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INSTITUTE OF DISASTER RISK MANAGEMENT AND FOOD SECURITY STUDIES

GRADUATE PROGRAM

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MSc Thesis

By

Mahamed Abdilahi Madar

January, 2018

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE (MSC) IN DISASTER RISK MANAGEMENT AND SUSTAINABLE DEVELOPMENT

January, 2018

Bahir Dar

THESIS APPROVAL SHEET

As member of the Board of Examiners of the Master of Sciences (M.Sc.) thesis open defense examination, we have read and evaluated this thesis prepared by **Mr. Mahamed Abdilahi Madar** entitled **Indigenous Adaptation Strategies to Climate Change Variability: *the Case of Harshin Woreda of Somali Region State.*** We hereby certify that, the thesis is accepted for fulfilling the requirements for the award of the degree of Master of Sciences (M.Sc.) in Disaster Risk Management and Sustainable Development.

Board of Examiners

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Name of External Examiner	Signature	Date
_____	_____	_____
Name of Internal Examiner	Signature	Date
_____	_____	_____
Name of Chair Person	Signature	Date

DECLARATION

This is to certify that this thesis entitled "**Investigating Indigenous Adaptation Strategies to Climate Variability:** ***the Case of Harshin Woreda of Somali Region State***" submitted in partial fulfillment of the requirements for the award of the degree of Master of Science in **"Disaster Risk Management and Sustainable Development"** to the Graduate Program of College of Agriculture and Environmental Sciences, Bahir Dar University by Mr. Mahamed Abdilahi Madar (ID. No: BDU0805612PR**)** is an authentic work carried out by him under our guidance. The matter embodied in this project work has not been submitted earlier for award of any degree or diploma to the best of our knowledge and belief.

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Signature & date _____

Name of the Supervisors

1) Dr. Mossa Endris (Major Supervisor)

Signature & date_____

2) Dr. Kinde Gebeyehu (Co-Supervisor)

Signature & date_____

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ABBREVIATIONS

ANRDB	Agriculture and Natural Resources Development Bureau
AR4	Fourth Assessment Report
ASALs	Arid and Semi-arid Lands
BOFED	Bureau of Finance and Economic Development
CCA	Climate Change Adaptation
CSA	Central Statistical Authority
ESRS	Ethiopian Somali Regional State
ETB	Ethiopian Birr
GHGs	Green House Gases
IIRR	International Institute of Rural Reconstruction
IK	Indigenous Knowledge
ILO	International Labor Organization
ILP	Indigenous and local practices
IPCC	Intergovernmental Panel on Climate Change
LCRDB	Livestock, Crop and Rural Development Bureau
LZ	Livelihood Zone
NAPAs	National Adaptation Programmes of Action
NGOs	Nongovernmental Organizations
SC	Save the Children
SPSS	Statistical packages of social sciences
UK	United Kingdom
UN	United Nations
UNEP	United Nations Environmental Program
UNFCCC	United Nations Framework on Climate Change Conference
WB	World Bank
WDRP	Woreda Disaster Risk Profile

ABSTRACT

This study investigates the effectiveness of indigenous knowledge as an adaptation strategy to minimize the adverse impacts of climate variability on the livelihoods of the communities: the case of Harshin Woreda of Ethiopian Somali Regional State. The study focused both qualitative and quantitative data from primary and secondary sources and the main data collection sources were through the combinational use of questionnaires, focus group discussions and key informants interview through the use probability and non-probability sampling techniques. The materials for the study were drawn mainly from four purposively selected kebeles, namely; Kudaramale, Sogsog, Adadle, and Garabeldan. The results of the study depict that Harshin communities are repeatedly hit by recurrent droughts and however, most of them (49.15) do not know about climate change. More than half (44.2%) of the respondents associated the cause of climate change and variability risks with the will of Allah. But, the climate variability is reported to have a significant adverse effect on food security, income, crop yield, biodiversity, food prices and other variables. As a result, the community has been utilized indigenous coping and adapting strategies which includes herd mobility, herd diversification, splitting of herds and families, adjusting planting date, and food reserve. Among these, the highest percentage (25.5%) of the households preferred herd mobility at times of stress. Therefore, the use of indigenous adaptation strategies alone can't fully withstand the hazards of climate variability. The research concludes that communities whose livelihoods are sensitive to the variability of climatic factors are the most affected. As a result, an alternative ways of improving the resilient capacity of the community needs to be researched and supported with scientific interventions together with indigenous knowledge of the community which is an imperative means to reduce the impacts of climate variability instead of employing indigenous knowledge alone to withstand the ever-changing adverse impacts of climate variability.

Key Words: ***Climate Change, Climate Variability, Indigenous Knowledge, Adaptation Strategies, Harshin woreda***

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1. INTRODCTION

1.1 Background and Justification

Climate change is considered to be one of the international hot issues at the global forums and dialogues because it has become one devastating man made plights at all levels since the international community together with the available scientific researches made it clear that changing climate is of course the one of the biggest threats facing the survival humanity in recent centuries because the associated impacts of climate change and climate variability affects all humans irrespective of a given nationality transcending from national and international borders of the world. Therefore, no person, country nor continent is supposed to be immune to the impacts changing climatic conditions and climatic variability as well while at the same time it might devastate geopolitical and socioeconomic impacts from one region to another (Kumar et.el, 2014).

In general, it is widely accepted that indigenous knowledge represents an alternative way of thinking, which has evolved through times keeping in the mind the requirement to safeguard themselves and their families from variations in the local climate. In today's society, where science is playing pivot role, many people believes that orally transmitted knowledge is non-scientific, which is totally false. Indigenous knowledge is also as scientific as any other form of present knowledge as it evolved on the same principles of experiments and trial and error methods which are widely followed in sciences (Particularly in physical sciences). So, given the urgency to cope with climate changes present study is an attempt to discover the traditional skills prevalent among communities in Harshin *woreda* that can help to build future course of actions for present generation.

Moreover, indigenous knowledge and information systems have a prominent role in rangeland and livestock management, and regarding the gaps in information from remote sensing, pastoralists would have been badly advised only to rely on modern systems. Indigenous knowledge is sensitive and comprehensive and can be adapted also to changing conditions. Nevertheless, Indigenous knowledge has been developed under conditions, where climate and calendar were in harmony, where climate was mainly influenced by the positions of sun, moon and earth to each other and by the movement of trade-winds, undisturbed by atmospheric disruptions caused by increased emissions of greenhouse gases. (Ahmed A.M, 2014).

It is widely recognized that climate change is real while its impacts are devastative no matter how rich and poor countries are from the different countries of the world. The frequency and severity of droughts, floods and unpredictable seasons currently occur due to the devastative impacts of climate change in the recent past and of course, is a clear manifestation of the climate change (Edward W. et el, 2014).

The livelihoods in this region are based mainly 95% on pastoralist and 5% of semi urban. Generally, the livelihood of pastoralists, which are highly dependent on natural resources for livestock keeping, is very sensitive to climate change and vulnerable to a number of risk factors. They frequently experience 'shocks' (events with adverse effects) that erode their ability to cope and this makes them more vulnerable to further shocks (SC-UK, 2005). Furthermore, the study identified those vulnerabilities in this particular livelihood zone in general including recurrent droughts, extreme water shortage, ethnic conflicts, animal and human diseases, and poor transport and communication infrastructures.

Similarly, people living in dry lands have developed complex pastoral and cropping systems to cope with the erratic and harsh climate (Bonkoungou and Niamir-Fuller 2001).

While drylands people are acknowledged to be among the most vulnerable communities due to a combination of political, economic and social factors as well as erratic rainfall (Trench et al 2007), it is these people who have an extensive knowledge about adaptation to climate variability and who have successfully managed and lived from dryland ecosystem services over centuries.

Most of the dry lands characterize and usually are associated with shortage of water, but by its erratic availability and a variable climate. Consequently, some argue that for instance pastoralists will be best equipped to adapt to climate change (WISP 2007) given their traditional knowledge and management systems. However, because of their political and economic marginalization, their adaptive capacities have been severely undermined and they have become in many cases more vulnerable than other community has. If adaptation and development strategies embrace the sustainable management of dry lands and promote the adaptive capacity of indigenous peoples and local communities such as pastoralists, there is a potential that "pastoralism may in fact provide food resources where climate change lead to lower reliability of marginal farming" (WISP 2007).

Moreover, it's expected that these climatic events have negative implications on the indigenous coping and adaptation strategies of the communities residing Harshin *woreda* of Somali Region where climate change induced droughts occur repeatedly.

According to the IPCC's Fourth Assessment Report (AR4) noted that 'indigenous knowledge is an invaluable basis for developing adaptation and natural resource management strategies in response to environmental and other forms of change' (Parry et al., 2007).

The researcher intends to evaluate how the communities of the study area have been coping and adapting to climatic changes by employing available indigenous knowledge and accordingly establish the correlation between the adoption of indigenous knowledge as a means of coping and adaptation in countering the existing trends of climate change impacts by the agro-pastoral communities of Harshin *Woreda*. This research was conducted in Harshin *woreda* of Fafan, the Ethiopian Somali Regional State.

1.2 Statement of the Problem

Most researches on climate change have been dominated by studies in the physical and biological sciences aimed mainly at prediction of effects (Petheram *et al.*, 2010). Such studies based on hard science are vital; however, it can be argued that lack of attention to social aspects has often led to a rather limited analysis of adaptation which can underplay the complex relationships between people and their environment (Klein *et al*., 2007).

The adaptive capacity of Somali pastoral communities in the study area is very low. Climate change impacts on agriculture and food security lay serious challenges in the country. This might have pushed agro-pastoralists to make countless strides to adopt technologies that can help improve on their agricultural yields. In spite of all these visible indications, there is lack of established, as well as specific adaptive measures to redress the impact of climate change on agriculture, food security and economic growth (ESRS, 2010). As a result, there is a need by policy makers and decision makers to reveal the inter-related factors responsible for climate change, climate variability and impacts felt by agro-pastoral communities, their surroundings and their adaptation strategies against climate variability effects.

The history of climate extremes, especially drought, is not a new phenomenon in Ethiopia. Recurrent droughts have been a major issue throughout history in the Ethiopian lowlands,

and strategies to cope with, and adapt to these droughts are embedded in communities' traditional social structures and resource management systems (CARE International and SCF-UK, 2009). Pastoralists in Somali region in general and particularly pastoralists in Harshin district use various adaptive and flexible risk management indigenous copping Strategies, like migration, which has increased the sale of livestock and sale of larger stock, sending children to work in towns particularly poor and middle households, change food consumption, minimize expenditure, take loan, reduction in gifts of milk and milking animals from middle and better-off households of the pastoralists in Somali region in response to climate variability.

Despite the great role of those indigenous coping strategies it has been subjected to severe destruction in the past decade and breaking down in the face of climate variability problems, due to different constraints, some of them include:, pastoralists are being prevented from using their indigenous knowledge effectively and the constraints come from the weakening of determination and adaptation techniques, pastoralists' ability to adapt is constrained by many factors including increasing land degradation, conflicts over scarce resources, limited access to information, poor resource, limited education, skills and access to financial services and markets, demographic pressures, and social and gender inequalities and marginalization, which reduce the voice and adaptive capacity of the most vulnerable (IISD, 1997).

The design and implementation of climate change policies with an intention of reducing the climate change impacts and hazards especially the drought and floods at the local level, there's an urgency need to sufficient indigenous knowledge in countering the risks associated with climate change with use of locally available coping capacities and adaptation strategies.

To address these issues and concerns, there is a need for a comprehensive assessment of the agro-pastoralists perceptions and adaptation to climate change impacts at local levels.

The generated information could lead to complementary use of both indigenous and scientific knowledge in the policy and interventions formulation process. While scientific knowledge and its contribution to climate change, adaptations are well recognized and accordingly documented. The available indigenous knowledge on climate variability coping and adaptation strategies obviously remains only in oral forms because the international community as well as the respective national and local governments had

ignored their expected roles of promoting and encouraging the use of indigenous and local knowledge as an adaptation strategy minimize the adverse impacts of climate variability.

This study attempted to explore and document the correlation between the indigenous knowledge as a means of adapting the impacts of climate variability which had so long been practiced to mitigate the triggering effects of recurrent droughts related with the devastative consequences of the changing climates. The researcher assumed that this study may likely contribute and recommend about the adverse impacts of climate variability and the role of indigenous knowledge to withstand the recurrent climatic variations and the associated impacts on the livelihood of local communities in the study area.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of the study is to investigate the use of indigenous knowledge as adaptation strategies to withstand the climate variability induced adverse impacts on the Harshin Communities.

