. I am always rest assured that other duties will be handled appropriately. This allows me to be focused on the distance that I have to go that day. (Discussant, FGD, 08/10/2017, Kpongu)*

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The downside of this indigenous adaptation strategy is that as the youth are denied some opportunities. As the youth are assigned their task of tending to a section of the animals, they are denied the opportunity to have formal education and to develop their talents and potentials. Their world view becomes limited to a pastoral livelihood, as opposed to having a chance for other economic endeavours and thus their achievements in life become tied to the success of the household herd.

Stress management

Increases in temperature from greater solar radiation stresses cattle while the resultant moisture deficits puts pressure on grazing fields. These make animals vulnerable and sensitive to a number of exposures. Probing the strategy of stress management further during a focused-group discussion with herdsmen, they were undivided on the fact that solar radiation causes more stress in cattle as compared to the distance that they traverse every day. They mentioned that it is much better to have a little feed for the animals and then move them to a shade, than

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keep them in the sun. Feeding them all day would not compensate for the stress that the animals would suffer. To achieve optimal stress management, herdsmen in Kpongu use a variety of strategies. The main objective of these strategies is to reduce heat/temperature among their cattle. Herdsmen believe that temperature levels is the major determinant of stress levels, rather than the distance that the animals are made to traverse. Thus to effectively reduce stress among animals is to reduce their exposure to heat. The indigenous strategies in this regard are: (i) siting kraals near or under a tree for shade, (ii) building bigger kraals and (iii) the formation of sub-herds which are discussed in the succeeding sections.

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(i) Constructing kraals near or under a tree

A shady tree is usually identified in the neighbour that is not too far from the homestead. Hitherto, a kraal is sited in the open without paying attention to the exposure of the animals to solar radiation. When animals are camped under a tree, they are protected from the sun by the shade that the tree and/or its leaves provides. Speaking on the benefits of siting a kraal under a tree, a herdsman mentioned during a key informant's interview that,

> *When cattle are camped under a shade, there is less dehydration among them and thus no need to frequent a water source. While in a shade, the cattle are able to retain energy in them because there is little or no stress. Also, they are offered the opportunity to regurgitate food that was previously eaten. (Key Informant, 20/10/2017, Kpongu)*

Explaining further, the key informant mentioned that cattle are only able to bring back cud properly and with ease when they:

(i) Have first of all, eaten enough
(ii) Are stationary and inactive, i.e. standing still in one place, and
(iii) Are under or in a shade

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Cattle are ruminants and are thus able to bring back cud (the portion of food which is brought back into the mouth from the first stomach) to be chewed the second time. This is what they do when allowed to rest in a shade. Kraal location is a visible component of the stress management strategies among herdsmen. The nature and location of kraals was observed in the study area to be sited according to the descriptions by the herdsmen. Cattle that are kept within a shade are shielded from the rays of the sun until they are taken out for grazing.

Figure 12: Kraal of sub-herd sited under a tree and fenced with thorns

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Source: Field work, Kpongu, 2017

(ii) Building bigger kraals

This is another strategy of stress management that involves the kraals. When the animals are so many and become overcrowded, their bodies generate heat that adds to the high temperatures of the environment. The herdsmen have demonstrated knowledge of this and understand that the animals should not be crowded, and should be able to move about freely within the kraal. To this end, the herdsmen would often rebuild with the aim of expanding their kraals to make

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them spacious. During a focused-group discussion with herdsmen on the construction and expansion of kraals, this is what one discussant had to say:

> *The kraal has to be expanded every three to four years. The trick is to create a kraal that is big enough to hold about twice the number of animals that it is being intended for. The heat within the kraal reduces when a lot of cows have delivered young ones, since they are separated from the main kraal.* (Discussant, *FGD*, 14/11/2017, Kpongu)

The time frame of three to four years for the rebuilding and/or expansion of kraals is dependent on some variables such as the number of calves that are born in a year, the mortality rate among young and matured cattle and the total number of sales made from the herd in a year.

This stress management strategy is effective to the extent that it provides enough room for ease of movement by the cattle. A spacious kraal means that, the animals will not be congested and as a result, their bodies do not produce heat. An airy kraal means that the animals are not likely to suffer from stress. The challenge that has been identified with this strategy is the scarcity of logs that have historically been used to make the kraals and the burden of conveying such logs from the bush to the kraal sites at home. Through the cattle owners, some herdsmen are able to afford and use wire mesh and metal poles as the materials for their kraals.

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(iii) Separation and Formation of sub-herds

This is the third stress management strategy. In separation of animals or in the formation of a sub-herd, the selection criteria is to identify cattle that are predisposed to stress. These categories of animals are those that cannot remain with the main herd. By their nature, the other animals would cause them more stress, trample on them and possibly cause their death. Animals that are often separated or for which a sub-herd is formed include:

a) Sick animals
b) Pregnant cows

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c) Lactating cows
d) Wounded animals
e) Weak animals and
f) Calves (i.e. newly born cattle)

A sub-herd is simply a segment of the animals that are housed in a smaller kraal(s) close to the main kraal. The sub-herds are usually formed for some category of animals, determined by their age, level of endurance and their general state of health.

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The formation of sub-herds is somewhat distinct from separation of animals even though both strategies are aimed at relieving the stress of animals. Whereas a sub-herd maybe formed to comprise of young, weak and pregnant animals, separation involves taking aside lactating cows, wounded animals and sick ones. Even though both strategies are done according to the distance the animals can traverse, one strategy does not involve moving the animals from the homestead. The animals in a sub-herd (young, and/or more predisposed to stress) are taken out to the immediate surroundings in search of feed and water while separated ones (sick cattle, calves, lactating cows and wounded animals) are tied up at home without necessarily building a kraal for them.

Contributing to a discussion during a focused-group interaction, one herdsman, while corroborating the benefits in stress management as his colleagues have said, he added that he dreads the formation of sub-herds. This is because the process adds to the amount of work that has to be done each day. This is what he had to say:

> *Every herdsman wants his cows to deliver so as to increase the number of animals in his herd. But when they are pregnant or lactating they need special care, and I dread having to make another kraal to house them. The pain is in the fact that you have no need for that kraal after a few weeks. (Discussant, FGD, 14/11/2017, Kpongu)*

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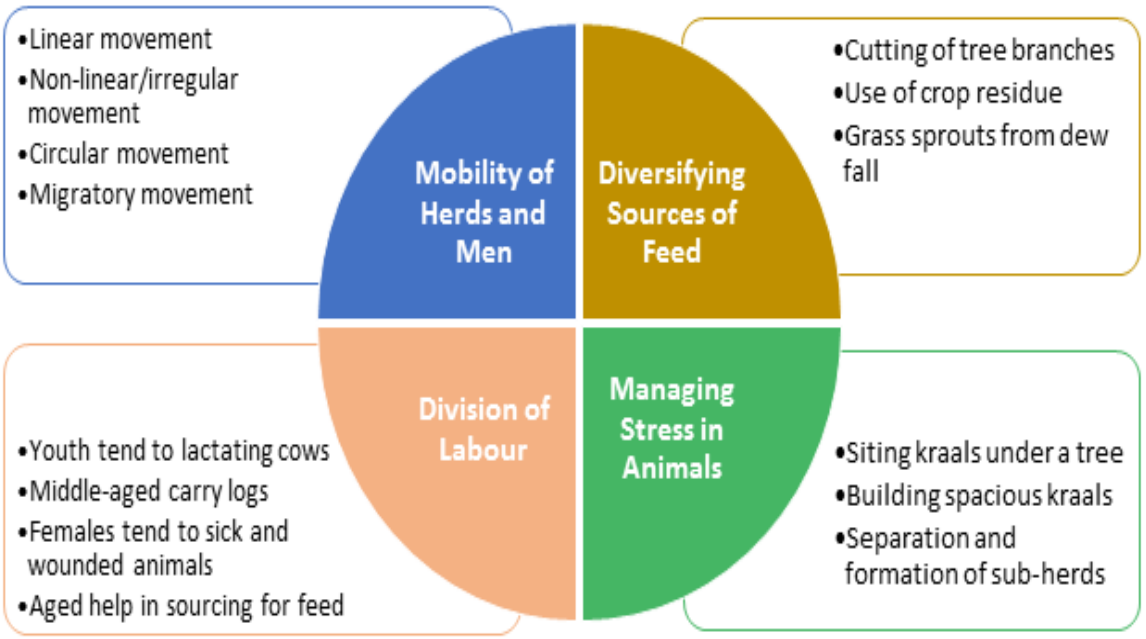
Comparative Analysis of Adaptation Strategies

From the analyses, the various indigenous adaptation strategies used by herdsmen can be grouped into four (4) broad categories. These include movement of herders and cattle, feed based strategies, labour and stress management (Figure 13).

Figure 13: Indigenous adaptation strategies to climate change



Source: Author's construct, 2018

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The various indigenous adaptation strategies stand limited in a number of ways and the herdsmen face numerous challenges in the practice of these strategies. The challenges are not only faced by the herdsmen. Directly or indirectly, there are some challenges for the wider community, the natural environment and other animal species that depend on the environment for food and shelter. There would be challenges to the extent that the various adaptation strategies are limited in geographic scope, in terms of topography, dependent on the natural environment for resources, the effects on the animals and also limited by the fact that it is race against time and the vagaries of nature and the weather.

- Remote distances to be traversed in order to get leaves of some tree species

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- Leaves from trees carry disease pathogens on them
- Confrontations with dry season farmers over space at river banks.
- Remnants of chemicals from their use in dry season farming at river banks cause animals to fall sick
- Non-economic tree species are becoming extinct and so herdsmen are trying some economic tress such as mango leaves.
- Pruning of tree branches is destroying the limited forests and plant cover
- Confrontations with some farmers over the cutting of tree branches in or around their farms. The Assemblyman for Kpongu Electoral Area, Hon. Yakubu Salia, bemoaned the number of such complains and hostilities that have come to his attention. The farmers, particularly yam farmers, need the fresh leaves from various plants for mulching and the tree branches for staking the geminating yams. This competing need would often result in confrontations between herdsmen and farmers.
- Similar to the confrontations between herdsmen and yam farmers, the Assemblyman also spoke about another challenge which is complains by food crop farmers. It is to the effect that their crop residue is often eaten by animals. These crop residue according to the farmers play a critical role in maintaining soil fertility and keeping the soil moist and loose until the next cropping season. When they are eaten up, the soil is said to harden up and fertility is diminished.