1.3.2 Specific Objectives

The main specific objectives of this research are as per the following focus areas:

- To examine communities perception to the major climate change impacts on their livelihoods
- To assess the challenges facing local communities' use of indigenous knowledge to minimize the effects of climate change
- To assess indigenous coping and adaptive strategies that have been used by the community to mitigate the impacts of climate change

1.4 Research Questions

- ✓ How does the Harshin community perceive the climate change impacts on their livelihoods?
- ✓ What are the indigenous coping and adaptation strategies in countering the impacts of Climate change impacts?
- ✓ What are the main challenges in pursuing Indigenous Knowledge's coping and adaptation strategies to climate change impacts?

1.5 Organization of the study

The thesis is organized into five chapters. The first sets out the introduction part, background of the study, statement of the problem, objectives of the study and research questions. The second chapter deals with the review of theoretical literatures and empirical studies relevant to the major theme of this study. Chapter three presents the research methodology and the background of the study area as well as the local customary institutions, social structure, the profile of Harshin *woreda*, the sampling techniques employed for this study, the type of data and the data collection sources as well as the data analyzing tools. The fourth chapter presents the data results and discussions of the study and analysis of the impacts of climate change on the livelihood assets of the community. Finally, the last chapter summarizes the main findings of the study, the conclusions drawn from the study and the forward recommendations of the study as well.

2. LITERATURE REVIEW

2.1 Analytical Concepts and Definitions

2.1.1 Climate change

The impacts of climate change including increasing global mean temperature and variations in rainfall are real and impacting ecosystems, biodiversity and human systems globally (IPCC, 2014). Substantial hazards from climate change are real and include disruptions of food production and water supplies, less incomes, destruction of homes and property, poor health and death (Opiyo et al., 2011). Although adaptation to climate change can reduce harm, challenges to adaptation exist mainly in developing countries where low adaptive capacity and high poverty rates shape vulnerability (IPCC, 2014).

Despite the continent‘s increasing efforts to support and implementation of climate adaptation at local, national and across sectors, most of it has been reactive and based on short-term motivations (Vermuelen *et al.*, 2008). Functional institutions, asset accessibility and peoples' ability to make informed decisions are key determinants of households' adaptive capacity to climate and other risks (Gupta, et al., 2008). Although a range of adaptation interventions for pastoral communities exist, a myriad of obstacles that include competing demands on natural resources, poor infrastructure, high poverty and poor governance could constrain people's efforts to adapt (Herrero *et al*. 2010).

When dealing with issues of climate change, it is important to understand the different terms used as "packages" in understanding the system. Accordingly, "*Climate Variability*" is the fluctuation in climatic parameters from the normal or baseline values, whereas "climate change" is a change in the long-term mean value of a particular climate parameter (Abebe, 2008, cited in Yohannes & Mebratu, 2009). Climate change had different definitions from different scholars. The Intergovernmental Panel on Climate Change (IPCC, 2007), an authoritative voice on climate change issues, defined climate change as any change in climate over time, whether due to natural variability or as a result of human activity. In other publication, climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land-use (IPCC TAR, 2001b).

2.1.2 Indigenous knowledge

Indigenous peoples, however, are not mere victims of climate change. These local communities, through their indigenous knowledge systems, have developed and implemented coping and adaptation strategies that have enabled them reduce their vulnerability to past climate variability and change (Nyong, Adesina and Elasha, 2007; Worden, Western and Waruingi, 2009; Raygorodetsky, 2011).

The community-based and collectively-held knowledge may offer valuable insights, which may complement scientific data with chronological and landscape-specific precision and detail that is critical for verifying climate models and evaluating climate change scenarios developed by scientists at much broader spatial and temporal scale. Moreover, indigenous knowledge may provide a crucial foundation for community-based adaptation and mitigation actions that sustain resilience of social-ecological systems at the interconnected local, regional and global scales (Raygorodetsky, 2011; Nakashima et al., 2012).

Indigenous knowledge on climatic change is vital in addressing food insecurity in ASALs. The World Bank underscores the crucial role that the knowledge capital of a nation plays in sustainable socioeconomic development and environmental sustainability.

The World Bank (2012) says that the basic component of any country's knowledge system is its indigenous knowledge that encompasses the skills, experiences and insights of people, applied to maintain or improve their livelihood. While this importance of indigenous knowledge has thus been realized in the design and implementation of sustainable development projects, little has been done to incorporate this into formal climate change mitigation and adaptation strategies (Nyong et al., 2007).

Despite this, studies carried in Kenya and the Southern Sudan has revealed that dependency on traditional agro-pastoral based livelihood options alone is becoming increasingly untenable (Ouma et al., 2011). This implies that the local communities' coping strategies have been able to make them survive through the climatic events impacts. However Yazan et al. (2012) found that the current livelihoods and resource use patterns in the dry lands are unsustainable and can no longer maintain the living standard of the inhabitants. Finding ways to improve livelihoods, food and nutrition security of households and alleviate poverty in the dry lands has thus become a key policy issue (Nyariki, Wiggins and Imungi, 2002).

Strategies to reduce the vulnerability of people directly dependent upon the primary resources of the ASALs and to improve the productivity of those resources must be sought urgently (Ngugi and Nyariki, 2005). This makes the need for diversification into and adoption of scientific technologies more and more urgent. However, out of tried scientific interventions, there has been also a growing awareness that scientific knowledge alone is inadequate for solving the climate change crisis according to Finucane, (2009). Therefore, Indigenous knowledge can be defined broadly as the knowledge that an indigenous local community accumulates over generations of living in a particular environment. This definition encompasses all forms of knowledge – technologies, knowledge skills, practices and beliefs – that enable the community to achieve stable livelihoods in their environment (UNEP 2009). Thus, a complementary mix of both indigenous knowledge and scientific interventions could therefore be a welcome and the best alternative to deal with the impacts of climate change from around the world.

2.1.3 Coping strategy

Coping Capacities and strategies are the abilities of people, organizations and systems, using available skills and resources to face and manage adverse conditions, emergencies or disasters. The frequency of adoption of different coping strategies provides an indication of the sequence in which they are adopted. Moreover, the strategies that are the least costly (both economically and socially) and are most easily reversible, are adopted first, as an immediate response to a food shock while strategies that are most damaging to livelihoods or social status, and most difficult to reverse, are adopted last, after all other survival strategies have been exhausted.

Furthermore, Coping strategies are bundle of people's responses to declining food availability and entitlements in abnormal seasons or years (Davies, 1993). Coping is thus defined as a short-term response to an immediate and in-habitual decline in access to food, and means acting to survive. People living in conditions where their main sources of income are under recurrent threat develop strategies to minimize risk to immediate food security and to longer-term livelihood security.

2.1.4 Adaptation strategy

Research in many sectors and regions indicates an impressive human capacity to adapt to long-term mean climate conditions but less success in adapting to extremes and to year-to-year variations in climatic conditions. Climate change is experienced via conditions that vary from year to year, as well as for ecosystems (Sprengers *et al.*, 1994) and human systems (Downing *et al*., 1996).

Moreover, Mobility is one of the indigenous adaptive strategies practiced by Harshin community. "The key strategy of the community is the movement of their herds in response to seasonal and annual changes in pastures and water availability'' (Ali, 2008:82).

***Adaptation*:** it is adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. This refers to changes in processes, practices, or structures to moderate or offset potential damages or to take advantage of opportunities associated with changes in climate. It involves adjustments to reduce the vulnerability of communities, regions, or activities to climatic change (Burton *et al*., 1997).

Adaptive Capacity: is the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC, 2001)

2.1.5 Causes of Climate Variability

At global scale apart from natural conditions such as natural geologic, hydrologic, atmospheric and biotic factors, the main cause of greenhouse gas (GHG) emissions is from carbon dioxide (70%), primarily from burning of fossil fuel (petroleum) imported from industrialized countries, while the other sources for GHG are methane and nitrous oxide caused by deforestation and agricultural activities, particularly the use of pesticides (Yohannes and Mebratu, 2009).

The combination of generally increasing temperatures and shifting rainfall amounts and patterns will clearly have impacts on crop and livestock agriculture. Developing countries are generally considered most vulnerable to the effects of climate change than more developed countries, largely because of their often limited capacity to adapt (Thomas and Twyman, 2005 Cited in ILRI 2007; Akililu and Alebachew, 2009).

2.2 Indigenous Knowledge and Adaptation Strategies

Indigenous and local practices (ILP) are the result of the application of culture, context, and location-specific knowledge to solve local problems. The use of indigenous and local knowledge have practically evolved and been in use over hundreds of years because these practices are nowadays are considered to be locally and tailored, cost-effective and community-owned.

As the 2007 report of the Intergovernmental Panel on Climate Change (IPCC 2007a) clarified, warming of the climate system is unequivocal and accelerating, and a certain amount of change in the climate is inevitable. This means that both mitigation and adaptation actions are essential.

Adaptation to climate change is the ability to respond and adjust to the actual or potential impacts of changing conditions in order to reduce harm or exploit opportunities. 'Mitigation' refers to actions to reduce greenhouse gas (GHG) emissions and enhance sinks for GHGs.

Coping strategies are bundle of people's responses to declining food availability and entitlements in abnormal seasons or years (Davies, 1993). Coping is thus defined as a short-term response to an immediate and in-habitual decline in access to food, and means acting to survive. People living in conditions where their main sources of income are under recurrent threat develop strategies to minimize risk to immediate food security and to longer-term livelihood security. It is shown that populations living in marginal environments are much better to cope with periods. Coping strategies are useful in the short term, but do not necessarily bring a change in livelihoods. They may not also be economically and environmentally sustainable. Coping strategies can also be identified according to mild, medium and acute stages of drought (Eriksen, 2001).

Indigenous knowledge can be defined broadly as the knowledge that an indigenous local community accumulates over generations of living in a particular environment. This definition encompasses all forms of knowledge – technologies, knowledge skills, practices and beliefs – that enable the community to achieve stable livelihoods in their environment (UNEP 2009). Therefore, Indigenous knowledge is defined as institutionalized local knowledge that has been built upon and passed on from one generation to the other by word of mouth. It is the basis for local-level decision-making in many rural communities.

Indigenous knowledge has value not only for the culture in which it evolves, but also for scientists and planners striving to improve conditions in rural localities.

The knowledge set is influenced by the previous generations' observations and experiment and provides an inherent connection to one's surroundings and environment. Therefore, indigenous knowledge is transferable and provides relationships that connect people directly to the environments and the changes that occur within it, including climate change (Woodley E.1991). 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 such as the planting of early maturing crops, adoption of hardy varieties of crops and selective keeping of livestock in areas where rainfall declined. However, incorporating indigenous knowledge into climate change concerns should not be done at the expense of modern/western scientific knowledge (Kebebew, Tsegaye, Gry, 2001).

2.2.1 Indigenous Indicators of Climate Change

According to Steiner (2008), an indigenous knowledge is a body of knowledge built up by a group of people living in close contact with nature. Langhill (1999) had a similar definition as he defined indigenous knowledge as the knowledge possessed by the original inhabitants of an area. Gufu Oba's work (2009) described indigenous knowledge as a product of time, society and environment. According to him, the useful parts of knowledge would persist through time, while the dysfunctional components eliminated accordingly.

The dysfunctional parts are abstained because they fail to achieve repeated uses. Indigenousness is transmitted from one generation to the other through the process of socialization.

The indigenous indicators of climate change includes the changing way of life based and recurrent droughts that are happening everywhere while the specific indicators are the loss of life and livestock by Harshin community (own source).

2.3 Climate Change and Livelihoods

Climate change adaptation (CCA) strategies aim to reduce vulnerability to expected impacts of climate change. However, the concept of CCA is very broad (McGray et al., 2007). CCA strategies exist across local and global scales, from community level responses through to local, national and international government interventions (UNFCCC, 2006; McGray et al., 2007). At the community level, strategies include improvements to agricultural systems such as crop diversification or the introduction of hazard resistant crop varieties; risk assessments and associated plans; the protection of natural resources; early warning systems; education and awareness measures and protection of water resources (UNFCCC, 2006). At the national level for least developed countries, some countries have developed National Adaptation Programmes of Action (NAPAs). NAPAs identify areas in which adaptation strategies are essential in mitigating against adverse climate change effects.

According IIRR et al. (2004) and Nyong et al. (2007), there is a list of indigenous adaptation strategies by the Sahelian communities, with a lot of emphasis on Ethiopia, both in the areas of crop and livestock production. For livestock production, adaptation strategies that are applied among the pastoralists include the use of emergency fodder in times of droughts, multi-species composition of herds to survive climate extremes, and culling of weak livestock for food during periods of drought. During drought periods, pastoralists and agro-pastoralists change from cattle to sheep and goat husbandry as the feed requirements of the later is less than the former. Pastoralists' nomadic mobility reduces the pressure on low carrying capacity grazing areas through the circular movement from the dry Northern areas to the wetter Southern areas of the Sahel.

This system of seasonal movement represents a local type of traditional ranching management system of range resources.

Though these studies endeavor to bring out adaptation strategies used by pastoral and agro-pastoral communities, they nevertheless cover a very wide area. More localized studies focusing on specific pastoral or agro-pastoral communities are likely to bring out differences in adaptations, which on a wider scale may appear similar but are different in content and approach.

Therefore, households are confronted with a livelihood shock that undermines their access to food can react in a number of ways. Households cope and respond to food shocks

through those that ‘protect consumption’ and those that ‘modify consumption’. Protecting consumption requires buying or being given food to maintain food intake levels. The modifying consumption includes reducing or diversifying consumption, or ‘reducing consumers’ by migrating or sending some household members elsewhere.

The capacity to adapt depends largely on the livelihood assets of the community such as the natural, human, social, physical and financial capital that one has or can access to, and how well these livelihood assets are managed and utilized by the host communities accordingly. The institutions and processes operating from the household to national level determine an individual’s, a household’s or communities’ access to assets, livelihood options, and thereby affect the vulnerability to climate change impacts.

Transforming the structures and processes of organizations that design and implement policies and legislations, deliver services, and perform other functions that affect livelihoods can reduce or worsen the impact of climate variability on vulnerable people. These structures and processes form the link between individuals or households at micro level and national governments at the macro level. Both the micro and macro contexts will have an impact on livelihood strategies and outcomes (Scoones, 1998). Livelihood strategies consist of a range of activities that people engage themselves in so as to achieve their livelihood goals. In this study pastoralists choose different types of livelihood strategies depending on the livelihood assets they have, and the social structures and institutions that impact them under a given climate vulnerability.

2.4 Challenges of Indigenous Knowledge

Long before the advent of complex numerical climate models, many communities have used changes in their environments to predict fluctuations in the weather and climate. Social and communal activities such as feasting, fishing and hunting patterns were planned in response to changes in weather and climate and revolved around the different seasons. While weather and climate patterns have been documented for many years using western scientific techniques, little attention has been paid to documenting the traditional environmental observations made by indigenous peoples (Penehuro Lefale, 2003). There is growing evidence that climate change, specifically higher temperatures, altered patterns of precipitation and increased frequency of extreme events such as drought and floods, is likely to depress crop yields and increase production risks in many world regions (IPCC, 2001).

Finally, the researcher used the literature sources regarding climate change coping and adaption strategies used by indigenous communities around the world. In this study, the researcher also used available research topics on climate change adaptation documents developed by the international organizations including World Bank, international Climate change negotiations forums, United Nations organization, the nongovernmental organizations research papers, African development Bank, intergovernmental climate change impacts and reports, indigenous climate change adaptation policy brief documents, similar research papers and publications as well.

2.5 Theories of Indigenous Knowledge and Adaptation to Climate Variability

2.5.1 Indigenous knowledge

This section analyses the concept of 'indigenous knowledge', and how this concept functions theoretically as well as empirically. Indigenous knowledge, as conceptualized in this thesis, consists of everyday practices, learning and experiences of local communities with regard to their surrounding environment. The first part of this section interrogates what should be considered as 'indigenous' to any given society. It is difficult to find a reasonable way to understand how people of various backgrounds develop, practice and sustain their knowledge. This section, therefore, cautions us not to take the concept of indigenous knowledge for granted by generalizing it as something homogenous or inherent only to particular groups. Rather, what is emphasized is that there is a hybridization of knowledge that takes place due to external influences and on-going socio-cultural transformations. The last part of this section addresses the issue of separating indigenous knowledge from western knowledge. Such a differentiation originates from a western world-view that brought within, among other things, a dichotomy between developed and developing societies. On the basis of the existing debate concerning the content, usage and impact of indigenous knowledge on the development, this section therefore, raises the following questions: what is considered indigenous? What constitutes indigenous knowledge? Who is responsible for producing indigenous knowledge and for what purpose?

Current debates in the literature and practice are mostly centered on the question of what is considered 'indigenous' (Hughes, 2003; Niezen, 2003). The major concern is based on the conceptual choices and the terms used by different scholars. Lonzano argued that the term 'indigenous' should be considered politically charged and that its definition varies significantly from one context to another. In relation to SSA, where many interventions in

the name of development exist, the concept can be difficult to define clearly (Lonzano, 2013, p.4).

Thus, to any given society, it is often difficult to distinguish locals from strangers, given the fact that people always migrate from one place to another, sometimes settling temporarily and sometimes taking up permanent residence. However, the term 'indigenous' has been used by marginalized groups all over the world to define and justify their movements (Hodgson, 2002, p.1032). In turn, during the colonial era, particularly in Africa, local residents were often described using denigrating terms such as 'tribal,' 'primitive,' 'savage' or 'wild', and were seen as worthy only of domination, providing a justification for colonial rule (Sundra, 2000, p.81).

The marginalization of indigenous people has greatly put their knowledge outside the realm of science and technology as it was seen as something that cannot bring tangible results like western knowledge could (Luthfa, 2006, p.14).

However, marginalization is not synonymous with 'indigenous'. There are diverse groups of people around the globe who have been marginalized for many years, but are not recognized for indigenous rights or labeled as indigenous people (Niezen 2003; Dei *et al*, 2000; Semali and Kincheloe, 1999). One can use the example of the beggar and homeless communities, such groups are not entitled to indigenous rights despite being marginalized and vulnerable members of society. This is due to the fact that many of the advocates for indigenous peoples put a disproportionate amount of attention on those living in the countryside and neglect others. As accentuated by Li (2000, p.151) "one of the risks that stems from the attention given to indigenous people is that some sites and situations in the country side are privileged while others are overlooked, thus unnecessarily limiting the field within which coalitions could be formed and local agendas identified and supported".

Another crucial issue is centred on the conceptual relationship between indigenous people and indigenous knowledge. The focus here is centred on what constitute indigenous knowledge? Who produces indigenous knowledge and for what purpose? Conventionally, indigenous knowledge has been represented as something opposed to western knowledge (Nygren, 1999, p.267). It subsumes a cumulative body of beliefs, practices, and information evolving by adaptive processes and passed through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment (Berkes et al. 2000). Indigenous knowledge is acknowledged

as playing a fundamental role in the management of local resources, in providing locally valid models for sustainable living, and in the husbanding of the world's biodiversity. This knowledge, which is believed to be owned by indigenous people is argued by some to be complementary to, equivalent with, and applicable to western knowledge (Turner et al. 2000, p.1275). Unfortunately, existing conventional perspectives envisage indigenous knowledge as internal to a particular community or household and unaffected by the outside world. Although much of the knowledge held by local people may indeed be indigenous in the sense that it has been handed down through the generations within a community or household, much of it is also comes from outside. It is difficult to find knowledge being utilized by local communities in the present era that has no outside influence whatsoever. In the study area for example, local people usually adopt outside knowledge as part of a broader environmental knowledge list, but only if it makes environmental, socio-cultural and economic sense to do so.

Most anthropologists have been happy to emphasize the 'indigenous point of view' and to view local people as the predominant producers of indigenous knowledge concerning natural resource management, medical cures and cosmological theories and medical cures (Moore (1996, p.2-3).

This is deliberately done to defend their theoretical position that local people are the producer of indigenous knowledge; however, less attention has been paid to the hybrid character of such knowledge. Indeed, indigenous knowledge entails various forms of knowledge, which are often assessed, re-worked and used in the interests of household activities (Briggs et al. 2007).

Thus, community knowledge on the environment is not something that only emanates internally, but is rather, influenced by external influences such as extension staff (local agricultural experts), non-governmental organizations (NGOs), and farmers from other communities. Hence, the indigenous knowledge held by a certain community is usually updated and mediated due to external influences. This clearly challenges the idea of a binary divide between indigenous knowledge and western knowledge, which pits indigenous knowledge against western knowledge (Briggs et al. 2007, p.247). Thus, outside knowledge does not negate indigenous knowledge, but rather, local people evaluate outside knowledge to see if it is appropriate to their socio-cultural, economic and environmental setting. This fact is reflected in the empirical part of this thesis, in that

Harshin Communities usually apply different forms of knowledge, which are useful and affordable to them when adapting to climate change.

However, the very notion of 'indigenous knowledge' is a western created concept, which introduces a dichotomy of traditional *versus* modern within the distinction of indigenous *versus* western knowledge. It is ethnocentric to relegate certain knowledge as 'indigenous' as opposed to 'scientific' based on the difference in the origins of the knowledge. Western scholars created the dualism between 'developed' and 'underdeveloped' societies, and suggested that underdeveloped societies had to follow the example of developed societies in order to become 'developed' (Luthfa, 2006, p.3). It is not reasonable for any knowledge to be fixed as 'indigenous' or 'western', and thus, an attempt to create a dualism between indigenous and western knowledge does not make sense.

Existing evidence has demonstrated that due to contact, variation, transformation, exchange, communication, and learning between different cultures for the last several centuries, it is problematic to adhere to a view that indigenous and western types of knowledge are untouched by each other (Agrawal, 1995a, p. 14). Thus, the debate over the dichotomization of indigenous knowledge and western knowledge can be considered artificial (Ehlert, 2007). As argued by sociologists Berger and Luckman (1980 cited in Ehlert, 2007, p.8), "local knowledge is not exclusively to be associated with Western societies. Instead, both forms of local knowledge and global constitute every society in general and therefore are not to be misunderstood as bipolar reference systems".

From the above discussion, it can be seen that indigenous knowledge is a complex concept. There should be a comprehensive, dynamic, and flexible approach relevant for precisely understanding the concept of indigenous knowledge in contemporary societies. This is due to the fact that historical, cultural, political, and social transformations underway today, particularly in the global south have resulted in the cultural hybridization of indigenous peoples and their knowledge.

In any given community or household there are varieties of knowledge which may assist local people to adapt to any environmental changes particularly climate change. This knowledge originates internally and externally. It is therefore important, to recognize different forms of knowledge within communities and households, rather than to rely on one kind of knowledge, be it 'western' or indigenous'. If a certain piece of knowledge is useful to a local community, and it is appropriate for their environmental, economic and

socio-cultural context, then it will be worth using, irrespective of whether it is drawn from indigenous knowledge or western knowledge (Briggs et al. 2007).

As previously conceptualized therefore, the term 'indigenous knowledge' is used in this thesis to represent everyday practices, experiences, learning and teaching exercised by the local communities inhabiting in Harshin woreda to adapt to different on-going changes, particularly climate change and variability impacts.

It is however important to emphasize that, this thesis does not treat the concept of 'indigenous' as something rigid or static that is unable to incorporate innovations. Rather, it is a flexible concept, which can easily integrate skills and insights from external knowledge as well as from daily practices and experiments.

2.5.2 Indigenous Knowledge and Development

This section presents a critical reading of indigenous knowledge and how it is depicted as an important resource, which can contribute to the increased effectiveness, efficiency, and sustainability of the development process. Many scholars have recognized the benefits that indigenous knowledge can offer to development among the poor rural communities in many parts of the world (Brokensha et al. 1980; Briggs and Sharp, 2004; Briggs, 2005; Bryan, 2005; Briggs, 2013, 2014). This section starts by examining the benefits of indigenous knowledge in development. The section draws on post-development theory to explain how indigenous knowledge can provide a possible alternative for development among the global rural poor population. It is argued that development cannot be attained through a top-down approach that does not take serious consideration of people, culture, and knowledge in a local context. Finally, the section concludes by highlighting the problems and tensions that have caused indigenous knowledge to fall short of its expected usefulness.

Since the end of the Second World War the development agenda has lumbered through different stages, from its focus on economic growth, to growth with equity, to basic needs, to participatory development, to sustainable development (Agrawal, 1995a). Over recent decades, indigenous knowledge has emerged as one of the popular phrases in the rhetoric of development all over the world. Interest in indigenous knowledge gained popularity during the 1980s, mainly in response to dissatisfaction with modernisation as a means of improving the standard of living among the rural poor population in the global south. The failure of modernisation to eradicate poverty in the global south was a major factor in the

rise of indigenous knowledge as a concept in development. It was assumed by the proponents of modernisation that, global south could be lifted out of poverty by the transfer of technical knowledge from Europe and North America. By the 1980s, however, it became clear that this approach was not having the expected success, particularly in Africa (Briggs, 2013, p.127). Consequently, alternatives were sought to promote local-level development while undertaking anti-development movement (Dada, 2016).

This was the major reason for the rise of the post-development perspective, which takes a critical look at the practice and theory of development. Different scholars have emphasized that indigenous knowledge is the latest and best strategy in the age old battle against poverty, hunger, and underdevelopment (Agrawal 1995a; Ajibade and Shokemi, 2003; Akullo et al. 2007; Ayana et al. 2012; Ajani et al. 2013). Since indigenous knowledge has allowed its owners to exist in harmony with their environment, using this knowledge sustainably is perceived as crucial in discussions of sustainable resource use and balanced development (Agrawal 1995a, p.413; Briggs, 2013).