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The limitations of each strategy prompted the need for ranking these indigenous adaptation strategies according to their importance for adaptation. Pairwise ranking (sometimes referred to as preference ranking matrix) was employed during a focus group interaction with herdsmen to prioritise the list of indigenous adaptation strategies (Table 3). The strengths and benefits of each indigenous strategy was marched against all others and the process had to be repeated for

all the strategies that were listed in rows and columns, within a tabular graphic representation. It is a tool that helped the herdsmen to brainstorm and come to consensus on priorities without recourse to voting on issues. The various broad categorisations of the indigenous adaptation strategies are listed in a grid of row and columns, listed in the first column and across the top in the first row. During a focused group discussion with the herdsmen, two adaptation strategies are taken at a time and the herdsmen were asked which of the two was more important to the survival of their herds in the light of climate change impacts.

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When there are arguments among the herdsmen about a choice, this was skipped and returned to later. If the arguments continued upon returning to a particular set of adaptation strategies, the letters assigned to both of them are recorded and taken as a tie. This was the case when comparing division of labour and diversified feeding.

Table 3: Pairwise ranking of indigenous adaptation strategies

Broad categories of indigenous adaptation strategies	Stress Management (SM)	Diversified Feeding (DF)	Mobility (M)	Division of Labour (DL)	Total score	Rank
Division of Labour	SM	DL/DF	M	DL	1 ½	3RD
Stress management		SM	SM	SM	3	1ST
Diversified feeding			DF	DF	2	2ND
Mobility of herds and men				M	1	4TH

Key: Division of Labour (DL), Mobility (M), Diversified Feeding (DF), Stress Management (SM)

From the table of scores and rankings (Table 3), herdsmen identified stress management as the most effective and reliable indigenous adaptation strategy in comparison with the others. The herdsmen agreed with the ranking because, according to them, the level of stress is central to

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the survival of their herds. They mentioned that an animal can go without food or water for at least two (2) days but cannot withstand stress for the same length of time. In their estimation, it is better to let the animals feed a little and then seek shelter under a shade than to stay in the heat of the sun all day because of feeding. Cattle are ruminants and are thus able to bring back cud (the portion of food which is brought back into the mouth from the first stomach) to be chewed the second time. This is what they do when allowed to rest in a shade.

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4.2.3 District Development Planning and climate change adaptation needs of herdsmen

To address the question of how and to what extent district development planning is addressing climate change adaptation needs of the herder community, this analysis is structured in two main parts. The first part analyses the empirical results on the extent to which herdsmen participate in the community consultation phase when district development plans are being prepared. The second section draws on content analysis to show the extent to which the plans address herders' climate change adaptation needs.

Community consultation and participation in the planning process

During data collection in the community, the question of consultative engagements during the preparation of district development plans was put to the herdsmen of Kpongu during a focused group discussion. The herdsmen responded in the negative. They expressed their desire to have some participatory interactions with staff of the Assembly (i.e. the plan preparation team). The herdsmen know fully well that it is such a forum that will offer them an opportunity to communicate their needs and concerns. Speaking on the matter, one discussant mentioned:

> *We have never been part of any meeting with the Assembly people. All these years, nobody has invited us to sit and discuss the frustrations that come with our kind of work. Most of our time is spent in the bush with our herds. If there are meetings in our community, then they always happen when we are in the bush (Discussant, FGD, 14/11/2017, Kpongu).*

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The herdsmen however noted that they were once invited to a meeting and those present were the chief of Kpongu, the police hierarchy, the Municipal Assembly officers, immigration officers and other community members who could attend. The purpose of that meeting, they said, was to address issues of conflict and trans-border movement of cattle and had nothing to do with climate change and their adaptation needs.

For many of the herdsmen, it was a surprise to hear that their views on climate change and their adaptation needs should have been sought by the Municipal Assembly at the time of planning. Expressing his frustration about not being consulted in any way during planning, another herdsman stated that:

> *The only time we see workers of the Assembly is when it is time for them to go round and collect 'lampoo' (cattle rates). The big men themselves do not come to meet us. They send other officers who come every year without fail. They usually visit in the company of veterinary officers who routinely vaccinate our animals (Discussant, FGD, 14/11/2017, Kpongu).*

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Probing further, one herdsman spoke about the kind of relationship that exist between them and the Assembly. He mentioned that their relationship is not pleasant, and that in some years, it is almost hostile. In his opinion, the 'lampoo' that the officers collect from them is inflated because they (the herdsmen) know how much is being charged per animal if that animal belongs to people of different ethnic extraction. Recounting the unfriendly interactions with officers of the Assembly, he narrated how they are often even accused of bush fires. He indicated that:

> *Any time the assembly workers come into the community, particularly during the dry season, they often accuse us of setting fire to the bushes. Sometimes we hear them make these allegations over the local radio stations. Our animals are able to feed on dry grasses and straw. It is unimaginable how someone would therefore suggest that we are to blame for the many bush fires. (Discussant, FGD, 14/11/2017, Kpongu)*

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From the many narrations of the herdsmen, it is evident that there has never been any form of consultation with herdsmen during the preparation stages for the compilation of the various MTDPs. It would thus be very difficult to adequately represent the views of this minority community, particularly their climate change adaptation needs since no participatory engagements on the phenomenon ever took place.

Institutional level interviews confirmed the lack of engagement with herdsmen in pastoral communities. For instance, the Assistant Planning Officer of the Wa Municipal Assembly mentioned that:

> *The Assembly often seeks to interact with persons such as the assemblymen, chief, and religious heads who are leaders in the various communities. They know their community and can speak to the development aspirations there. Different segments and interest groups in the society such as farmers, weavers, herdsmen, fishermen, traders and many others are not necessarily scheduled to meet separately with the plan preparation team* (Assistant Planning Officer, Wa Municipal, KII, 12/09/2017).

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Speaking further on the nature of consultative processes, the Assistant Planning Officer stated that even though there is no avenue for a particular group to meet with the plan preparation team, various meetings are organised for large communities or a cluster of settlements, usually every four (4) years. The purpose of such interactions, according to him, is to validate problems that have been previously mentioned. Describing such an event, he detailed that:

> *Engagements with the plan preparation team are demand driven. When a community is organised and ready to meet us, we move there. The turnouts are often encouraging and we respond to a wide range of issues. There is no specific forum that is organised solely for herdsmen (*Assistant Planning Officer, Wa Municipal*, KII, 12/09/2017).*

Probing further about the communication channel that the Assembly uses to reach community members, it became clear that information is carried back-and-forth by the assemblyman of each community. Justifiably so, such persons are usually literate, they appreciate the inner

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workings of the Assembly, are accustomed to the office environment and are already familiar with the personnel that work in the offices.

Preliminary discussions with the Assistant Planning Officer at the Municipal Assembly indicated that he fully understands that climate change is manifest in the Municipality and the Upper West Region as a whole. Similarly, he agreed that the pastoral families are not just a minority group but also confined to the countryside and thus, are most affected by the impact of climate change. Probing to know why such a marginalised group and one that is most vulnerable to climate change and climate variability is not involved at all, the Assistant Planning Officer lamented about the challenges that face at the Assembly. He also revealed that there are many communities within their jurisdiction and this accounts for the fact that it is not feasible for the plan preparation team to interact with all interest groups. He mentioned that:

> *Even if there are enough staff at the Assembly to interact with every minority group, the Assembly works within a budget and has logistical and other constraints. There are also time limitations regarding the gathering of information. The Wa Township alone has 37 sections and there are over 40 communities within the municipality. It is just not feasible to meet every group that is engaged in a livelihood activity (*Assistant Planning Officer, Wa Municipal*, KII, 12/09/2017).*

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As part of his concluding remarks, the Assistant Planning Officer assured that there are continuous dialogue channels that are opened, making reference to a communication plan (Table 4) which is attached to the MTDP (2014-2017). This is a schedule of planned interactions with community members when the MTDP is complete. If herdsmen are not consulted directly during planning, this he said is another opportunity for them to make inputs during the communication stage. They can present their concerns if they feel that their community leaders did not represent their interest very well.

Table 4: Communication plan of the MTDP (2014 – 2017)

Activity	Purpose	Audience	Method/Channels
Community sensitisation	To create awareness on the MMTDP, progress reports on implementation	Community members, Traditional authorities etc.	Zonal/urban council meeting, Community durbars, drama, role play etc.
Meeting with Political leadership	To get them to appreciate the MMTDP, to update them on the status of implementation	MCE, PM, MPs and chairpersons of the sub-committees	Meetings with audio visuals, round-table discussion and PowerPoint
Meeting with Development partners	To appreciate the MMTDP, collaborative proposal writing and implementation	NGOs, CBOs, FBOs, Donor agencies, Private sector	Meetings with audio visuals Round-table discussion and, PowerPoint.
Meeting with traditional and opinion leaders	To create awareness on the MMTDP, progress reports on implementation	Chiefs, women, youth & religious leaders	Workshops
Meeting with organised associations	Appreciate the MMTDP, Collaborative proposal writing and implementation	Women, farmer, SME, youth & disable groups	Workshops
Meeting with the media	To create awareness on the MMTDP, Progress reports on implementation	Radio stations, TV stations, Print media, Electronic Media	Meetings with audio visuals, round-table discussion and, PowerPoint.

Source: Wa Municipal MTDP 2014-2017, pg. 113

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The principle and significance of a communication plan to disseminate the intended projects cannot be over emphasised. Community sensitisations are mainly intended for the community members where further awareness is created and the progress of the MTDP is communicated. This is reportedly done using durbars, drama and role play. From the MTDP 2014-2017, communicating the progress of a plan is the responsibility of the Municipal Planning Officer (MPO), Municipal Planning and Co-ordinating Unit, the Municipal Coordinating Director (MCD) and a standing communication committee. According to the MTDP 2014-2017, the

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stated timeframe for such community sensitisations to report on the progress of implementation of a plan is quarterly and yearly meetings.

Both plans (MTDPs 2006-2009 and 2014-2017) mentioned that various forms of community engagements were undertaken. The preparation of the MTDPs were done using information and concerns that are mainly "*generated from grass root activities and community level planning exercises*" (Wa MTDP 2014, pg. 4) using "*participatory and collaborative approaches*" (Wa MTDP 2006, pg. 13). The processes were said to ensure the participation of greater percentage of the population of communities including opinion leaders, women, children and the physically challenged. For the 2014-2017 MTDP, the community level planning process as well as the review of the previous plan's implementation process were supported by the United Nations International Children Emergency Fund (UNICEF).

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It was evident from the two development plans that the extent of community-level participation and consultative engagements go only as far as the opinion leaders of each community. None of the MTDPs has any mention of a direct engagement with herdsmen or any such pastoral group that could represent their interests.

Addressing herdsmen's climate change adaptation needs in the MTDPs

The findings from content analysis of the Medium Term Development Plans (MTDPs) largely show that the plans did not address the climate change adaptation needs of herdsmen. To proceed with the analysis, an overview of the climate change adaptation needs of these herdsmen is first presented, this is then followed by an analysis of the results from the content analysis.