This orientation stands in stark contrast to the views of earlier theorists, who perceived indigenous knowledge and institutions as inferior, and obstacles to development. Current schools of thought concerning indigenous knowledge, however, recognize that disregarding the knowledge of the poor and marginalized populations may be naïve (Agrawal, 1995b).

Indigenous knowledge is an important and appropriate alternative approach which can empower local communities to develop themselves. Thus, the relevance of indigenous knowledge in development is, consequently welcomed, as it embodies "a shift from the preoccupation with the centralized, 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 1995a, p.414). In many instances, different environmental and resource management approaches have been formulated with the exclusion of local cultural factors and expertise on the issue, thereby resulting in the rejection of such initiatives by the local people leading to the failure of the project (Chaudhury, 1993). A lack of acceptance of indigenous knowledge, alongside a lack of participation, sense of ownership and responsibility among the local communities, eventually contributes to failure of many meaningful development interventions (Vorte, 2012).

In climate change research, indigenous knowledge has been steadily acknowledged for its value with respect to environmental issues, particularly climate attendant risks and weather forecasting (Green and Raygorodetsky, 2010, p.240). Most recent studies have incorporated the contribution of indigenous knowledge into works associated with climate and development as well (Orlove et al. 2010; Raygorodetsky, 2011; Egeru, 2012; Kirkland, 2012; Ajani et al. 2013; Parsons et al. 2013).

Importantly, the IPCC Fourth Assessment Report (2007) acknowledged the relevance of indigenous knowledge as the basis for developing adaptation and natural resources management practices to withstand environmental change.

This was reiterated at the 32nd session of the IPCC3 in 2010: "indigenous or traditional knowledge may prove useful for understanding the potential of certain adaptation strategies that are cost effective, participatory and sustainable" (Naanyu, 2013, p.15). Previous IPCC Assessments were unable to access this type of information as most indigenous knowledge either appears in grey literature outside the academic realm or remains in oral form, thus falling outside the scope of IPCC process (Naanyu, 2013).

Recently, there has been increased attention given to the knowledge and capabilities embraced by small scale farmers in Third World nations as a profound basis for sustainable agriculture development. Previously only anthropologists examined the relevance of indigenous knowledge for development; however there has been an increased interest in this topic by research scientists and extension staff members from various fields. They realize that rural people in many developing countries have relevant knowledge regarding their resources and can effectively adapt to different changes overtime. Some of these research scientists have attempted to integrate indigenous knowledge in research and development, as a substitute approach to the western knowledge that is often unsuitable for the interests of the local community (Thrupp, 1998, p.13). Despite this, indigenous knowledge and alternative bottom-up approaches continue to be side-lined because of the supremacy of Western knowledge and the conventional top-down approach in research and development.

A great deal of current development thinking still reflects the dominance of western science. Development remains a technical challenge and the voices of the poor rural communities are often drowned out (Briggs, 2013). In order to address this challenge, this

thesis attempts to investigate and document indigenous knowledge used by the Harshin Communities to adapt to climate change.

Despite the term 'indigenous knowledge' being widespread, it is problematic in many instances as many studies have shown that everyday knowledge in western societies is not different in principle from everyday knowledge in non-western societies. Furthermore, the words used in this field (indigenous knowledge, local knowledge, traditional knowledge etc.) cannot be easily seen as interchangeable technical terms, but must be understood in a political context (Antweiler, 1998; Chambers, 1983). Its inherent normative and political meaning implies a qualitative assessment that distinguishes between 'good' indigenous knowledge of ethnic minorities that should be protected, and 'bad' western knowledge that has been exported by western societies and applied to the 'rest' of the world that should be disregarded (Antweiler, 1995 as cited in Ehlert, 2007, p.7-8).

However, it is often wrong to presume that the indigenous knowledge of a community is evenly practiced throughout a community or that it is feasible that every community member should be familiar with that knowledge. It is important to note that, the successful application of indigenous knowledge to any community depends on whether this knowledge is in specific to the social and cultural context of that particular community (Antweiler, 1998), and hence inapplicable beyond its local context.

Indigenous knowledge is restricted by the language, traditions, and values of the specific communities which tends toward conservation and isolation of that knowledge (Gerke and Hans-Dieter, 2006). That means indigenous knowledge seems to be location specific and hence not easily transferable to other communities, which do not share the same traditional and cultural values of the community where the knowledge originates.

Most indigenous knowledge is not well documented for future generations. This knowledge is often transmitted orally from one generation to the next, which renders it difficult to preserve. This is due to the fact that traditionally, African education is been conducted orally. In the current situation where most of the custodians (elders) of this knowledge are decreasing too fast, particularly in SSA, indigenous knowledge is at risk of disappearing since few communities have a plan to compile this knowledge (Msuya, 2007). Therefore, integrating indigenous knowledge into development policies for the rural poor population may not bring fruitful returns in the near future because the population of elders is decreasing and hence the knowledge may be soon lost.

Indigenous knowledge is sometimes accepted uncritically due to naïve notions that whatever done by indigenous people is naturally in harmony with the environment. There is historical and contemporary evidence that indigenous peoples have also committed environmental degradation through over-hunting, over-grazing or over-cultivation of the land. Thus, it is misleading to think of indigenous knowledge as always being 'good', 'right', or 'sustainable' (Tanyanyiwa and Chikwanha, 2011, p.140). However, indigenous knowledge can be easily affected by socio-economic transformation. Such transformation may force indigenous peoples to integrate with larger societies, consequently, their social structures, which underpin indigenous knowledge and practices, can easily break down (Grenier, 1998, p.8).

However, post-development theorists who usually promote the autonomy of indigenous knowledge in the development process at local levels have been criticized for their narrow attitude towards actual, prevailing development. For example, Pieterse (2000) presents a homogenous and neo-populist outlook of development, which exaggerates indigenous knowledge and improperly critiques modern techno-scientific progress. In a related way, post-development theorists do not pay much attention on what might be considered the achievements of contemporary development such as the dramatic increases in life expectancy in recent years. Advocates of this theory usually respond that any such improvements are compensated by losses or sometimes ascend only with the maintenance of a lopsided international power structure. Whether the issue of losses and gains can be empirically resolved is arguable, but what is undoubted is that gains are realizable, as they have always been in the asymmetrically developing capitalist system (Storey, 2000).

2.5.3 Indigenous knowledge and learning

The acquisition of indigenous knowledge by any given community involves a process of learning and knowing. Indigenous knowledge have to be learned, respected, shared and received by people who come into contact with it. It must also be understood and disseminated to others within the community through generations. However, the main question is: how does one acquire indigenous knowledge? Indigenous knowledge can be considered a product or commodity that is embedded in a particular place and is attached to a community that holds and practices it (Battiste and Honderson, 2000). Such a view confirms that indigenous knowledge is an essential part of the indigenous peoples who own and use it and pass it from one generation to another. Therefore, this knowledge should not be separated and must be disseminated holistically. Indigenous knowledge has

to be incorporated in a form that is likely to be addressed by indigenous practices of knowing and learning (Tiu, 2007, p.26).

The process of knowledge acquisition within the community seems to be a cyclical process, in which one learns through the recreation of past experiences including "those of one's ancestors and builds on prior learning and tradition" (McGregor, 2004, p. 388). This learning process is rooted in informal teaching methods in which various knowledge and skills are learned and passed down throughout different generations (Tiu, 2007, p.26). The process of learning indigenous knowledge differs to some extent with that of Western contexts although there are some commonalities in the process of learning. For example, to achieve an outcome in learning indigenous knowledge, certain processes must happen in a specific order to achieve it. This is the same as someone undertaking a scientific experiment. Equally, indigenous knowledge is learned from many sources and includes observations and interactions with different objects and phenomena in one's environment. Knowledge gathered in this way is clustered into three groups namely; traditional knowledge, which is transmitted from generation to generation; empirical knowledge, which is gained from daily observation; and revealed knowledge which is obtained through spirit and recognized as a gift (McGregor, 2004, p.388). Of these three categories, it is much more convenient to acquire traditional and empirical knowledge, since these forms of knowledge are observable. Revealed knowledge however, is frequently seen as personal knowledge obtained by having encounters with spirits. Such forms of knowledge are confined to specific individuals within a community. There are many sources, in which indigenous knowledge can be acquired, ranging from interpersonal experiences to perceived spiritual experiences (Tiu, 2007). Thus, the learning of indigenous knowledge is often guided by specific rules that govern the acquisition of knowledge within the community (McGregor, 2004). It is often personal knowledge that causes conservation practitioners to face difficulties in implementing their projects as they either fail to recognize the existence of this indigenous knowledge or if they recognize its existence, it is difficult for them to establish its sources. This can cause conflicts if the entirety of indigenous knowledge is not acknowledged (Tiu, 2007, p.28).

Understanding the learning process of indigenous knowledge is important for this thesis as it illustrates how indigenous knowledge evolves and is passed from one generation to another. The learning process of indigenous knowledge is informed by nature since much of the coaching and learning process usually occurs on an ad hoc basis, in which the

acquisition, interpretation and dissemination of indigenous knowledge happens at varied locations and settings depending on the activity being administered (Tiu, 2007, p.28). For instance, the skills of sowing beans and maize in the Harshin community would be utilized in the home garden while the grazing of livestock would occur at the pasture. Indeed, the learning by doing approach is very common in the acquisition of indigenous knowledge. This kind of learning takes place between the learners and the community, and enables learners of indigenous knowledge to be actively involved and hence become more knowledgeable toward their local environment. Learning from direct experience and learning by doing gives learners a broader perspective of their environment (Simonelli, 1997).

2.5.4 Situated learning theory (SLT)

The theory behind the instructional approach of situated learning arises from the fields of psychology, anthropology, cognitive science and sociology (Vygotsky, 1978; Dewey, 1981; Lave, 1988; Lave and Wenger, 1991; Greeno et al. 1992).

Essentially, this theory demonstrates how learning or knowing certain knowledge within a particular community is embedded within the socio-cultural context of that community.

Situated learning scholars contend that knowledge must be learned or acquired in context and not in abstract. This theory accentuates the idea that much of what is learned is usually specific to the situation or event in which it was learned (Vincini, 2003). SLT examines learning as a fundamentally social phenomenon that occurs throughout everyday interactions. Such learning interactions are produced by the social relations, cultural context, specific artefacts, and physical dimensions of the learning environment (Henning, 2008, p.143). Making a new contribution to the growing body of literature concerning SLT is not an easy task, but there is a need for refinement, particularly in the way this learning concept is used to study knowledge acquisition from a geographical perspective. Thus, this thesis uses SLT to explicate the process of learning and knowing indigenous knowledge within the community.

SLT endeavors to portray the existing mismatch that exists between the knowledge learned from school *vis-à-vis* the knowledge learned from day to day experiences. As it has been discussed earlier, indigenous knowledge is culturally specific and is transmitted from one generation to another. The learning process of indigenous knowledge involves active participation as opposed to more passive methods often used in western learning.

Students are actually more likely to acquire certain knowledge by actively participating rather than simply listening to teachers (Lave, 1988, p.9).

This example illustrates that, a person learning indigenous knowledge is actively involved in addressing day to day community problems. Thus an individual learner becomes situated in the learning experience and knowledge acquisition becomes a part of the learning process as well as the culture from which the learning process evolved and is used (OTEC, 2007). The acquisition of indigenous knowledge thus includes daily interactions between people, culture, and environment. It is highly emphasized in situated learning that social interaction within the community is an important component since learners become actively involved in a community which utilizes the behavior and beliefs to be acquired (Lave, 1988).

The process of learning indigenous knowledge is informal and usually occurs on a spontaneous basis whereby those who are learning are expected to learn by being a trainee in different community oriented activities. Survival often depends on the learning of indigenous knowledge in this context, thus, every person within the community has a social commitment to learn from the expertise of others so as to contribute to the survival of their family, tribe and community (Tiu, 2007).

For example, the preparation of traditional herbs for curing different diseases in a given community requires learners to participate in different stages of the process starting with the collection of herbs from the bushes in order to master the skills needed to prepare the herbs. This idea is supported by Cajete who argues that learning in an indigenous context is a communal social activity. The idea of learning as a communal activity implies that the learning process involved is situated learning because the situations, in which individuals learn, are situated within cultural or social contexts (Cajete 1994, p.20).

Situated learning is not only applicable to learning indigenous knowledge, but can also apply to western knowledge if the learning process conforms to the socio-cultural milieu of a certain community. This view is corroborated by Rogoff (1990) namely, that a learning process that considers the cultural context of learners is important for learning any socio-cultural activity, since the relationship of personal development and social interaction cannot be isolated from the cultural setting of the learning. Additionally, learning processes can only be successful if learners are provided with the opportunity to co-participate with both participants and practitioners, and at the same time be integrated

in all types of social activities that will provide the basis for learning to occur (Tiu, 2007, p.30). As emphasized by Lave and Wenger (1991, p.18), “co-participation enables people to gain access to modes of behavior, eventually developing skills adequate to certain kinds of performance”. In the process of learning western knowledge specifically for adaptation to climate change, local communities are constantly involved in co-participation so as to advance more their skills.