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Climate change adaptation needs of the herders run through a spectrum of themes that are mainly territorial issues, resource needs and legislative gaps. Primarily, at the heart of pastoralism in any jurisdiction is the availability of sufficient feed and sources of water. Accessibility of fresh and nutritious grass species in Kpongu is threatened and negatively impacted by climate change and other human-induced land use activities. A prolonged dry season, frequent dry spells and bush fires (which is a human induced factor) aid the formation of iron pans that ultimately affects the moisture and fertility of top soils. Grasses are becoming stunted and less concentrated per unit area. Consequently, the availability and quality of feed is impacted even in the wet season. The ripple effect is that, men and herds are compelled to trek longer distances which increases the stress susceptibility in animals.

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Another adaptation need that is occasioned by climate change and climate variability is constant water availability for herds. The herdsmen narrated that water bodies in the community are shrinking in size over the years. Dams and ponds are unable to hold enough water through the dry season. Sources of water in the community are reduced to a suspension of particles during the dry season and eventually become a muddy marsh. In these conditions, the sources of water are unwholesome for intake of herds.

It is these and other climate change adaptation needs that the various MTDPs are here forth being reviewed to evaluate how the plans are identifying and addressing the needs of herdsmen through the implementation of targeted projects and strategies to benefit the whole Assembly in the long term.

From content analysis, the 113 pages MTDP 2014-2017 is a very inspirational and a pro-development document, considering the mention of the fact that the methodology of the plan

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was "*generated from grass root activities and community level planning"* and that the whole process *"ensured the participation of greater percentage of the population of communities including opinion leaders, women, children, the physically challenged etc"* (pg. 4). Such inspirational phrases are however not captured in the 204 paged document of the 2006-2009 MTDP.

In its preamble, the MTDP 2014 - 2017 is set to serve as a guide to facilitate the development process in the Municipality, so as to:

> *"Achieve food security thereby reducing poverty, create employment opportunities and improve average incomes distribution and the welfare of the people irrespective of gender, ethnic, political or religious diversity"*

which is believed will lead *"to an integrated economy and the realisation of its full benefits"* (MTDP, 2014-2017, pg. 2). Similar ideas are expressed in the introduction of the MTDP of 2006-2009.

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Collecting and analysing data from so many primary and secondary sources the plan of 2006-2009 has six chapters while the MTDP of 2014-2017 has been organised into seven chapters with some current development priorities, that are captioned as thematic areas and include: (i) Ensuring and sustaining macroeconomic stability, (ii) Infrastructure and human settlements, (iii) Accelerated Agricultural modernisation and sustainable Natural Resource, (iv) Enhancing competitiveness of Ghana's Private sector, (v) Human Development, productivity and employment and (vi) Transparent and accountable governance.

Following these development priorities, the MTDP 2014-2017 has a detailed matrix that gives an analysis on each priority, spelling out the key development issues, Potentials, Opportunities, Constraints and Challenges (POCC framework). A litany of development issues are then linked

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with the development focus of the plan as they correlate to six thematic areas (pg. 81). It is within the confines of all these parameters that the review is done to reveal whether planning for the Municipality has taken into account the needs of herdsmen relative to climate change and their indigenous adaptation to same.

The mention of herdsmen in the MTDPs

The term 'herdsmen' appeared only once in each of the MTDPs. In page 117 of MTDP 2006-2009, the term is used with indication that their activities are a constraint to "*improving soil fertility*". In section 1.2.2 of the MTDP 2014-2017 that is titled the "natural environment", the term has been used in the context of people from Fulani extraction and that their activities of pastoralism tend to affect the natural environment. Precisely the MTDP, 2014-2017 states that:

> *"The Fulani herdsmen through the open grazing of livestock also affect the natural environment … and new settlement imply that agricultural and grazing land is being used up."* (pg. 16).

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The MTDP 2006-2009 also makes a similar claim that activities such as grazing of livestock affect the natural environment and concludes that "*the overall effects of the above factors have developmental implications"* (pg. 32). The plan goes further to say that "*current means of rural livelihood (the traditional farming & animal rearing methods) need transformation*" (pg. 32). This admission of the need for transformation of rural livelihoods is a very significant step that would pave way for the design and implementation of policies, strategies and development interventions.

In terms of strategies and interventions, what is provided in the MTDP 2006-2009 as a solution to over grazing is that, "*animal ranching and housing will protect the natural vegetative cover*"

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(pg. 32). The MTDP 2014-2017 also goes on to discuss some developmental implications of the current environmental situation and reflects the need for the

> *"formulation of strategies for alternative means of livelihood to the traditional farming & animal rearing especially for the rural dwellers; public education on … bush burning, shifting cultivation, and over grazing; and the promotion of … animal ranching and housing"* (pg. 16).

The strategies of public education on bush burning and over grazing on the one hand and then the promotion of animal ranching and housing on the other hand are certainly very practical interventions and somewhat goes to the heart of the climate change adaptation needs of the herdsmen. Where the incidence of bush fires was mentioned as a key development issue, the existence of environmental policies/programmes on bush fire prevention and trained volunteers as bush fire squad was mentioned as the potential for dealing with it. As an opportunity to the Assembly, educating the general public on the need to prevent bush burning was mentioned in the MTDP 2006-2009, (pg. 110). A similar strategy of "*awareness creation*" was mentioned in the MTDP 2014-2017 (pg. 81). Noble as these strategies are, their implementation was not corroborated during interviews and focus group discussions with the herdsmen of Kpongu. The herdsmen did not hold back in saying that they haven't had any strategy-based collaboration with or intervention by the Assembly.

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Describing the physical features of the Wa Municipal Assembly, the MTDP 2014-2017 mentioned one of the climate change adaptation needs of the herdsmen. The plan stated that

> "*the streams are seasonal and thus dry up during the long dry season thereby reducing available water for agriculture and other uses such as domestic, industrial and construction*" (pg. 15).

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The MTDP 2006-2009 also mentioned variously in pages 109 & 110 the issue of prolonged dry seasons as a development challenge without any connection to the activities and needs of herdsmen.

Climate change, impacts and adaptations in the MTDPs

In the MTDP 2006-2009, there is neither any mention of climate change, nor its impacts and adaptation. There is no mention or discussion at all. The MTDP 2014-2017 however came as an improvement as it made space for some acknowledgement of the phenomenon. Section 1.2.15 of the MTDP 2014-2017, actually has the heading "climate change" that discussed the dimensions of climate change and also touched on the causes, and in that light, mentioned that, *"global pollution of the ecosystem and over exploitation of the natural reserves have combined to bring about severe climatic conditions"* (pg. 34). The section also mentioned some manifestations of climate change including *"droughts particularly in the year 2013 which affected production of crops and livestock rearing"* (pg. 34).

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Under the thematic area of accelerated agricultural modernisation and sustainable natural resource, the MTDP 2014-2017, mentioned one of the municipal strategic objectives committed to *"promote community adaptation to climate change impacts"* (pg. 81). Two climate-change-specific strategies mentioned for achieving this objective are to:

- *Create awareness on climate change and its effects and*
- *Implement alternative livelihood strategies to minimise climate change impacts* (MTDP 2014-2017, pg. 81)

In furtherance of this thematic area, a sector based activity was outlined that would "*sensitise farmers on climate change, water management and safety use of agro-chemicals*" (pg. 101).

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This sensitisation was intended to be undertaken throughout the Municipality. Four (4) of such sensitisation events were scheduled in the plan to take place each year from 2014 to 2017, making a total of sixteen (16) community sensitisations on climate change. For the purpose of these exercises, Twenty Thousand Ghana Cedis (GH¢20,000.00) was budgeted and indicated to be funded by the Government of Ghana and donors. The implementation agencies that were assigned the responsibility of community sensitisation on climate change are the Ministry of Food and Agriculture (MoFA), Savannah Accelerated Development Authority (SADA) and the Northern Rural Growth Project (NRGP) while the Municipal Assembly play a collaborating role (MTDP 2014-2017, pg. 101).

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Strategies and interventions in the MTDPs and their implementation

Focusing on the two MTDPs as a composite, the means of rural livelihood including traditional crop farming and animal rearing were issues that were said to need some transformation. The challenges of the environment were also mentioned without specific connection to the activities and climate change adaptation needs of herdsmen. It is however the case that most of the challenges that confront the physical environment also undermine the activities of herdsmen. The challenges stated included drought, prolonged dry seasons, bush fires and the seasonal nature of water bodies that cause them to dry up before the next rainy season.

To address the stated challenges, a number of strategies and development interventions were proposed. Most of the interventions were not given stipulated durations, budgeted amounts and no indication of the officers or department that had the responsibility for implementation. Some of the strategies and interventions in the MTDPs are:

- Education/awareness creation on bush fires (MTDP 2014-2017, pg. 81).
- Use of bush fire volunteers squad (MTDP 2006-2009, pg. 110).

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- Community sensitisation on climate change (MTDP 2014-2017, pg. 101)
- Introduction and promotion of animal ranching (MTDP 2006-2009, pg. 32)
- Sensitisation to promote community adaptation to climate change and impacts (MTDP 2014-2017, pg. 81)
- Awareness creation on water management (MTDP 2014-2017, pg. 101)

There is also a mention of the introduction of alternative livelihood strategies to help minimise climate change impacts (MTDP 2014-2017, pg. 81). However no further specifics were provided regarding the kind of alternatives, their locations, the time frame, target population, monitoring team, funding requirements and the sources, for effective implementation.

Under the thematic area of accelerated agricultural modernisation and sustainable natural resource, the MTDP 2014-2017 mentioned the *"reduction of climate change impacts"* (pg. 77) without also giving any practical and measureable steps that should be taken to achieve this development focus within the 2014-2017 development time frame. Of all the itemised strategies that were mentioned, it is only the planned 16 community sensitisations on climate change impacts that detailed the timeframe, the budgeted amount, funding source and the implementation departments assigned the responsibility of sensitisation (MTDP 2014-2017, pg. 101).

In discussing the success or otherwise of these interventions in terms of implementation, it is important to state that the development interventions were proposed without mentioning the groups that suggested them or presented the challenges to begin with. They were just mentioned under various thematic areas that have no direct connection with the activities of herdsmen or their climate change adaptation needs. That being said, the narratives of the herdsmen were that they have not had any interactions with workers of the assembly to elicit their views,

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challenges and climate change adaptation needs. They maintained that the only time they see assembly officers in their community is when they collect property rates and taxes on cattle ownership. The only strategy that they identify with, is the education on bush fires which they agreed has been ongoing on the local radio stations. From the narratives of the herdsmen regarding their general pastoral challenges, awareness creation over the local radio stations alone would merely scratch the surface of their climate change adaptation needs.

Indeed field work in the community of Kpongu revealed that no such community sensitisation event took place, at least not in the form of a physical or face-to-face interaction, and none of the other strategies and development interventions that have being listed were implemented, at least none involving the herdsmen, relative to climate change impacts, adaptation needs and water management for which monies were budgeted.