3. MATERIALS AND METHODS

3.1 Description of the Study Area

This study was carried out in Harshin *Woreda* of Fafan (formerly known as Jigjiga) zone, Ethiopia located 125 Km east of Jijiga town. The population of Harshin *woreda* is around 80,215 where 45% and 55% are males and females respectively according to (CSA, 2007) and the average household size in this *woreda* is 6.5 (BoFED, 2010).

About 90% of the Harshin *woreda* communities dwell in the rural area and depend mainly on livestock production for their livelihood and 10% are urban and suburban dwellers.
The livelihood of the people mainly depends on extensive traditional livestock production, natural rangeland vegetation, and water resources. Yet, environmental degradation throughout the region has intensified in the past 10 years and manifested in the forms of deterioration of drinking water quality, and increased rate of evapo-transpiration (Kassahun *et al*., 2008). The water resource in the Harshin *woreda* is scarce and with erratic nature. Traditionally, the people in Harshin *Woreda* store the only available source of water, rain water, in cisterns (known as Birkas) for domestic as well as livestock consumption.

Administratively, the *woreda* comprises of 23 *Kebeles* that are grouped into 15 Development Centres. Its climate is typical of semi-arid lowlands, with erratic rainfall patterns and recurrent droughts. The *Woreda* is composed of two livelihood groups, pastoral (90%) and agro-pastoral (10%). The livelihood zone of Harshin *woreda* is part of Harshin - Dagahbur East Pastoral Livelihood Zone (LZ17**)** and Households are engaged in pastoralism mainly on sheep and goat production. Camel and cattle are also important types of livestock, which are in fact declining recently.

According to the *Woreda* disaster Risk Profile (WDRP) of Harshin *Woreda,* Drought is the most important disaster risk in all *Kebeles* of Harshin *Woreda*. The major effects of this disaster are loss of grazing land (pasture), loss of water sources for human and livestock, and physical damage on household members and property (including on crop and livestock). Economic shock (inflation) in the *Woreda* is reflected in high food price and low livestock price, which depletes household's saving and income level resulting in food shortage and loss of access to social services. Livestock diseases (mainly caused by anthrax, faculiasis, internal and external parasites, CBPP and foot and mouth disease) are

potential hazards in livestock production and their impact is significant as the *Woreda* is mainly a pastoralist area.

On the other hand, the main human sicknesses reported by households in their order of importance include pneumonia/ lung problem, backache, diarrhea, chronic fever and headache, while main sicknesses of children below 7 years of age are diarrhea, pneumonia/ lung problem, chronic fever and malaria. Drought is the most important disaster risk in all *Kebeles* of Harshin *Woreda*. The major effects of disasters are loss of grazing land (pasture), loss of water sources for human and livestock, and physical damage on household members and property (including on crop and livestock).

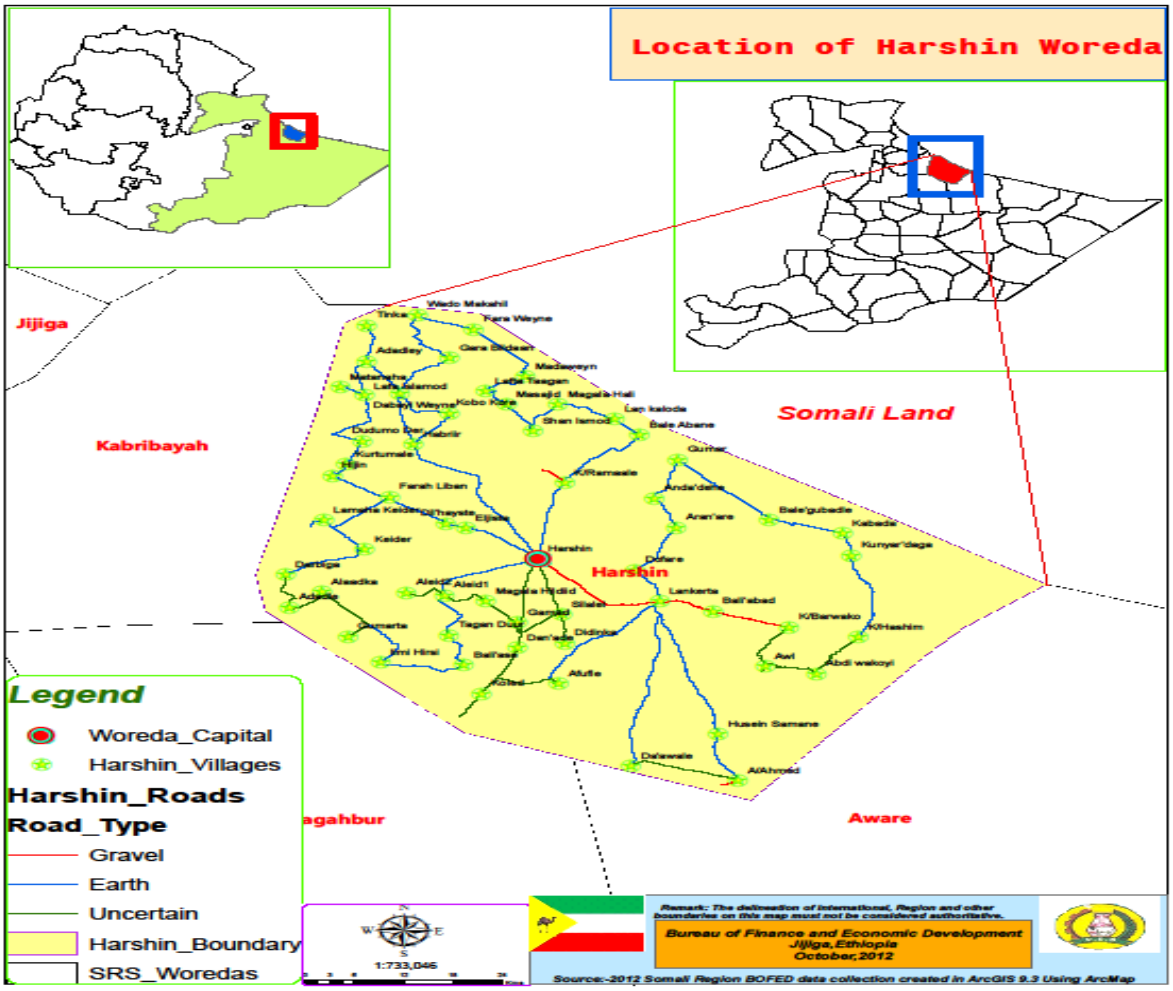
Economic shock (inflation) in the *Woreda* is reflected in high food price and low livestock price, which depletes household's saving and income level resulting in food shortage and loss of access to social services. Livestock diseases (mainly caused by anthrax, faculiasis, internal and external parasites and foot and mouth disease) are potential hazards in livestock production and their impact is significant as the *Woreda* is mainly a pastoralist area. On the other hand, the main human sicknesses reported by households in their order of importance include pneumonia/ lung problem, backache, diarrhea, chronic fever and headache, while main sicknesses of children below 7 years of age are diarrhea, pneumonia/ lung problem, chronic fever and malaria.

More importantly, drought and economic shocks are among the major disaster risks in Harshin *Woreda*, whose effects are reported increasing over the last decades. Livestock, crop and human diseases are also among the major hazards reported in the *Woreda*. Environmental problems (such as water pollution and deforestation), poor veterinary facilities, and lack of agricultural inputs and extension services are the major factors enhancing households' vulnerability to hazards, (Harshin, WDRP Program).

3.1.1 Location

Harshin *woreda* is one of the eight *Woredas* of Fafen Zone in the northern part of The Ethiopia Somali Regional State. The *woreda* is located and bounded between 8° 27' 11.0187" N to 10° 01' 40.170 North and "N" and 41° 40'13.6557" E to 45° 32' 35.7129" East. It covers a total area of 1,315.1 km^2 and is bordered by Kebribayah *woreda* in the west, Somaliland to the north, east, and Aware and Degahbur *woredas* to the east and south respectively. Harshin town is about 120 km from Jigjiga.

Figure 1: Map of Harshin Woreda



Sources: *Somali Region BoFED, 2012*

3.1.2 Climate and Vegetation

The climatic conditions of Harshin *woreda* characterizes as arid agro-ecological locality where the rainfall pattern characterizes by two short rainy seasons. The two predominant rainy seasons in this zone are the '*Gu'* rains in late March– late June and the '*Deyr'* rains in October – November. Harshin *woreda* falls on the boundary between the areas of Somali Region that receive '*Karan'* rains in late July – September and those that receive '*Deyr*' rains. Vegetation cover consists of various acacia species, bush trees and grasses, which form the life-sustaining resources for local pastoralists.

3.1.3 Livestock Population

Livestock is an important component of farming system in the region. The total livestock population consists of 1,174,807 out of these 573,515 (48.82%) are sheep, 399,815 (34.03%) are goat, 134,090 (11.41%) are camel, 48,645 (4.14%) are cattle, and 17,343 (1.48%) are donkeys. The remaining 1,399 are mule and horses., Camels and small ruminants represent over 90% of the district`s total livestock population.

3.1.4 Production system

Livestock economy, mainly selling of milk, is the predominant livelihood in the area, although cross-border and petty trade as well as charcoal production provides alternative incomes. Due to recent and recurrent droughts as well as a livestock import ban imposed by Arab Gulf States, livestock prizes are on the decrease. The cropping pattern of the *woreda* is dominated by sorghum and maize. The main source of crops is nearby agro-pastoralist and farming areas in Jijiga zone (SCF-UK, 2008).

3.2 Methods of Data Collection

3.2.1 Research Design

According Kothari (2004) research design is the arrangement of conditions for the collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. In fact, the research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data. So research design plays a pivotal role in serving as a road map.

This study had used an explanatory research design and the main purpose of selecting this research design was that it formulates a problem for more precise investigation or of developing the working point of view. Because an explanatory research goes beyond description, it examines the aspects of a described situation or an event simultaneously. Therefore, to describe and explain the impact of climate change and its current trends in Harshin *woreda* of Somali region, the researcher applied an explanatory research approach which combined both qualitative and quantitative approaches in order to give better depth and breadth to the findings of the study.

3.2.2 Sources of Data

The researcher gathered the data from both primary and secondary data sources. The primary data sources were collected from the pastoral communities living in the study area that included the elders and intellectuals, civil society and nongovernmental organizations through the use and distribution of a structured questionnaire.

The researcher gathered the secondary data from both online and offline available sources such as documentary based secondary data, prior published papers and similar research findings regarding the impact of climate change and the role of indigenous knowledge as coping and adapting strategies employed by the Harshin community as well as other multisource secondary data sources.

The main methods used in this study for the purpose of data collection are accordingly through the combinational use of questionnaires, focus group discussions and key informants interviews as well.

3.3 Data Collection Tools

The nature of data collection used in this study was an explanatory research design that utilizes both the qualitative and quantitative research approaches in order to increase the validity and reliability of the findings of this study.

The study focused both qualitative and quantitative data. Both primary and secondary sources were used. Therefore, in order to obtain the required primary data, the following tools and techniques were used such as having an Interview scheduling and then collected the relevant data accordingly from the different respondent groups of the study by using separate interview schedules for each respondent group.

In addition, questionnaires were also distributed to collect data from the community living of Harshin *woreda* including elders while an informal meeting and visits were also conducted with key informant focus groups. Moreover, other related documents were also reviewed for obtaining the secondary data relevant to the issue being addressed under this study.

Questionnaires have the advantage to cover a large area easily and quickly and low cost even when the universe is large and is widely spread geographically and, it is free from the bias of the researcher, respondents have adequate time to give well thought out answers,

respondents, who are not easily approachable, can also be reached conveniently and large samples can be made use of and thus the results can be made more dependable and reliable (C.R Kothari, 2004).

This study used close-ended questionnaire in order to gather information from the employees. Because this type of questionnaire generates statistics in quantitatively as these it follow a set format, and as most can be scanned straight into a computer for ease of analysis and greater numbers can be produced. Therefore, in this study 165 papers were distributed to the purposively selected community members to collect the necessary data. The questionnaire was firstly prepared in English language and then it was translated into the local Somali language for that expert checked the consistency between the two versions which avoided a certain inconveniences and communication barriers. Finally, data collectors were recruited from the experts of the *woreda* sector bureaus as well as from the local people and more consideration were given those having with adequate knowledge about the local institutions being investigated by this study.

3.4 Sampling Techniques

The sampling technique employed in this research was both probability and non-probability sampling techniques which were considered to be an important due to the nature of the research methods chosen by the researcher.