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4.3 Discussion of results

4.3.1 Climate change perspectives and experiences of herdsmen

The key findings in respect of herders' perspectives on climate change is that the dry season is becoming longer each year. The duration has increased from about five (5) months to seven (7) months. Furthermore, dry spells during the rainy season have become more frequent and last longer. Furthermore, the results also show that climate change is causing the water bodies in their neighbourhood to shrink in size and triggering the formation of iron pans on top soils. The results also reveal that climate change has negatively affected vegetation. There is less concentration of grass and that grasses are affected by stunted growth and their stalks have become smaller. These key findings will be discussed in the ensuing section relative to what other researchers have done.

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One of the key findings is that, there have been longer dry seasons, frequent and longer dry spells, as compared to what it had been in the past. There are some works that have been done in this area. Boer and Faqih (2004), in their study of precipitation changes that are occurring in parts of Indonesia reported that rainfall has decreased and is projected to continue to decrease and can lead to prolonged droughts. Annual precipitation overall has decreased by 2 - 3 percent across all of Indonesia over the last century. They also reported that there is significant spatial variability particularly in the southern regions, e.g., Java, Lampung, South Sumatra, South Sulawesi, and Nusa Tenggara. There has also been a shift in the seasonality of precipitation and changes in the timing and seasonality of rainfall is projected to change (Boer and Faqih, 2004).

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Some recent analysis of data from the Indonesian regions also suggests that there is an increased likelihood that the annual monsoon could be delayed by 30 days because of changes in regional climate and a substantial decrease (up to 75%) in rainfall from July–September (Naylor et al., 2007). Consequently, regions of Indonesia with decreasing rainfall might be exposed to high drought risk, and the frequency of extreme events might increase (Boer and Faqih, 2004). Even though the works of Boer and Faqih (2004), did not involve the experiences of pastoralists, their evidence and conclusions corroborate the narratives of the herdsmen in Kpongu. That is, there is a change in seasonality and that the rains are delaying due to climate change. Whereas their methodology involved climate change modelling and technology-based simulations using time series data, this research relied on primary sources, that is, narratives of the experiences and perspectives of herdsmen about climate change.

In the area of dry spell occurrences and analysis, much of the literature is related to cropping activities. That notwithstanding, the various findings still corroborate the narratives of the

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herdsmen of Kpongu. For instance, a study in India investigated the mean Starting Date of Critical Dry Spells (SDCDS) and the mean duration of the critical dry spells. Undertaken by Taley and Dalvi (1991), this study used daily rainfall data of 22 years (1965-1986) for nine stations in Vidarbha region of India. Their findings showed that dry spells were not only frequent, but also that the intensity was higher over the years. Just as in Kpongu, the months of July, August and September record the most rains in the Vidarbha region. For these months, the study found that the first critical dry spell commenced on the first or second week of July with the length varying from 12 to 25 days. The second critical dry spell started during the second week of August with length varying from 18 to 40 days. The corresponding value for the third critical dry spell was the first week of September with the length ranging between 15 to 50 days (Taley and Dalvi 1991). Although the study provided predictions on SDCDS, this was not based on a specific statistical distributions or statistical methodology. Furthermore, some predictions made were not validated for an independent set of data.

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Another experience and impact of climate change is shrinking sizes of water bodies in the Kpongu community and this phenomenon has been reported as experienced in some parts of the African continent. In Africa's large catchment basins of Niger, Lake Chad and Senegal, the total available water has already decreased by 40-60 percent, and desertification has been aggravated by lower than average annual rainfall, runoff and soil moisture, especially in Northern, Southern and Western Africa (UNFCCC, 1992). The consequences for water supply include smaller flows in springs and rivers.

Water supply is changing. Almost 67 percent of the glaciers in the Himalayan mountain ranges, the source of major rivers in India, have retreated in the past decade (Lal, 2001). For India, climate change and consecutive droughts in 1999 and 2000 led to a sharp decline in water tables

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in the northwest, and the 2000-2002 droughts caused crop failures and shortage of water sources for livestock, leading to great impacts on over 11 million people in Orissa (Cruz et al, 2007).

In 2007, Noah D. Hall and Bret B. Stuntz prepared a report on behalf to the American National Wildlife Federation, regarding the state and future of water resources in the Great Lakes region of America. The report begun by noting that the science and evidence of climate change is compelling. The first part of this report focused on how climate change is impacting water resources. It explores how a changing climate is impacting on the Great Lakes, including lowering of lake levels, impacts on fisheries, changes in Great Lakes shorelines, reduction of groundwater supplies, loss of ice cover and shrinking surface area. The stress of reduced water supplies is compounded by expected increased demand for water unless water conservation laws and policies are adopted. The report concludes by stating that most climate models predict that Great Lakes water levels will drop during the next century; the frequency and duration of low water levels could increase, dropping water levels below historic low levels (Hall and Stuntz, 2007).

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In 2014, Laga Tong and others authored an article about the wetland ecosystem in the "Three-River Headwaters" (TRH) region of China. They began by stating that the region plays an irreplaceable role in "*water source conservation, run-off adjustment and biodiversity maintenance*" as recent assessments of wetland resources affected by climate change has raised enormous attention. Climate change is considered as one of the most important natural factors which affect wetland landscape patterns (Su and Wang 2012). Their findings showed that the wetlands have undergone great changes since the early 1990s. Swamps, streams and rivers showed a continuously decreasing trend particularly in the Yellow River and Langcang River

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basins. From the early 1990s to 2004, the decrease of swamps was mainly concentrated in Maduo County in the Yellow River source region, while the decrease of lakes, reservoirs and ponds mainly occurred in Maduo County. From 2004 to 2012, the shrinkage of all kinds of wetlands was concentrated in Maduo County in the Yellow River source region, the western parts of Zhiduo County and the northern parts of Tanggulashan County (Tong et al, 2014). Thus, this study also gives credence to the fact that climate change is impacting on water bodies, causing many lakes, ponds, rivers and reservoirs to shrink in size.

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Formation of iron pans on top soils is another impact of climate change and climate variability that has been experienced. Climate change have had stronger, permanent and unfavourable primary or secondary impacts on soil processes. Among these processes soil moisture regime plays a distinguished role. The literature on the modification of loose top soils into hardened iron pans as a result of the impacts of climate change is quite limited. The Soil Science Society of America (SSSA) is one society which in 2011 published some work although it mainly focused on the general effect of climate change on soils. The society fosters the transfer of knowledge and practices to sustain global soils. Among other things, their publication noted that climate change and particularly prolonged spells of heat and drought between rainy periods cause wilting, desiccation, and soil salinisation, which in combination reduce soil fertility and cause top soils to harden up.

Climate change impact on the nature and quality of forage has also been experienced in the form of stunted growth, smaller stalk sizes and less concentration of grasses. Whilst the effects of climatic variables on forage quality (e.g. Raymond, 1969; Seligman and Sinclair, 1995; Polley et al., 2000; Fales, 2007) and the role of genetic improvement (e.g. Vogel and Sleper, 1994; Casler, 2001; 2006) have been well documented, the effect of climate change resulting

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in stunted growth, smaller stalk sizes and less concentration of grasses have received little attention. The anticipated impacts of climate change on grassland systems and appropriate management responses have also been studied extensively, though the emphasis has been on European temperate and North American rangeland systems (Cambell et al., 2000; Morgan, 2005; Baron and Bélanger, 2007). Options for mitigation and adaptation have also been discussed in a European context (Humphreys et al., 2006).

Sautier et al. (2013) studied the vulnerability of grassland-base livestock systems to climate changes in South-western France, and also wrote on changes in seasonal forage boundaries, herbage production, and production gaps between seasons. Sautier et al. (2013) reported that as a result of climate change, and except for the spring, the simultaneous effect of temperature and increase in evapotranspiration affected the potential yield of grasses. In the spring, the reduced availability of water in soils suppressed or even nullified the thermal effect.

A number of authors also did some research relating to the effect of climate change on grasses. However, these works did not focus on the diminutive structure of grass species or the level of concentration of the grasses. For instance, in the Latin American region, the work of Magrin et al. (2007) focused on the sizes of grasslands and reported that in Brazil, climate change is particularly affecting livestock productivity because of changes in grasses and gazing fields. From 1996 to 2006, the total grassland area decreased from 177.7 million to 158.6million hectares, while in the same period cattle herds increased. Thomas, C. D. et al, (2004) also published generally that drought reduces plant productivity, induces widespread plant mortality and limits the geographic distribution of plant species without an assessment of the changing physical structure or spatial concentration of the gasses.

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4.3.2 Herdsmen's indigenous adaptation strategies to climate change

The key findings of this study show that there are various strategies that are being employed in climate change adaptation. These can be categorised into four (4) broad strategies namely, mobility of herds and men, diversifying sources of feed, division of labour for differential needs of herdsmen and stress management in animals.

Mobility of herds and men

The results reveal that mobility of herdsmen and their cattle is an important strategy for adaptation. Herdsmen distinguished between four (4) different forms of mobility strategies, namely: linear, irregular, circular movement around a water body and migratory movement. Mobility is imperative because grazing lands are being taken over by other competing land uses and the need to access water and sometimes markets. Without efficient mobility, pastoralism would be increasingly difficult and the profitability of livestock keeping would be critically undermined. Mobility of men and herds is carefully managed and relies on large social networks and the rapid gathering of information on the concentration of high quality pasture.

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Writing on *the role of pastoralists' local knowledge in rangeland management* in Eastern Sudan, Yasin (2012) mentioned that the most efficient climate change adaptation strategies include herd mobility, flexible stocking densities and diversification in animal species, as well as income generation activities. On herds' mobility among the Shukriya and Rashida tribes, Yasin (2012) touched on how local knowledge and experiences influence it. His work did not provide details of the various kinds of mobility, except to say that "they move to the north during rainy season and to the south during dry season" (Yasin, 2012, pg. 4). He made time and space for the importance of mobility, saying that through mobility pastoralists can access information on socio-spatial heterogeneity, animals' behaviour and performance, carrying

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capacity, spread of disease, quality and quantity of different plants species, and water availability.

This study is similar to the work of Yasin (2012) when he mentioned that mobility is considered as a strategy rather than just a kind of movement and that a huge task needs to be settled before pastoralists decide to the direction to move. When a movement is planned, an expert herder will do a surveillance that is accepted and trusted by the group, assured that it will be safe and beneficial to move. Another similarity is the advantages of mobility he cited to include that it is a risk management strategy, necessary for optimal utilisation of the meagre recourses that are varied over space and time. Diversification in animal species which was stated as an adaptation strategy is the point of departure between this research and the work of Yasin (2012). Whereas the pastoral tribes of Eastern Sudan would diversify their cattle species, this was not mentioned by the herdsmen in Kpongu.

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According to Scoones (1994) pastoralism in drylands across the world is based on mobile livestock keeping. This is economically the most efficient way, securing livelihood for large sections of the population and causing minimal ecological impact on the environment. In the discussion of herds mobility, Scoones (1994) challenged many previously held notions such as "tragedy of the commons", overgrazing, overstocking and "beyond carrying capacity". Falling short of mentioning the various mobility strategies, Scoones acknowledged the process of tracking and matching the available feed supply with animal numbers at a particular site, and places emphasis on the importance of mobility as a whole for maintaining opportunistic tracking of feed.

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In March of 2013, the Global Drylands Initiative (GDI) published a paper titled *Pastoralism and Mobility in Drylands*. Beginning with an admission that mobility can create definition problems, the GDI (2013) states that "mobile pastoralism" is a sophisticated technique to make the best use of ecological variability in one's environment and that mobility allows herdsmen to find vegetation which is scattered sometimes over long distances. There are many types of mobility and the degree of mobility may change according to environmental conditions, or household life cycle stage. The work of GDI (2013) pointed out some of mobility strategies. According to the GDI, mobility can be seasonal, regular as a pendulum between two well-defined pasture areas. It can also be nearly random, following erratic rain clouds, and rarely the same from one year to another. Movement can be up and down mountains. The GDI stated that a *Wodaabe* pastoral nomad household in Niger may move its camp every few days throughout the year (GDI, 2013, pg. 4). This kind of movement is clearly similar to the migratory movement that is embarked upon by the herdsmen of Kpongu every now and then.

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For pastoralists, migration is mainly influenced by livestock deaths and acute food shortage due to depletion of pasture and water for livestock. For example, during the severe droughts in 2000, the Maasai pastoralists moved as far as the slopes of Mount Kenya (approximate distance of 29 km) and the Aberdare ranges (approximate distance of 38 km) in search of pasture and returned to their base afterwards.

Diversifying sources of feed

To overcome the scarcity of green pasture for cattle, the herdsmen are also diversifying the sources of feed. They resort to cutting branches of trees to provide leaves, pods, flowers and fruits of the trees for the consumption of the cattle. Some of the trees whose leaves have become feed for cattle were given in the Waale dialect as *bornea* and *kakala*. With regards to pruning,

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the resourcefulness of young herdsmen become a principal element. Their agility, speed and light weight are essential in harvesting a good measure of leaves from a tree. As part of the diversification of sources of feed, the herdsmen also rely on crop residue which become plentiful in the aftermath of the season's harvest. The residue include those from crops such as maize, millet, groundnuts and beans. A third diversified source of feed is the reliance on grass sprouts within low lying areas that come up during the dry season. The sprouting of grasses is supported by dew fall in the valleys.

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There are increasing reports in literature on the evaluation of diversifying fodder and feeding resources (shrubs and trees) from ecosystems and a system to exploit local biodiversity of plant species: 16 species from the Philippines, (Moog, 1992b); 45 from Costa Rica, 40 from Guatemala and 20 from Colombia, (Rosales et al, 1992). For instance, Roggero, et al (1996) report that during the dry season, livestock (cattle, sheep and goats) in the Brazilian Caatinga woodland are forced to survive on the leaf litter of the unmanaged vegetation which has open parklands with sparse cactus. The survival of cattle on the litter of leaves in that Brazilian region is similar to what happens in Kpongu where tree leaves are cut by hand for cattle to feed on. The Caatinga woodland covers about 10% of Brazil (Hardesty, 1988). It is an arid region characterised by low rainfall and poor soils. The "coppice" in the woodland is managed under a bush fallow system and the growth has the ability to retain supply of adequate green foliage longer into the dry season than intact trees of the same species. Roggero, et al (1996) also reports on other local plant species that are used as alternative feed for cattle and other ruminants. The African palm (*Elaeis guineensis*) is one interesting and important alternative for the development of integrated livestock and a good illustration of the principles of adaptation and flexibility. About 20% to 30% of the harvested fruits of the African palm that is meant for oil production is rejected because of its low quality (unripe due to recent plantings)

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and used for animal feeding. Using rejected fruits as animal feed enables the system to support a higher stocking rate (Roggero, et al, 1996). Though the work of Roggero, et al, (1996) is extensive, there is no mention of food crop residue or the reliance on grass sprouts in valleys as alternative or diversified sources of feed for cattle as is the case in Kpongu.

Division of Labour for differential needs of herdsmen

The third adaptation strategy is division of labour for differential needs of the herdsmen. The impact of climate change also means that a lot more pastoral work needs to be done in order to sustain herds. To this end, a pastoral family would share their daily and seasonal tasks of tending to the cattle. Adults and the aged take the herd out into the distant fields in search for feed, the middle-aged and strong bodied herdsmen carry logs and build or repair kraals while the youth and females tend to sick animals, pregnant cows, lactating cows, calves and wounded animals. The tasks are shared according to the skills and abilities of each member of the pastoral household.

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Within literature, the continuous dynamic between factors suggests that the type of livestock in relation to the quality of labour categories available to the pastoral household is a critical issue (Behnke and Kerven 1984, McCabe 1988, Sperling 1985). These qualitative distinctions mean that various types of human labour for different livestock species have attributes which define their function within the pastoral system. Among many pastoral settlements in the arid and semi-arid field, labour requirements are sometimes met through sourcing for labour from other households, near or distant. This is known as ‘quasi-adoption’. A labour-deficient household makes up the difference by ‘borrowing’ a child from close relatives. This strategy has been widely reported; cases include the Gabra (Torry 1977), the Samburu (Sperling 1985), Ngisonyoka Turkana (McCabe 1988), Somalis (Behnke and Kerven 1984) and among the West

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African Woodabe Fulani and Twareg (Swift 1979a). The adopted children range between six and ten years of age and may remain with the adopters for several years, sometimes up to the time when they get married. There is no discussion in these aforementioned literature regarding the differential labour roles that are assigned to each member of the pastoral household.

It is Niamir's (1989) work that looked at the division of labour roles according to animal species and by the age and sex of the pastoral household. Given the "biological characteristics" of different cattle species, as well as practical considerations and social prescriptions which govern the social division of labour by age and sex, each cattle species is typically managed by different categories of household labour. Niamir (1989) notes that in the majority of cases, men and/or boys herd and care for large stock (camels and cattle), while women and girls tend small stock (goats and sheep) and are also responsible for milking. There are exceptions to this pattern, particularly in the extent of pastoral duties undertaken by women, but the point here is that within each pastoral society there exist cultural norms defining the most appropriate kinds of people for each livestock task. A state of disequilibrium between herd and labour can therefore exist not as a result of the inadequate number of people available to a household but as a result of the inappropriate kind of people available in the household. This observation has significant implications for pastoral sustainability (Niamir, 1989).

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In her study of the Maasai pastoral communities in Kenya, Elizabeth Edna Wangui, (2003) reported that the way livestock feeding labour is organised is a reflection of herd composition, grazing method (stall feeding versus range grazing), distance to pasture and labour availability in the pastoral household. Regarding grazing, women are more involved in grazing during the normal rainy and dry seasons. In periods of extended drought, the livestock are taken to the better watered Chyulu Hills (pg. 28) until moisture conditions at home become more

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favourable. “Long distance grazing orbits” could necessitate up to several months absence from the home. These orbits are also similar to the migratory movement that is practiced by the herdsmen of Kpongu. Because women have other responsibilities related to child care and home management, this longer grazing trips are done by men (Elizabeth, 2003, pg. 26).

There is a general consensus in the literature that males still spend more labour time on livestock activities than females. The difference in labour time between men and women may be related to the changing role of livestock as a measure of wealth. Males dominate grazing of herds of cattle, watering the herds and conducting activities that involve the treatment and prevention of diseases. Females dominate fodder and manure collection, milking and selling milk and grazing herds of small stock. Of these activities, time spent grazing mixed herds (cattle and goats) and on treatment and disease prevention varies significantly between males and females.

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Stress management

The results reveal that stress management in animals is the preferred adaptation strategy among the herdsmen. This is the fourth broad category of indigenous adaptation. Increases in temperature from solar radiation and the distances that they traverse every day stresses cattle. In the view of the herdsmen, it is better to have a little feed for the animals and then move them to a shade, than keep them in the heat of the sun. Feeding them all day would not compensate for the stress that the animals would suffer as a result. To minimise stress levels in animals, the alternatives for herdsmen are siting kraals under trees, building more spacious kraals and the formation of sub-herds to reduce congestion and heat levels or a combination of these.

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The work of Belsare and Pandey, (2008) in India states that emphasis is given to proper water supply and proper animal housing to reduce or to manage heat related stress. Shades of trees provides an ideal protection from "radiant heat". The principles for creating an optimum microenvironment for cattle is to reduce heat gain and promote heat losses from the structure. Belsare and Pandey, (2008) reports that water intake is increased for dairy animals in particular during time of heat stress to dissipate heat through respiration and sweating. Water consumption increases by as much as 50% as the environmental temperature rises. The water is often fresh, clean and at a temperature of 70- 86 F. These reports are significantly different from what pertains in Kpongu. The herdsmen of Kpongu do not increase the water intake among their cattle as a stress management strategy. This is because, in their view, stress is brought by the heat of the sun and the distance that the animals traverse. They would therefore rather keep the cattle in a shade for most part of the day and give them the opportunity to regurgitate cod while they are shielded from solar radiation.

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The need for herdsmen to manage the stress levels of their animals has gained an overriding importance in the face of climate change. Constant and usually unpredictable changes in the climate have several implications for herdsmen across the country. These consequences in the form of exposure-sensitivities have already been identified in some vulnerability assessments (Gallopin, 2006).

It became evident during the study that pastoralists of Kpongu are immersed in indigenous knowledge. The indigenous adaptation strategies that they practice are invariably derived from their repository of indigenous knowledge, which are handed down over generations. The indigenous knowledge-based adaptation strategies are shaped by their physical landscape and socio-cultural orientation towards the environment. This finding is consistent with other works

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that have been carried out particularly in Africa. For instance the United Nations Environment Programme (UNEP) together with partners in Kenya, South Africa, Swaziland and Tanzania conducted a study between 2004 and 2006 to provide information on the use of indigenous knowledge in climate change in the four countries. The study showed that agro-pastoralist in these countries have very deep indigenous knowledge. The study of the four project countries shows clear evidence that when the best practices in indigenous knowledge are disregarded, environmental degradation and poverty sets in and grows (UNEP, 2006). Maasai pastoralism, an indigenous knowledge skill acquired over centuries, illustrates this point.