To select sample from each *kebele*, sample proportional was used, out of 23 *kebeles*, four sample *kebeles* were selected with a sample size of 165 respondents from a target population of 1040 that were selected from the four *kebeles* of *woreda*. Therefore, out of 300, a sample of 48 participants were selected for Kudaramale *kebele* while which was calculated as 165/1040*300. Therefore, the same procedure was used by the researcher for the other three *kebeles* of Adadle, Sogsog and Garabelden accordingly.

Probability sampling techniques were employed in order to select sample for filling a questionnaire, respondents were selected in a systematic random sampling by taking every 6^{th} from the respondents. This procedure was useful because sampling frame was available in the form of a list. In such a design the selection process started by picking some random point in the list and then every 6^{th} element was selected until the desired number was secured.

On the other hand, non-probability sampling was employed in order to select the key informant for the interview, and in this process of selecting these informants, a purposive sampling was employed in order to get further relevant information.

Firstly, this study mainly focused on the Local elders, pastoralists, farmers, community and religious leaders as well as *woreda* sector office heads and *kebele* administrations, extension experts, local NGOs staff and *Kebele* Development Agents (DAs) for the KII and FGD expecting them as stakeholders in indigenous knowledge and the climate change impacts on the livelihoods of each sample *kebele* households.

The researcher had purposively selected other institutions that are also important stakeholders from the target population (1040) as key informants including women and youth.

Secondly, it is not possible to study all *kebeles* and the community as a whole in the *woreda* within this limited period of time and resource constraints. Accordingly, only four sample *kebeles* were randomly selected from a total 23 *kebeles* of the *Woreda*, those *kebeles* are namely; Kudaramole, Adadle, Sogsog, and Garabeldan.
Out of the four *kebeles*, 165 respondents were randomly selected based on probability proportional to size. The sample *kebeles* population and sample households from each *kebeles* is shown in the below table.

Table 1: Sample Kebeles by Number of Total Households and Sample Size

S/N	Kebele Name	Total Households	Sample Size	Percentage
1	Kudaramale	300	48	29%
2	Adadle	280	44	27%
3	Sogsog	250	40	24%
4	Garabeldan	210	33	20%
	Total	**1040**	**165**	**100%**

The researcher applied the rule of thumb which says in deciding sampling interval divide the total population by the sample size that means Kth=N/n, Where k^{th} is the sampling ratio, N is the estimated population size and n is the sample size. For this study N=1040 and n=165 Therefore, the skip interval will be 1040/165=6. Approximately, this was considered as the random starting point and was included in the sample study.

To ensure that appropriate respondents for quantitative data are included in the study, a sample plan was developed. Moreover, this study applied the formula suggested by Kothari (2004), to calculate the sample size:

$$n = \frac{z^2.p.q.N}{e^2(N-1) + z^2.p.q}$$

$$= \frac{(1.96)^2(0.5)(0.5)(1040)}{(0.07)^2(1040-1) + (1.96)^2(0.5)(0.5)}$$

$$= \frac{(3.8416)(0.25)(1040)}{(0.0049)(1039) + (3.8416)(0.25)}$$

$$= \frac{998.816}{5.0911 + 0.9604} = \frac{998.816}{6.0515} = 165.053$$

Where n equals sample size, z is the confidence level, e is the tolerance. For this study P = 0.5 to achieve a normal distribution. n= 165 by setting confidence to be 0.95 and error tolerance = 0.07. Therefore, the sample size was determined to be 165 which were 15.87% of the total population. This sample size was therefore considered to be adequate for the study. Similarly, the researcher had purposively selected *woreda* sector officials and *kebele* administrations to include in the Focus group discussions (FGD) and the key informant interviews (KII). The reason was that participants in top level positions were assumed to be a major source of information for the data gathering process required by this study.

As far as employee and experts representation is concerned in the study population, a systematic random sampling technique was used to include in the sample.

3.5 Data Analysis Tools

Analysis of the data is a crucial part of the research study. This section gives an overview of the analytical techniques. On the other hand, since the findings and conclusion are based on the analysis and interpretation of the data. The data were analyzed in accordance with the nature of data which is either qualitative or quantitative as discussed below.

The qualitative data were gathered through un-structured interview that was transcribed, classified and categorized. Then the categorized data were enrolled under thematic areas and presented in a narrative form. To further enrich and enhance the information collected, the quantitative data were independently analyzed and triangulated with the qualitative data. In this study, the quantitative data which were obtained through questionnaire were

analyzed using descriptive statistics of central tendency measurements and percentages. The data were first coded, organized and discussed using tables. The median was used to show the central tendency for the ordinal scales and skewness to show the distribution of the population. In addition, percentages was used for the nominal scale especially in the demographic and questions with non-likerty scale through the statistical package for social science (SPSS 20V) while ANNOVA methods were also employed for the analysis of this study accordingly.

4. RESULTS AND DISCUSSIONS

The human relationship with nature has produced complex knowledge systems, which are responsive to change, self regenerating as well as being multidimensional in nature. The close knit association between this knowledge systems and ecosystems offers us the greatest opportunity to understand how humans respond to change. These human responses includes coping with water related stresses, agricultural and other practices, housing pattern and its density, conservation skills etc. Here, an attempt has been made to assess the various dimensions related to indigenous knowledge and climate variability.

4.1 Socio-economic Characteristics

As it has been mentioned earlier in description of the study area under chapter three, Harshin *woreda* is among the mainly pastoral districts of Fafen zone of Ethiopian Somali Region and the community are mainly dependent on livestock for their livelihoods although a very minor portion of the community also practice farming by making use of the limited rains they get. This part of my results summarizes the socio-economic characteristics of my respondents in the study area.

4.1.1 Respondents' profile

The respondents' profile constituting of Age, Sex, Educational level and household size is presented in Table 2.

Table 2: Respondents Profile

Descriptors	**Mean±SE**		**Median**	**Mode**	**Range**
Age	45±1		44	45	22-89
	Male			**Female**	
	N (%)			**N (%)**	
Sex	114 (69.5)			50 (30.5)	
	Illiterate	**Adult Education**	**Primary education**	**Secondary education**	**Other**
	N (%)	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Educational Level	78 (47.3)	48 (29.1)	15 (9.1)	10 (6.1)	14 (8.5)
	Between 1-3	**Between 4-7**	**Between 8-11**	**Above 11**	
	N (%)	**N (%)**	**N (%)**	**N (%)**	
Household Size	32 (19.4)	81 (49.1)	38 (23)	14 (8.5)	
N=165					

As shows in the table, the mean age group of the respondents was found to be 45 years between the ranges of 22-89 years old. Similarly, majority of the respondents (69.5%) were male while the remaining 30.5% were females. In terms of the educational level of the respondents, as the results in above table show, the majority of the respondents were illiterate accounting 47.3% whereas 29.1% and 9.1% of the respondents possess adult and primary education levels respectively. Respondents having an educational level background above secondary school and are considered as diploma holders only accounted for only 8.5%.

With regards to household size, the majority of the respondents (49.1%) possess household size between 4 and 7 followed by respondents that have household size between 8 and 11 accounting for 23%. Moreover, 8.5% and 19.4% of the respondents have the largest and smallest household sizes above 11 and between 1 and 3 family size respectively.

Table 3: Correlation for Households Income by Source

		Monthly Income (ETB)		
Source of Income*	**N** (%)	**Mean±SE**	**SD**	**Range**
Selling Livestock	52 (31.52%)	$ 2,518.17(±105.6)	$ 761.9	$ 1200-5000
Milk Marketing	30 (18.8%)	$ 2,586.67(±105.8)	$ 580	$ 1500-4200
Remittance	37 (22.42%)	$ 4,082(±263.3)	$ 1,601.8	$ 2000-8000
Employment Salary	35 (21.21%)	$ 4,175.6(±260.5)	$ 1,541	$ 1500-7000
Hunting	1 (0.61%)	$ 1,310	-	-
Other	10 (6.06%)	$ 3,620(±332.5)	$ 1,405.4	$ 1200-8000

* There is a significant (P<0.05) difference of Monthly Income between groups.

The above correlation results table (Table 3) portrays that the monthly household income for the majority (31.52%) of the respondents depend on livestock selling with the monthly income range between 1,200 Birr and 5,000 Birr followed by the second major category of respondents (22.42%) that earn their monthly income as remittances from an overseas financial support from close relatives and family members with an income between 2000 ETB and 8000 ETB. Moreover, the moderate monthly household income (21.21%) usually goes to the government employees who earn it as salary on a monthly basis from their respective government departments and institutions while the monthly household income sources for milk marketing households and others constitute 18.8% and 6.06% with an income range between (1500 – 4200) and (1500-8000) respectively.

According to Brooks and Adger, (2005); the community could or could not adapt to climate change, it could depend on its resources including financial capital, social capital (e.g., strong institutions, transparent decision-making systems, formal and informal networks that promote collective action), human resources (e.g., labor, skills, knowledge and expertise) and natural resources (e.g., land, water, raw materials, biodiversity). Therefore, the more a given community has wide range of income sources, the researcher assumes the more likely the community may withstand climate variability induced shocks.

Moreover, communities which have a strong kinship network may increase adaptive capacity though collective action and conflict resolution between members. Adaptations are manifestations of adaptive capacity thus populations having better adaptations or changes in the systems can deal well with problematic exposures of climate variability according to Smit and Wandel, (2006).

Furthermore, The IPCC (2007) further points out that 'those in the weakest economic position are often the most vulnerable to climate change and are frequently the most susceptible to climate-related damages, especially when they face multiple stresses'. In this respect, specific reference is made in the AR4 to indigenous peoples and traditional ways of living.

4.2 Access to Media & information on Climate Change

Climate change effects are substantial that unless and otherwise effective adaptation strategies are in place the consequences can be devastating. Accordingly, in order to device a sound and working adaptation strategy requires the availability or accessibility of climate change information. Hence, the status of climate change information sharing and availability of sources in the study area are presented as follows.

4.2.1 Media Accessibility

Results of household's access to media in Harshin *woreda* and how this access is correlated with their educational level they have is presented in Table 4 as follows:

Table 4: Correlation Results of Household's Access to Media & Educational Level

Level of Education	Households' access to media		Total
	Yes	No	N (%)
	N (%)	N (%)	
Illiterate	14_a (17.9)	64_b (82.1)	78 (100)
Adult education	31_a (64.6)	17_b (35.4)	48 (100)
Primary Education	14_a (93.3)	1_b (6.7)	15 (100)
Secondary Education	10_a (100)	0_b (0)	10 (100)
Other	14_a (100)	0_b (0)	14 (100)
Total	**83 (50.3)**	**82 (49.7)**	**100**

Each subscript letter denotes a subset of Household's access to media categories whose column proportions do not differ significantly from each other at the .05 level.

As shown above, out of 78 illiterate households, only 14 illiterate households (17%) have access to media while the remaining 64 illiterate households have no access to media regarding climate change. Similarly, from 48 adult educated households, the majority of them (31 HHs or 64.6%) having an adult education usually access media while there's no media accessibility for rest of 17 (35.4%) of households having an adult education followed by a media accessibility for 14 (93.3%) of households because they have a primary education while the remaining households with no primary education (6.7%) and have no chance for media accessibility. Moreover, households with secondary and higher levels of education have 100% full media accessibility and coverage respectively.

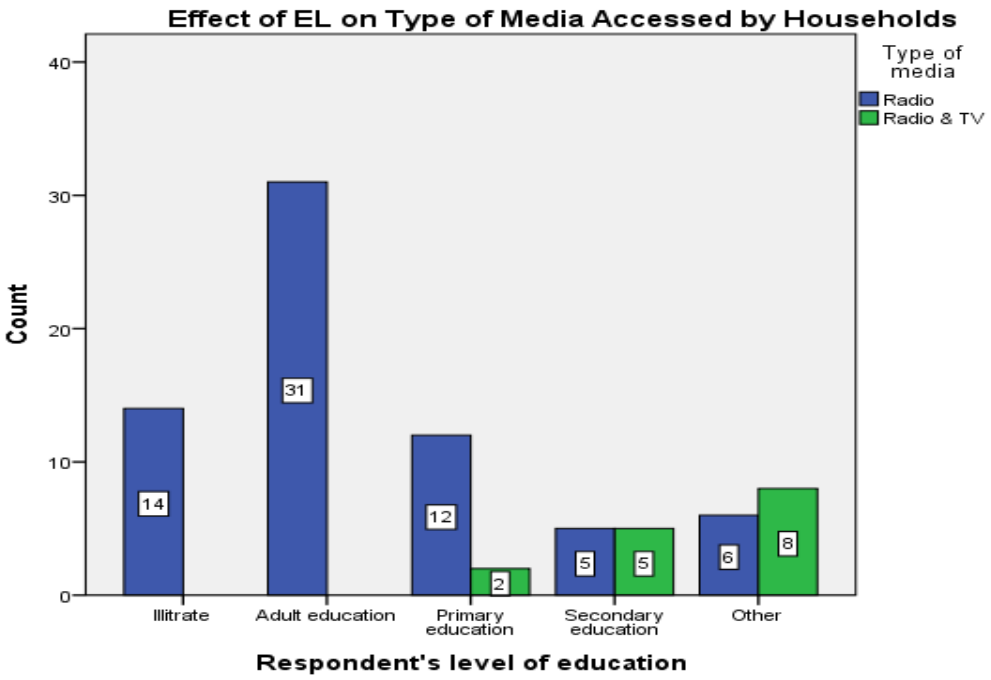
As per the above illustrations, there's an inverse correlation between the level of education and the media accessibility. As a result, it's the level of education that increases a household's chance of accessing the media because as shown above table, the more a household have a level of education even adult education, the more that household have more chances and easy accessibility of media compared to households are full of illiterates accordingly.

According to Vinod Kumar (2014), the integration of indigenous and modern form of skills would be yard stick of his learning from past glorious history. Apart from this role of mass communication and media is also important in spreading knowledge among general masses.

4.2.2 Type of Media Accessed

The type of media through which any early warning regarding climatic variability is communicated is as important as the accessibility of the media itself. The type of media accessed is influenced by different factors constituting of socio-economic and personal preferences, socio-cultural values and alternative options available. In Harshin *woreda* the media options available for the community include an FM broadcasting radio, a satellite TV channel (ESTV) and the Internet as well. However, the preference of which of the available media options to use is entirely dependents on different factors. The results of this study regarding the type of media accessed and how this is correlated with the educational level of the respondents is presented in the following figure (Fig 4).

Figure 2: Type of Media Accessed By Level of Education



From the above table, it's all about the relationship effect between the level of education and the type of media accessibility a pastoral household have on their disposal accordingly. Accordingly, there are two types of media that can be accessed by the Harshin pastoral communities, namely; Radio and Television transmitting in local (Somali) language. Moreover, households that are illiterate (14%) and households with an adult education (31%) similarly only access to radio while households that have a primary level of educational background have radio and both radio & TV accessibility of 12% for radio access and 2% for both radio & TV accessibility accordingly while households with secondary levels of educational backgrounds above similar access to both Radio and

Television (TV) followed by those households that possess far higher educational backgrounds and thus have more access to Television rather than the Radio (8% and 6%) because of their advanced levels of educational background accordingly.

Therefore, it's clear for the researcher that higher levels of education constitute higher monthly income for a given household while at the same time higher income whatever the sources, is also contributing factor for the accessibility one may possess for the type of media such Television and Radio.

4.3 Community Perceptions to Climate Variability

Climate change adaptation (CCA) strategies; whether traditional/indigenous or modern; aims to reduce vulnerability of the communities to expected impacts of climate variability. In order these to be effective, it requires the awareness of the community regarding the climate change variability, how it can be averted. Results of the study regarding how the pastoral community's; in the study area awareness level is discussed as follows;

Climate change is among the many drivers of change which contribute to community vulnerability. Its impacts cannot be isolated from the multiple agricultural, economic, socio-cultural and environmental changes facing the local communities. These impacts intermingle, creating exacerbating and cascading effects. This section attempts to identify how local communities in Harshin *Woreda* perceive and explain their local climate conditions. Their perceptions are relevant as they indicate and predict the state of the local climate in the future, by considering their information access, local experiences and indigenous knowledge.

The results of awareness levels of the Harshin pastoral community regarding the climate change is presented here by Table 4 as shown below:

Table 5: Households Awareness Levels of Climate Change and Variabilityy

Descriptors	Climate Variability Awareness Level			
	N	%	Valid %	Cumulative %
Knows a lot	26	15.8	15.8	15.8
Knows	31	18.8	18.8	34.5
Knows a little	27	16.4	16.4	50.9
Does not know	81	49.1	49.1	100
Total	165	100	100	

As presented above frequency table, the communities of the study area do not know much about climate change though they witness the impact of climate variability on their livelihoods on a daily basis because majority (49.1) of the respondents know nothing about climate change followed by 18% of the respondents that say they know about climate change while 16.4% group of the respondents out of the 165 sample knows little and have some information regarding climate change and its only 15.8% of the respondents that are well aware of the climate change.

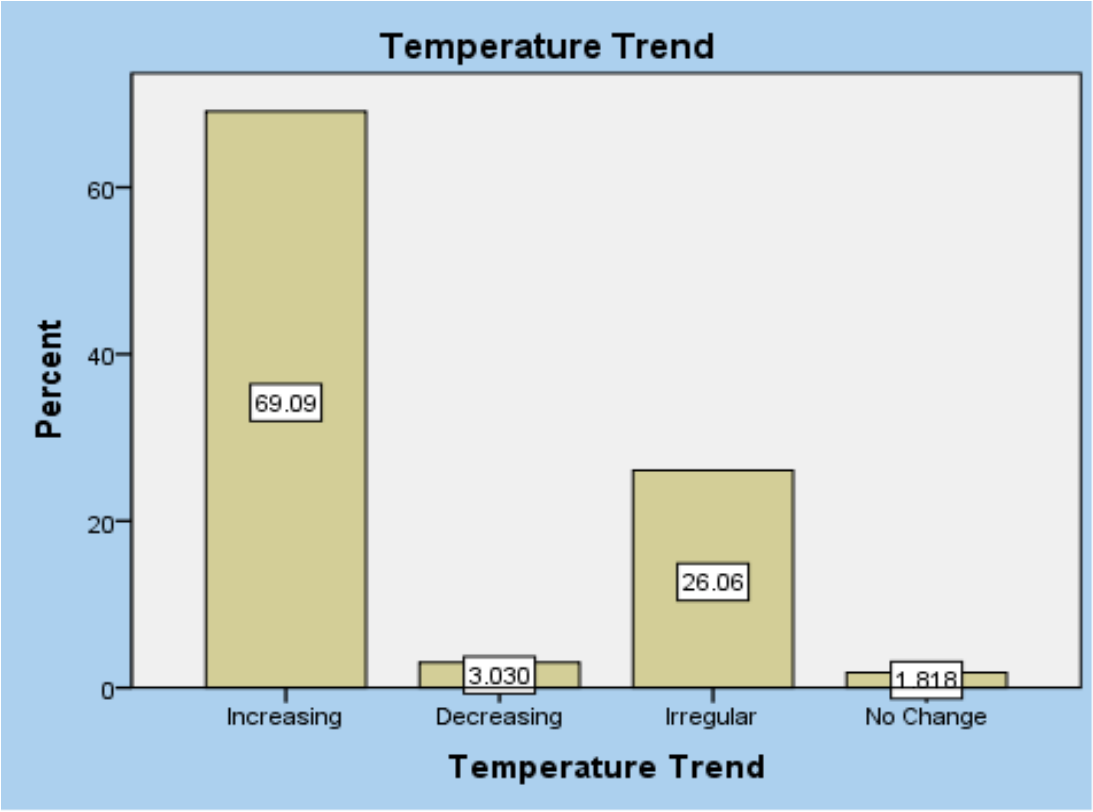
Perception has a very strong impact on adaptation measures at the individual or community level (Maddison, 2006). It affects the specific nature of their behavioral responses, and shapes adaptation options, processes and outcomes (Pauw, 2013, p.270). Therefore, understanding the local community's perception of their local climate is important since it raises individual cognition (Grothmann and Patt, 2005, p.205) regarding the ways he/she should adapt hence, this enhances adaptive capacity (Smit et al. 2001). For rural households, perceptions of local climate change help them to make decisions to change their daily practices in order to adapt to climate change risks (Ndaki, 2014). Thus, any misconceptions on climate change and its related risks may result in no adaptation or maladaptation which can increase the negative impact of the changing local climate (Grothmann and Patt, 2005). The following sections present different perceptions of the changes in local climate from local community members. Different methods were used to collect information regarding local perceptions including questionnaires, focus group discussions and interviews. Therefore, the overall assumption is that most of the respondents actually know nothing about what climate change is or it's possible that they are ignoring the variability of climate change for deliberate various unknown reasons including religious factors and other beliefs as well accordingly.

4.3.1 Temperature Trend

The results of the study as indicated on Figure 4, the majority (69.09%) of interviewed respondents perceived increasing changes in temperature. However, 26.06% of the sample households' perceived irregularity of temperature while 3.03% perceived decreasing temperature and the rest 1.8% perceived that there is no change of temperature.

This indicates that there is a change in temperature in recent years which is one indication of climate variability which increases the vulnerability of the community to various types of shocks affecting their way of life and livelihood systems accordingly.

Figure 3: Household Perception in Temperature Trend



Source: Own survey (2017)

4.3.2 Precipitation Trend

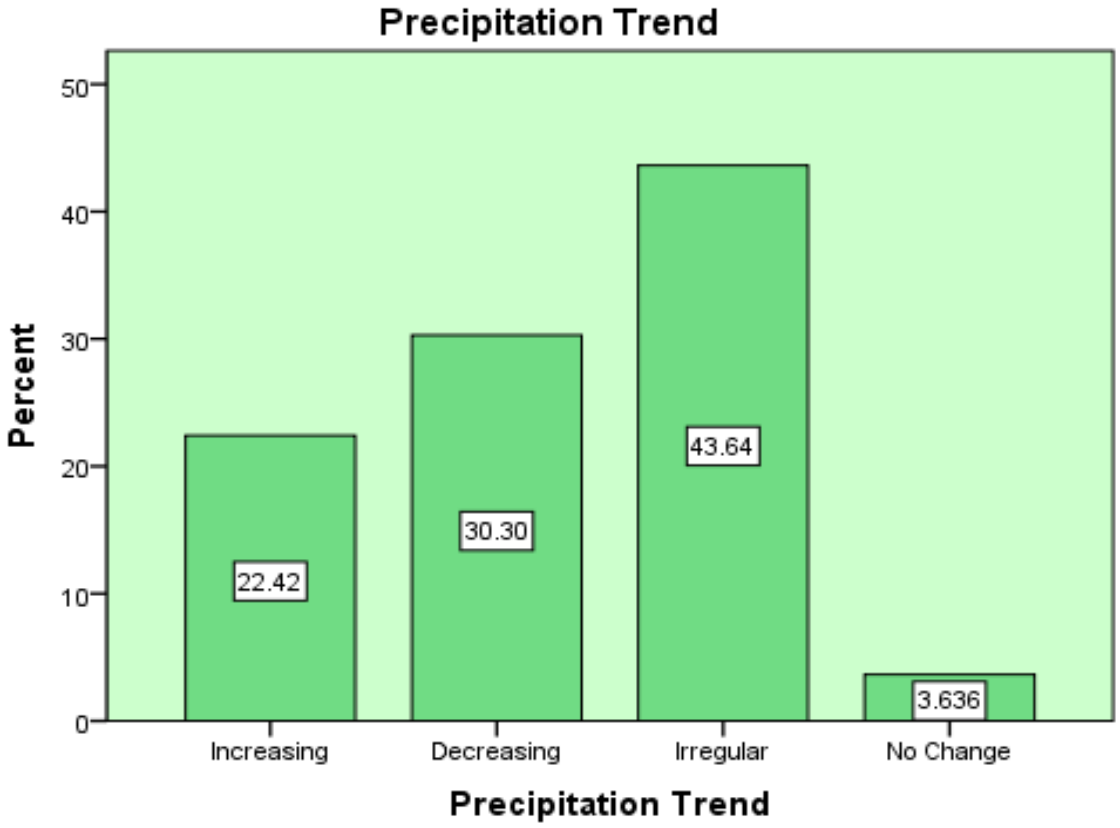
As indicated in the below figure, agro-pastoralists' perceptions on changes in precipitation of the study area shows that most of the respondents noticed changes in precipitation pattern and 43.6% 13% of the respondents noticed that the change was irregular (the timing of the rain, with rain season coming either earlier or later than expected) while

about 30% noticed a decreasing trend in the amount of precipitation. However, 22% of interviewed households perceives that the precipitation was increasing. Furthermore, the increasing precipitation only concentrated on a short time and precipitation intensity was higher than that of the previous years.

They also explained the occurrence of heavy rain in short period which causes floods because the timing of the rain was irregular and it did not follow any pattern. Thus, many respondents observed that the rainy season was coming later and shorter. The rest and very few households (3.62%) perceived that there was no change and they intended to relate it with *Allah*. They say that it is *Allah's* anger against our evil deeds. Most of the time, community relate the occurrence of wind and flood with the rainfall. According to FGD and KII made in the area flood and wind occur accidentally.

In addition to these, focus group discussion made with Harshin community members, traditionally they forecast rain by looking into the direction in which Camel herd sleeps. If the Camel herd sleeps facing to the south, it is an indication that *Dayr* rainfall season is coming. Otherwise, if the Camel herd sleeps facing to the north, it is an indication that *Karan* rainfall season is coming in the next few days.