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Among the Lake Victoria communities, rotational grazing is practiced as a form of adaptation where animals are grazed in the higher areas during the wet season and brought back to the river banks and lake shores during the dry seasons (Kamwenda, 1999). This practice is similar to what pertains in Kpongu except that there are no highlands, but the river banks become the rallying points for the herdsmen during the dry seasons. In the drier areas of Makueni and Kwale districts of Kenya, livestock was moved from pasture to pasture in order to maintain the ecological balance. Even though that is an adaptation, Kamwenda (1999) did not probe further to show the kinds of movement. This study in Kpongu goes further to show that the herdsmen employ four (4) kinds of movements, namely: linear, irregular, circular and migratory.

In his study of the adaptation among the hillside tribes of Uganda, Thomas (1945) mentioned that “herd splitting” is used to reduce or spread the risk of loss; if animals are kept together, particularly during dry periods, the risk would be greater. Female animals used for milk production were kept near the homestead where the majority of the members of the pastoral families, particularly women, children and the elderly, were living (Thomas, 1945). This strategy is in line with one of the findings in the Kpongu community. In Kpongu the “herd-

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splitting" or the formation of sub-herds is done as a stress management strategy and also to reduced grazing pressure on forage near the homestead.

The herdsmen also agree that the separation of animals helps to optimise resources that are spread out in their terrain. Such resources include natural graze lands, fallow fields, crop residue, low-lying wet lands, seasonal ponds and plant species. All these resources are common pool resources, that is, resources that are used simultaneously or sequentially by members of the community. Common pool resources have the attribute of excludability (i.e. difficult to exclude others). Because of this attribute, the herdsmen would rather have sub-herds that can move in different directions in search of feed. In the dry Sahel region, where annual rainfall is low and its distribution erratic, whatever is obtained from common pool resources become critical elements in the livelihood and survival of herdsmen and herds (Bernus, 1988).

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In the Sahelian climate, the floral availability and the nutritional value of forage depends largely on the composition of top soils. Mobility of herd and men therefore enables animals to achieve the optimal dietary rations on a daily and seasonal basis. Mobility is consequently an ecological factor of climate change adaptation which enables herdsmen to exploit ecological niches that are subject to productivity variations over time. It is mobility that enables a herd to optimally exploit resources spread out in time and space, and also to escape ecological and localised epidemiological crises. This adaptation strategy is documented by other works, showing that in the Sahelian climate, herd mobility enables animals to achieve value from diminishing forage and also fosters the exploitation of ecological niches.

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4.3.3 District Development Planning and Climate Change Adaptation

The case of Kpongu reveals that the adaptation needs of herdsmen are not addressed by the Municipal Development Planning Process. First, herders are hardly consulted or involved in the development planning process and secondly, the development plans do not reflect policies and programmes that address their climate change adaptation needs. Historically, pastoralists have been ill-served by development policies and actions, since planners have almost without exception tried to convert the pastoralists into something else and judged them with prejudice. As a result, their aspirations, particularly their climate change adaptation needs are not met. Herdsmen and their activities are still viewed by many people, including decentralised decision-makers, through a prism of myths and half-truths. On closer study, many widely held beliefs and ideas about pastoralism turn out to be without logical or factual basis, grounded in large part on ignorance and prejudice. These views and the lack of consultation tend to distort policy-making about pastoral livelihood systems and their needs, and result in policies, strategies and many development interventions which are at best inadequate and ineffectual, and at worst highly destructive and discriminatory if they are implemented at all.

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The reality that surrounds the community of Kpongu and many others in the Municipality is that, the concept and practice of decentralisation has come to stay as it has several legal backings. To this end, the inhabitants and various interest groups in the community are subject to the developmental orientation and direction of the political and administrative structures and the political elite. Be that as it may, the inhabitants of the Municipality are entitled to some levels of consultation, policy sensitisation and inclusive composite planning, design and implementation of development interventions.

Granted that we had an ideal situation relative to local level planning, the nature and extend of climate change impacts would be assessed with the help and input of the herdsmen in the

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various Zonal Councils and communities in the Municipality. Similarly, the indigenous adaptation strategies that are also being employed by herdsmen to mitigate the impact of climate change would equally be explored. Apart from the benefits of inclusive planning, the object would be to ensure that indigenous adaptations do not pose a threat to the national drive towards climate change adaptation and environmental sustainability.

Writing on *The Participation Trap: The Limitations of Participation for Ethnic and Racial Groups*, Yasminah B. (2006) uses the terms 'ethnicity' and 'race' and acknowledges the widely acclaimed notion that they are socially constructed phenomena which retain power through their relationship to visual difference. These constitutive identities gain meaning in relationship to other presumed ethnic and racial groups, and these relationships are mediated by power. He posits that nations necessitate a narrative to distinguish itself from others and this has often become tied to ideas of true ethnicities and races setting up a boundary between the presumed 'ethnic majority' and the 'ethnic minority'. While understanding ethnicity and communities to be fluid and contested concepts, the identification of an ethnic community in everyday life gains solidness and realness. The idea of communities based on ethnic affiliations has undoubtedly become a strong force for mobilisation and allowed for the voices of the formerly unheard to become vocal. Still this prioritisation of ethnic community membership is of concern.

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Community participation and empowerment have become a rallying cry for policy-makers and development advocates in favour of minority ethnic groups. As Goodlad and Meegan (2005) have noted, consultation and participation have been promoted as a solution to a number of perceived failings in local government decision-making. While many of the forums for public involvement have been created at the behest of current governmental agendas, historically planning has been the only statutory function of local government required to carry out public

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consultation (Skeffington, 1969). Development planners continue to engage in debates regarding the role of participation, effective processes and the outcomes of consultations and participation in empowering communities (Healey, 1997; Sandercock, 2003; Forester, 1999).

While participation has lessened within the formal political realm, demonstrated most basically through the decline in voter turnout, it has spilled over into wider areas of public life to the arena commonly known as civil society (Goodlad & Meegan, 2005). Contemporary political rhetoric emphasises the centrality of the 'active citizen' to a strengthened and accountable democracy (Levitas, 2000; Taylor, 2003). There are associated concerns with the need to reconnect individuals to community and thereby society (Putnam, 2000). However, the idea of community ties have tended to change in focus from more traditional ideas of geographic or class-based allegiances to cultural and identity-based ties (Forrest & Kearns, 2001), giving rise to the acknowledgement of ethnic minorities.

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Ethnic minority groups are often perceived as difficult communities to engage with. Certainly, these groups deserve special attention as they have been marginalised and discriminated against within society (Pilkington, 2003). However, the difficulties refer to the challenges development planners feel they face in engaging certain groups with planning rather than an inherent problem of the group (Higgins et al., 2005, Reeves, 2005). Ethnic minority groups as a whole often face economic and social problems, but these are a result of complex social phenomena rather than being inherent to the group per se (Miles, 1993). However, it is important in practice to be aware of the dangers of over simplification leading to the assumption that there are homogeneous life experiences based upon presumed racial or ethnic similarities (McDowell, 1999; Amin, 2002).

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There is continuing evidence that government institutions and mainstream organisations are consistently discriminating against ethnic minority people (Morris et al., 2004). The result is that the civil society space is promoted as a key arena of participation for 'ethnic' minority groups to have their interests met. The intention of such targeted consultation is a desire to incorporate marginalised viewpoints into shared public forums. However noble such intentions may be, they can act to focus attention upon ethnic interests and separated from the mainstream rather than integral to the general society. This has raised new problems as limited attention has been given to the underlying rationale in seeking to involve ethnic minority groups and the unintended outcomes it may have.

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Despite the heterogeneity of population, planning has until very recently been resolute on the capacity of planning to mediate in the determination of public interest (Taylor, 1998). This has been challenged by exploration of the dimensions of the public and how they are conceptualised (Hillier, 2002). Critiques based within gender and ethnicity have raised fundamental questions about equity of citizen involvement (Sandercock, 1998). There are strong linkages between literature which tend to emphasise the problems of planning as technical practice and also emphasised its political nature (Krumholz and Clavel, 1994). Planning has been critiqued for failing to listen to the full range of public opinion and favouring vested interests (Thomas, 2000). The approaches to redressing the balance have varied, with some tending to favour advocacy and deliberative modes of planning, with development planners working openly with marginalised groups. Others prefer a more pragmatic approach, to open up participatory processes to a wider set of interest groups (Thomas, 1996). This is not surprising given the different thinking about race and ethnicity which has led to the synthesis of these concepts into professional practice taking markedly different directions.

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Representing ethnic or minority groups needs to be linked to power relations and political representation as a whole within the decentralised structure. This raises questions for participation strategies in planning, policy making and the implementation of development interventions, seeking to incorporate marginalised groups in general: the sense in which they nested within the desires to make society more equitable, promoting consultative planning processes relative to issues of equality and discrimination, and whether engagement with ethnic minority groups is a conversational act that subtly supports the creation of ethnic communities. Despite the positive contributions of pastoralism as a source of livelihood for many rural folks, the actors within that sphere are increasingly marginalised by the development process. Most of the planners and decentralised decision makers often hold a common view: that indigenous pastoralists are destructive of the resources they relied upon and unconcerned about, or ignorant of, the ecological consequences of their actions (Fernandez-Gimenez, 2000). This negative image is partly due to the influence of inappropriate theories which blamed pastoralists, especially those who utilised resource communally, for destroying the environment. Major among these are the theory of the "cattle complex" and "the tragedy of the commons". The former theory viewed pastoralists as irrational in their livestock accumulation and seeking prestige rather than for the sustenance they provide (Herskovitz, 1926). Hardin (1968) later showed that herders would seek to intensify the exploitation of resources, because the benefits of increasing production are for the individual, but the costs of degradation are borne by everyone. As each herder follows the individual interest, over-exploitation is inevitable.

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Recent evidence coupled with the failure of several projects established to settle pastoralists (Sandford, 1983) challenge these assumptions and indicate that pastoralists are often knowledgeable and capable of managing their grazing resources in appropriate manner if they are consulted and involved in the development planning process. In fact, there are numerous

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examples, which show that pastoralists' behaviour in managing rangeland is ecologically, and economically highly productive (Behnke et al., 1993; Niamir-Fuller, 1999; Scoones, 1994) and that knowledge is not the scarce commodity among them. This knowledge base ought to be tapped into during policy formulation and development planning.

As droughts occur with greater and greater frequency in Kenya, continuous preparedness and adaptation measures are needed for communities to be able to cope. Trócaire's programme in Kenya works to build community resilience, which involves improving management of natural resources, community-managed disaster risk reduction, protection of the environment and advocating for favourable policies, including climate change policies. The programme focuses on improving food security, promoting the sustainable management of natural resources for improved livelihood security and advocating for policies, laws and institutions that support sustainable livelihoods. Recent successes include increasing the diversity of livelihoods and food groups, reducing the distance to water and establishing and working with community-based groups, such as Natural Resource Management and Community Managed Disaster Risk Reduction committees, and linking them to government structures and systems. Kenya is moving in the right direction in creating an enabling environment to respond to climate change, and Trócaire partners are active participants in this process. Partners have contributed to developments in Climate Change Policy, the Community Land Policy and the Forest Act, which are integral to ensuring people can access the natural resources such as land and forestry that they need to build resilience and sustainable livelihoods.

A more realistic vision of future pastoralism should envisage a thriving economy, with well-informed and successful pastoral producers, who are no longer marginalised from mainstream society the decentralised planning structure. To achieve this, there is need for new policies,

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strategies and interventions about the basic structure of the pastoral economy, a ranching and other housing models; the ability to regain flexibility in relation to climate change and the natural resources that sustain the herders; managing natural resources especially pastures and water bodies to give priority to pastoralism where that is justified; providing services including education and health, often through a mix of mobile and static facilities; providing education on a wide range of issues including financial services and basic insurance, in forms adapted to a nomadic lifestyle; and developing risk management plans, and ways to reduce land use conflicts between herdsmen and others over resources.

For this situation to change, researchers, development planners and decision makers ought to revise their ideas and approaches and identify a new development agenda. Many of the needs, particularly the climate change adaptation needs of herdsmen could be realised from successful attempts to listen to herders themselves, or at least, meeting with their front liners, traditional heads and opinion leaders.

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CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study set out to investigate the indigenous adaptation strategies to climate change among herdsmen, and how decentralised development planning is meeting the adaptation needs and aspirations of herdsmen in the Kpongu community in Wa Municipal, Ghana. Specifically, the study sought to analyse the narratives of climate change and climate change impacts from the perspectives and experiences of herdsmen, identify and analyse herdsmen's indigenous adaptation strategies to climate change, and lastly to assess how District Development Planning is addressing the climate change adaptation needs of herdsmen in cattle production.

Drawing on the findings from a qualitative research approach, this chapter presents the conclusions from the study. It also puts forward some recommendations for enhancing the adaptive capacities of herdsmen and their cattle for adapting to climate change and climate variability.

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5.2 Conclusions

Drawing on the results, the following conclusions are put forward:

Herdsmen describe climate change and climate variability in reference to multiple key pointers and indicators that constraints their primary livelihood and way of life around cattle production. These pointers include longer seasons and frequent dry spells, shrinking size of water bodies, formation of iron pans on top soils, stunted growth of various grass species and then smaller stalk sizes and less concentration of grasses. The indicators are an essential part of their indigenous knowledge given that their perspectives reflect their experiences, practices and world view.

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The study concludes that herdsmen employ multiple indigenous adaptation strategies for adapting cattle production to climate change and climate variability. These indigenous strategies may be classified into four (4) broad categories as follows: stress management among the herds, mobility of men and herds, diversifying sources of feed and division of labour among herdsmen and their families for meeting differential needs in cattle production.

The study also concludes that the District Development Planning Process has failed to address the climate change adaptation needs of herdsmen in cattle production. This is because first, herdsmen are not part of the consultation process as important stakeholders and secondly, the plans and programmes neither recognise their dependence on indigenous adaptation strategies nor support their efforts at adaptation through policy formulation and programming.

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5.3 Recommendations

The recommendations of this study that are aimed at improving herdsmen indigenous adaptive capacities and effectively mitigate against climate change impacts are on the backdrop that climate change and climate variability affects everyone in various ways. The following specific recommendations are made for adoption and implementation by the appropriate quarters. The task of implementation rest individually and collectively on the shoulders of the herdsmen themselves, the traditional rulers, political representation in the community and the Municipal Assembly.

Recommendations for policy and practice

Dredging of existing water bodies in the community: To prevent water bodies in the community from shrinking rapidly and drying up, the herdsmen in collaboration with other community members need to de-silt and/or dredge the water bodies to hold enough water throughout the

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dry season. Given that the construction of new dams and dugouts would be a long term effort and would come with huge financial burden, it would be prudent for the community members to organise themselves into groups that would be scheduled to work on different days. Some logistical support can be sought from the Municipal Assembly in this endeavour. Once de-silting is done, it would prevent the water bodies from completely drying up especially in the dry season. Also, enough natural run-off water from rains would be channelled into the water bodies to slow down the rate at which they are shrinking.

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Prevention of bush/wild fires and deforestation: The herdsmen are able to feed their cattle on dried grass and young sprouts that emerge with the help of dew. However the annual bush burning in the community and its environs prevents the herdsmen from accessing the dried grasses. Therefore, efforts should be made at the community level by its traditional rulers to prevent wild fires and punish culprits of same. Wild fires and deforestation also contribute to exposing the top soils to hardening. Wild fires also has implication for soil nutrient levels and as a result facilitates the formation of iron pans on top soils. Deforestation especially around the homestead makes it a lot more difficult for herdsmen to locate and site their kraals under shady trees in an effort to manage the stress levels in animals. The Municipal Assembly should implement their proposed intervention of using bush fire volunteers and forest squad to complement the efforts that would be made at the community level.

Regular engagements between herdsmen, the Municipal Assembly and other climate change concerned institutions: This is at the level of policy and development planning. The Assemblyman for the Kpongu Electoral Area (comprising Kpongu and Kparisaga), Hon. Yakubu Salia, should be encouraged and given support from the Municipal Assembly to continue to organise regular engagements with the herdsmen and other interest groups. Since

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according to the Municipal Assembly engagements are demand driven, the assemblyman should reach out more often. One of such meetings was held in Kpongu on the 14th of August, 2017. Even though the agenda for this forum was not centered on the impact of climate change and its mitigation, some of the issues were for the information of the herdsmen. The idea of having such a forum is so commendable. It is not only recommended that this be continued but also that the agenda for such engagements be broaden to include issues of climate change impacts and the appropriate adaptations and mitigation strategies as well as alternative livelihoods for the herdsmen.

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Similarly, broader consultation and inclusive planning for climate change adaptation is recommended. Participatory and consultative planning and management of climate change adaptation interventions should be done, particularly by the plan preparation team of the Municipal Assembly. Using participatory and collaborative approaches, climate change adaptation needs and concerns would be generated from grass root activities and community level planning exercises. These processes would ensure the participation of a greater percentage of the population of communities including opinion leaders, women, children, the physically challenged and especially the minority groups such as the herdsmen. At the policy, planning and projects implementation level, it is accordingly recommended that the Municipal Assembly should not just prepare their termly plans based on guidelines from the National Development Planning Commission (NDPC) as alluded to by the two assistant planners (Mr. Nurilai Ibrahim and Ms. Sarah Abdulhaq) at the Assembly. Rather, the plans for improving people's wellbeing should emanate directly from them. A call to action against climate change cannot succeed if the beneficiaries and many stakeholders are not involved in the planning process. Baseline information is required from the communities so as to reflect their needs and aspirations in the climate change adaptation process. In a similar vein, climate change adaptation strategies

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cannot succeed if they stand alone or are pursued outside existing institutions and frameworks. In fact, the pervasive impacts of climate change means that climate change adaptation needs to become integral to nearly every aspect of project design, natural resource management, planning and policy. Project design and development activities should be reviewed to ensure that the implications of climate change for project outcomes are appropriately considered, and strategies for minimising climate impacts and for minimising stresses that can intensified. A participatory and inclusive development planning process is therefore advocated. This is to ensure that, as a minority group in the community, the herdsmen are involved in the design, implementation and management of interventions for enhancing their climate change adaptation needs in particular and climate change and climate variability processes in general.

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Continuous education, awareness creation and sensitisation of community members: On a regular basis, various issues such as bush fires, sustainable climate change adaptations, water management and safety use of agro-chemicals should be brought to the fore by the Municipal Assembly, by education community folks. These issues and sensitisations have already been pencilled in the MTDPs to be undertaken throughout the Municipality but not carried through. The implementation agencies that are assigned the responsibility of community sensitisation on climate change should be well resourced logistically by the Municipal Assembly to carry out this important role. The agencies are the Ministry of Food and Agriculture (MoFA), Savannah Accelerated Development Authority (SADA) and the Northern Rural Growth Project (NRGP) while the Municipal Assembly collaborates.

Facilitating the adaptation of reusable materials for making kraals: The Municipal Assembly should partner with willing donor organisations to assist herdsmen with the construction of their kraals, making use of environmentally friendly, affordable and reusable materials that can

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be easily dismantled and reassembled. This kind of structure can be made from iron, treated wood, wire mesh or industrial fibre. Such construction materials would make the kraals airy and thereby helps to reduce stress levels in animals. Such innovative kraal structures can be provided to the herdsmen and/or the cattle owners on hire purchase basis. Granted this provision, the herdsmen will not have to rely on forest wood for their frequent construction of kraals. The use of logs that are chopped from the bush contributes to deforestation and eventually works against the efforts of climate change mitigation and adaptation.

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Planting of fast growing leguminous plants for shade-drying and feeding to cattle: To help with the diversified sources of feed for herds, the animals' production unit at MoFA and the Municipal Assembly should liaise with the leadership of the community and the herdsmen to allocate some lands for the sowing of pigeon pea and *mucuna pruriens*, a leguminous plant that is native to Africa and tropical Asia. These have been known to be fast growing and more resistant to drought and dry spells. The leaves of the pigeon pea can be harvested and taken through a process of shade drying. This is to ensure that a proportionate amount of the nutrients are retained in them for the benefit of the animals. As part of the activities of the Livestock Development Project that was under the auspices of the Animals' Production Unit, stylo seeds were given to herdsmen in some communities to broadcast as they graze their herds. This initiative can also be replicated in the study community to provide fast growing pasture for the cattle.

The herdsmen of Kpongu should regularly initiate meetings and extend invitations to the Municipal Assembly and other interest groups: It is recommended that the herdsmen should occasionally organise themselves together and then extend invitations to the Assembly and other stakeholders that they deem fit to meet and brainstorm with them on the most innovative

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and acceptable climate change adaptation strategies. As a guide for the herdsmen, the assistant planners mentioned that engagements with the Municipal Assembly should be channelled through the Assemblyman for the area. Also as a guide, the Assembly carries out validation of problems in communities every four (4) years and this should inform the timing and scheduling of future interactions.

Integration of indigenous knowledge systems with the modern scientific methods in climate change adaptation: There is a need to recognise that good indigenous knowledge is an asset that already exist in local communities, and at the same time there is wisdom in adopting and benefiting from the advances that current science offers us. There is no defined line of equilibrium between the two. The approach of balancing the gains of modern technology and indigenous knowledge, however, has to be taken up with adequate caution. It is a transitional domain, which has to be worked within a highly contextual manner that delivers benefits without undermining related assets. Two different stakeholders have been identified, those of indigenous knowledge (individual, community, civil society, CBOs and local government), and those of scientific knowledge (scientists, researchers, technicians, government, institutions and external agencies). These two groups of stakeholders will need to work together in order to incorporate both types of knowledge into climate change adaptation policies. A dialogue is needed between the two in order to determine the best strategies.

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Recommendation for further research

Sustainability of indigenous adaptation strategies: In the face of climate change and climate variability, herdsmen are constantly planning, coping with and adapting to climate change in ways possible using their indigenous knowledge. Some of the indigenous adaptation strategies and coping mechanisms only come as a cure that is worse than the disease. There is the need

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to interrogate the sustainability of the indigenous adaptation strategies in the light of environmental sustainability. Such a study will not only be appropriate, but also timely so as to align indigenous adaptations to best ecosystem management practices towards the broader goal of environmental sustainability.

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APPENDIXES

Appendix 1: Tabular Representation of Research design

Research Design	Kinds of data required	Sampling Techniques		Sample size
▪ Case Study Exploratory in nature ▪ Indigenous knowledge systems and their generational evolutions ▪ Appreciating local indicators of climate change ▪ Exploring experiences and perspectives of herdsmen regarding adaptation strategies	▪ Primary data collected from pastoral households, cattle owners, chief, assemblyman, planners, MoFA officials and meteorological officers ▪ Secondary data reviewed by means of desktop studies (plans, policies and interventions)	Study community Kpongu SAMPLE FRAME ▪ Herdsmen (Fulani) ▪ Cattle owners ▪ Planners at Assembly ▪ Assembly man ▪ Chief of Kpongu ▪ Veterinary officer ▪ Meteorological officers ▪ Officers at MoFA	Purposive Census Census Purposive Purposive Purposive Purposive Simple random	Population of the whole community SAMPLE UNITS Census of young and aged herdsmen Census of cattle owners in Kpongu 2 planners at the Municipal Assembly The Assemblyman for Kpongu Chief of Kpongu 1 Senior veterinary officer 2 officers from Wa meteorological station 2 officers at animals production department, MoFA **Total of 82 respondents**

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Appendix 2: Data collection matrix

Research questions	Data required	Source(s) of data	Data collection tools	Method(s) of data analysis
1. How do herdsmen narrate climate change and climate change impacts from their perspectives and experiences?	▪ Year-on-year climate variations ▪ Indicators of climate change ▪ Nature of impacts	▪ Herdsmen (perspective and experiences) ▪ Cattle owners (complaints received)	▪ Semi-structured interviews ▪ Focused group interactions	▪ Narrations ▪ Descriptions
2. What indigenous adaptation strategies are used by herdsmen to mitigate the impact of climate change on their pastoral activities?	▪ Location of grazing fields ▪ Size and quality of fields ▪ Relocations of fields ▪ Individual & communal adaptive capacities	▪ Herdsmen ▪ Cattle owners ▪ Meteorological service	▪ Observation ▪ Semi-structured interviews ▪ Interviews/ discussions	▪ Narrations ▪ Descriptions ▪ Seasonal calendar analysis ▪ Ranking of indigenous adaptation strategies
3. To what extent does decentralised development planning take on board the climate change adaptation needs of herdsmen in cattle production?	▪ Knowledge-based adaptation strategies ▪ Specific interactions between herdsmen and Assembly	▪ Herdsmen ▪ Cattle owners ▪ Traditional leaders ▪ Officers at MoFA ▪ Municipal Planning Officers	▪ Focused group interactions ▪ Semi-structured interviews	▪ Review of MTDPs developed by the Wa Municipal Assembly

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Appendix 3: Data Collection Tools

Focus Group Discussion Guide for Elderly, Middle-Aged And Teenage Herdsmen And Women/Wives Of Herdsmen

A. Background information/Herdsmen Seasonal Calendar

1. Indigenous conception of time:
   .....
   .....
2. Local ways of representing time and seasons (e.g: names, symbols, descriptions):
   ……
   ……
3. Which month/time does it rain the most and which month/time does it rain the least?
4. Are there any differences in how much it rained 10 years ago in comparison to last year?
5. Which other weather/climatic conditions vary comparing 10 years ago and now? Discuss
6. Which environmental conditions do you observe variations comparing 10 years ago and now? Discuss

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Aspects of herdsmen's lives that fluctuate on a seasonal basis

- Holidays and festivals
- Rainfall / wet seasons / dry seasons
- Availability of pasture
- Location and direction of pasture lands
- Water availability
- Best and worst grazing months
- Periods of food scarcity / plenty
- Income sources (times of higher and lower income)
- Expenditures (times of higher and lower expenditure)
- Planting and harvest seasons
- Labour for agriculture (intensity)
- Times of migration
- Timing of hazards / disasters such as cyclones, droughts and floods
- When common seasonal illnesses occur
- Labour availability
- Presence of birds, insects or other animals

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Key Informants Interview Guide for Individual Herdsmen

(Community Level)

Respondent's Name: ……. Age: ……

Date of Contact: ……..……

****

Background information

1. History as a herdsman
2. Number of cattle being herded
3. Ownership of cattle and reward system

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A. Identify indigenous adaptation strategies to climate change among herdsmen

1. What is your understanding of climate change?
2. What are the signs of climate change in your community?
3. How long have you observed these signs of climate change?
4. In what ways does climate change affect your pastoral work?
5. Give some experiences

B. Evaluate whether indigenous adaptations undermine or reinforce environmental sustainability (Effectiveness and sustainability of indigenous adaptations).

1. Which indigenous methods do you use to adapt to the changes in climate? (Make a list of the indigenous adaptation strategies)
2. How long have you been using each of the indigenous strategies?
3. What are the advantages/benefits and disadvantages/challenges of these strategies?
4. Which indigenous adaptations have been successful/reliable and which have not been very helpful? (Rank adaptation strategies in order of usefulness)

C. Assess the responsiveness of district planning to adaptation needs

1. Have there been any form of contact with the Municipal Assembly or other institution in respect of your herding activities?
2. Have there been any support from the Municipal Assembly?
3. If yes, what is the nature of the support?
4. What has been the level of effectiveness of the support?

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Key Informants Interview Guide for Municipal Planning Officers (Institutional Level)

Respondent's Name: …….. Title: ……

Date of Contact: ……..……

****

Background information

1. Age of respondent: ……..……..
2. Years serving as an officer: ……..……
3. Brief responsibilities as an officer: ……..……..……

……

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A. Identify indigenous adaptation strategies to climate change among herdsmen

1. What is your understanding of climate change?
2. What are the signs of climate change in the municipality?
3. How long have you observed these signs of climate change?
4. In what ways does climate change affect herdsmen in the Municipality?
5. What indigenous adaptations have been observed among herdsmen?
6. How long have these adaptation strategies been used?
7. What are your general observations of herdsmen activities in pasturing their cattle?

B. Evaluate whether indigenous adaptations undermine or reinforce environmental sustainability (Effectiveness and sustainability of indigenous adaptations)

1. What are the Municipal Assembly's environmental targets and goals?
2. In what ways do herdsmen undermine the achievement of environmental goals?
3. Which indigenous adaptations undermine the survival needs of humans and animals?
4. Which indigenous adaptations reinforce/promote environmental sustainability?

C. Assess the responsiveness of district planning to adaptation needs

1. What specific planning has been done in respect of herdsmen in the Municipality?
2. Have there been any form of consultations with herdsmen during planning?
3. Which specific interventions are there to address the challenges of herdsmen?
4. How were these specific interventions arrived at, in terms of the extent of consultations?
5. What monitoring mechanisms are in place to ensure the success of the specific interventions?

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Semi-Structured Interview Guide For Assemblyman, Chief And Traditional Women Leaders At The Community Level

Introductory comments

- Greetings and introduction of self
- Description of the expectation and the procedures for the discussion; encouraging full and open participation

A. Identify indigenous adaptation strategies to climate change among herdsmen

1. What are the signs of climate change in the community?
2. How long have you observed these signs of climate change?
3. In what ways does climate change affect herdsmen in the community?
4. What indigenous adaptations have been observed among herdsmen?
5. How long have these adaptation strategies been used?
6. What are your general observations of herdsmen activities in pasturing their cattle?

B. Evaluate whether indigenous adaptations undermine or reinforce environmental sustainability (Effectiveness and sustainability of indigenous adaptations)

1. What are the community's environmental goals?
2. In what ways do herdsmen undermine the achievement of environmental goals?
3. Which indigenous adaptations undermine the survival needs of humans and animals?
4. Which indigenous adaptations reinforce/promote environmental sustainability?

C. Assess the responsiveness of district planning to adaptation needs

1. As a community leader, how is the community involved in the pasturing activities of herdsmen?
2. What observations have been made regarding the challenges of herdsmen?
3. Which specific interventions are there to address the challenges of herdsmen?
4. How were these specific interventions arrived at, in terms of the extent of consultations?
5. Are there guidelines for herdsmen in the community?

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Semi-Structured Interview Guide for Cattle Owners

Background information

- Number of cattle owned
- Number of herdsmen employed to take care of cattle
- Reward systems for herdsmen and general relationship with herdsmen

A. Identify indigenous adaptation strategies to climate change among herdsmen

1. What is your understanding about climate change?
2. What are the signs of climate change that you observe?
3. How long have you observed these signs of climate change?
4. In what ways does climate change affect herdsmen in keeping your cattle?
5. What indigenous adaptations have been observed among herdsmen?
6. How long have these adaptation strategies been used?

B. Evaluate whether indigenous adaptations undermine or reinforce environmental sustainability (Effectiveness and sustainability of indigenous adaptations)

1. Have you recommended/suggested any adaptation strategies for herdsmen?
2. Which indigenous adaptations have been useful over time?
3. Which indigenous adaptations undermine the survival needs of humans and animals?
4. Which indigenous adaptations reinforce/promote environmental sustainability?

C. Assess the responsiveness of district planning to adaptation needs

1. Have you ever taken the concerns of herdsmen to the Municipal Assembly?
2. Which specific interventions are there to address the challenges of herdsmen?
3. How were these specific interventions arrived at, in terms of the extent of consultations?
4. How often to visit your herdsmen to observe how they are dealing with the effect of climate change?

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Appendix 4: Seasonal Calendar Mapping and Analysis

Conventional months	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Local Seasons/Months												
Climatic and weather conditions												
Defining characteristics and local events												
Major pastoral activities												
Other economic activities												
Undertaken by												
Vulnerabilities and risks												
Mitigating and Coping strategies												
Location/access to resources												
Distance of graze lands												

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Subject matter for discussion

- General pasturing activities by herdsmen in the community
- Ownership of cattle and reward system
- Nature of grazing fields
- Size and location of grazing fields
- Where and how animals are watered
- Understanding of climate change and climate variability
- Indicators/Evidence of climate change in the community
- The need for adaptations to climate change
- Forms/types of indigenous adaptation strategies being used
- Evolution of indigenous adaptation strategies
- Individual adaptations vs communal adaptations
- Challenges in the adaptation process
- How stress levels are managed among animals
- Any collaboration with or assistance from institutional bodies (e.g.: Municipal Assembly and NGOs) in dealing with the challenges of climate change adaptations.

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