Figure 4: Households Perception on Precipitation Trend



Source: Own survey (2017)

The rainfall is highly variable both in amount and distribution across regions and seasons. The seasonal and annual rainfall variations are results of the macro-scale pressure systems and monsoon flows which are related to the changes in the pressure systems (Tesfaye, 2003). The spatial variation of the rainfall is influenced by the changes in the intensity, position, and direction of movement of these rain-producing systems over the country (Temesgen, 2000).

Moreover, the spatial distribution of rainfall in Ethiopia is significantly influenced by topography which also has many unexpected changes in the Rift Valley. Being a closed basin, relatively small interventions in land and water resources can have far-reaching consequences for ecosystems goods and services, and potentially undermine the sustainable use of the area.

4.3.3 Change in Sheep Mating Calendar

Usually, Somali pastoralists keep rams and ewes apart throughout the year, to control mating in a way that the ewes do not give birth to new born lambs in the dry season, when

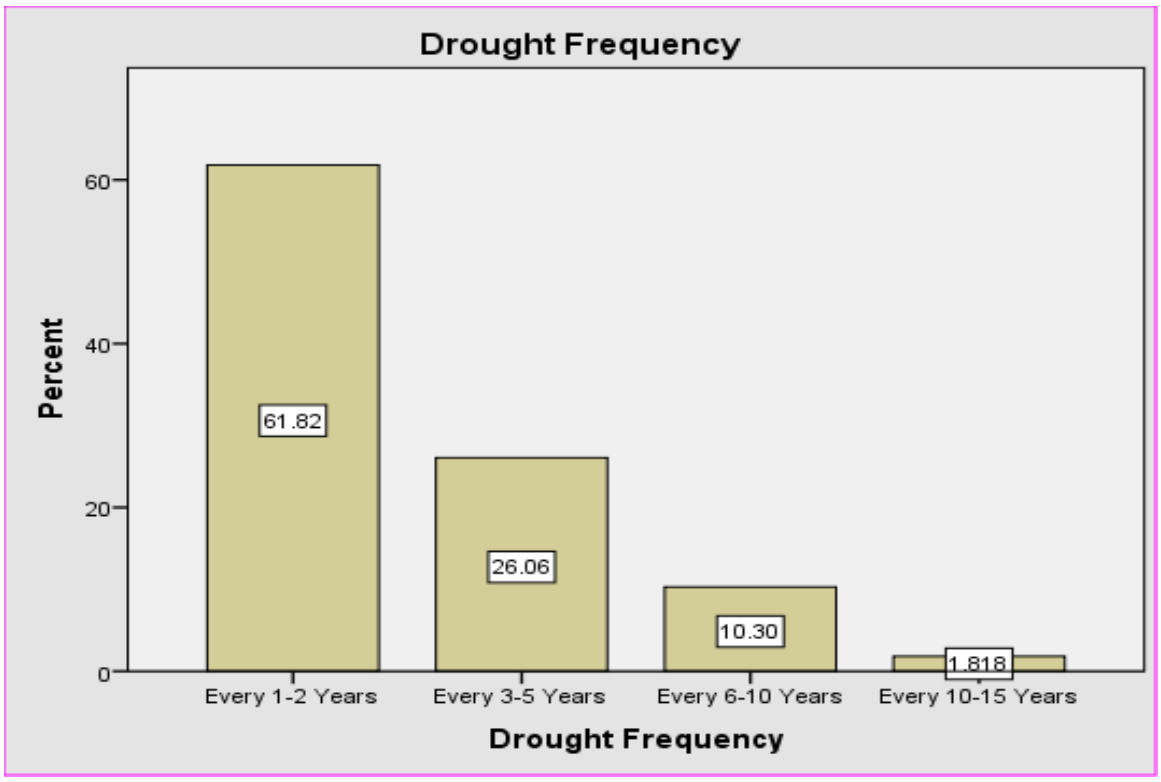
the feeding resources will not be enough for the next generation. *"Dambasame"* is the night, when Somali nomads let loose the rams with the ewes for mating, because it was about 150 days – the time the sheep are pregnant – until the beginning of the Gu rains. Dambasame night occurs exactly 120 days following the *Dabshid (Nouruz)* which marks the 1st night of the Somali year.

According to Hartmann & Sugulle (2009), while the night of "Dambasame" is still used to calculate the beginning of the Gu season, nowadays pastoralists are well aware of the changes of season and the unreliability of the onset of the Gu season, which is expected now to start about 30 days later than before (around May 15th earliest, sometimes even on June 15th). Therefore, from recent local experience, showing that Gu' rains shifted roughly around 30 days into the summer time, mating of the rams and ewes are not any more organized at Dambasame night, but 30 days later, meaning around December 15th. This shows the adaptive capacities of this traditional decision making system.

4.3.4 Frequency of Recurrent Droughts

Throughout southern Ethiopia, pastoralists themselves expressed doubts about the viability and future of the pastoralist livelihood. These transformed climate trends are likely to entail severe weather events whose increased frequency and intensity may well overwhelm political and social institutions, especially as they inevitably intertwine with other demographic, environmental, and developmental problems. According to Stark J, et.el (2011), severe drought now seems to be occurring persistently. In many instances, especially in southern Ethiopia, with no time to recover from year to year, household assets are collapsing.

Figure 5: Perception on the Frequency of Droughts



Source: Own survey (2017)

In the above figure, most of the respondents believe that drought happens in every 1-2 years while the second part (26.06) of the respondents assumes that it happens repeatedly about every 3-5 years. However, the third part of the respondents (10.3%) that the frequency of drought is every 6-10 years while the least group (1.8) of the respondents say that it actually happens only every 10-15 years which is not the actual case as a matter of personal experiences.

Ethiopia is hit harder than most countries by drought and its devastating consequences. Recurrent droughts have resulted in loss of life and property as well as the migration of people. Drought frequency is predicted to increase placing stress on already vulnerable production systems. The mainstay of the Ethiopian economy is rain-fed agriculture, which is heavily sensitive to climate variability and change (CSA, 2007).

Drought is also severely affecting hydropower generation, Ethiopia's main source of electricity. Flooding in turn causes significant damage to settlements and infrastructure, livestock and animal health, and the waterlogging of productive land undermines

agriculture by delaying planting, reducing yields, and compromising the quality of crops, especially if the rains occur around harvest time (World Bank, 2011).

In addition both droughts and flooding increase the stress on social institutions, and increase the vulnerability of households, particularly those living close to the poverty line, through loss of assets, impaired health, potential conflicts and animal disease with potential risk for humans. Climate change affects human and livestock health directly through morbidity and mortality impacts of temperature extremes, vectors of infectious diseases, proliferation of non-vector borne infectious diseases, air quality, floods and storms, and indirectly through impacts on food supply and water resources. Climate change creates a favorable environment for vector-borne diseases such as malaria and trypanosomiasis that are widespread in the country. Malaria and animal trypanosomiasis will expand their altitudinal range and it is anticipated that other new human animal and plant diseases will emerge and increase (World Bank, 2003).

The National Metrological Agency (2001) revealed that in Ethiopia climate variability and change in the country is mainly manifested through the variability and decreasing trend in rainfall and increasing trend in temperature. Besides, rainfall and temperature patterns show large regional differences. For the IPCC mid-range emission scenario, the mean annual temperature will increase in the range of 0.9 -1.1 °C by 2030, in the range of 1.7 - 2.1 °C by 2050 and in the range of 2.7-3.4 °C by 2080 over Ethiopia compared to the 1961-1990 normal. A small increase in annual precipitation is expected over the country. Other sources of data have also substantiated the variability of climate and its trends in a somewhat similar ways. Historical climate analysis for Ethiopia indicates that mean annual temperature has increased by 1.3°C between 1960 and 2006, an average rate of 0.28°C per decade. The increase in temperature in Ethiopia has been most rapid in June, August, and September at a rate of 0.32°C per decade (McSweeney et al, 2008). Rainfall is historically highly variable and there is no clear trend in the amount of rainfall over time. (McSweeney et.al, 2008 and NAPA, 2007). Studies of localized meteorological data alongside community perceptions indicate that seasonal change may already be occurring as there are declining and increasing trends in certain months of the year (ACCRA, 2011).

Mean annual temperature is projected to increase by 1.1 to 3.1°C in the 2060s and 1.5 to 5.1°C in the 2090s. Under a single emissions scenario, the projected changes from different models span a range of up to 2.1°C (McSweeney et al, 2008).

The wide range between these different scenarios highlights the uncertainty in future projections for climate change in Ethiopia. Clearly Ethiopia is highly vulnerable to current variability and there are also indications that climate change will increase rainfall variability which will likely increase losses from rain-fed agriculture.

The ecosystems of the country as well as its community are highly exposed to climatic variability. Ethiopia is vulnerable to climatic variability owing to its low adaptive capacity accountable to low level of socioeconomic development, high population growth, inadequate infrastructure, lack of institutional capacity and high dependence on climate sensitive natural resource-based activities (NMA, 2007).

4.4 Factors Associated with Climate Change Awareness Levels

Results of cross examination of different factors such as socio-economic status of the community, their educational level, the current accessibility status of media for sharing climatic variability related warnings, the type of media itself and the gender of the respondents and the role of these factors in the current awareness level of the community is presented in table below (Table 6).

Table 6: Cross Tabulation Results Associated with Household Climate Awareness

Factors		Climate Change Awareness Level				Total
		Knows a lot	Knows	Knows a little	Does not know	
		N (%)	N (%)	N (%)	N (%)	N (%)
Gender	Male	17_{a} (14.9)	22_{a} (19.3)	15_{a} (13.2)	60_{a} (52)	114(69.5)
	Female	9_{a} (18)	9_{a} (18)	11_{a} (22)	21_{a} (42)	50 (30.5)
	Total	**26(15.9)**	**31(18.9)**	**26(15.9)**	**81(49.4)**	**164(100)**
Level of Education*	Illiterate	1_{a} (1.3)	9_{b} (11.5)	10_{b} (12.8)	58_{c} (74.4)	78 (47.3)
	Adult Education	5_{a} (10.4)	7_{a} (14.6)	13_{b} (27.1)	$23_{a.b}$ (47.9)	48(29.1)
	Primary education	$4_{a.b}$ (26.7)	9_{b} (60)	2_{a} (13.3)	0_{c} (0.0)	15 (9.1)
	Secondary Education	4_{a} (40)	4_{a} (40)	2_{a} (20)	0_{b} (0.0)	10 (6.1)
	Other	12_{a} (85.7)	2_{b} (14.3)	$0_{b.c}$ (0.0)	0_{c} (0.0)	14 (8.5)
	Total	**26(15.8)**	**31(18.8)**	**27(16.4)**	**81(49.1)**	**165 (100)**
Households' access to Media*	Yes	25_{a} (30.1)	20_{b} (24.1)	15_{b} (18.1)	23_{c} (27.7)	83 (50.3)
	No	1_{a} (1.2)	11_{b} (13.4)	12_{b} (14.6)	58_{c} (70.7)	82 (49.7)
	Total	**26(15.8)**	**31(18.8)**	**27(16.4)**	**81(49.1)**	165 (100)
Type of media accessed*	Radio	12_{a} (17.6)	18_{b} (26.5)	15_{b} (22.1)	23_{b} (33.8)	68 (81.9)
	Radio & TV	13_{a} (86.7)	2_{b} (13.3)	0_{b} (0.0)	0_{b} (0.0)	15 (18.1)
	Total	**25(30.1)**	**20(24.1)**	**15(18.1)**	**23(27.7)**	**83 (100)**

** Factors significantly contribute and affect the level of climate change awareness. Each subscript letter denotes a subset of Climate change and variability awareness level categories whose column proportions do not differ significantly from each other at the .05 level.*

As shown above cross tabulation results table, there are many factors that contribute the levels of climate change awareness among the pastoral households. The main factors that positively contribute to higher levels of climate change awareness include the levels of educational background, the household's media accessibility and the types of media available for the common households accordingly because like a domino effect, higher level of education enables a household to be aware of climate change through easily accessible media followed by the relevant type of the media than can be accessible by the pastoral communities of Harshin *woreda* and the above factors significantly contribute and affect the level of climate change awareness accordingly.

As a result, the gender differences between the male and female respondents is not considered to be a contributing factor for level of awareness amongst the respondents though male and female respondents differ on the level of climate change awareness which is a very slight and doesn't have much more realizable effects on the ground accordingly. This is supported by Wondimagegn Tesfaye and Lemma Seifu, (2016), Sample farmers were asked whether they had noticed any significant climate changes over the past 15 years and the results showed that, from the sampled households, more than 95 per cent perceived changes in temperature (especially rise in average temperature), although there is no statistically significant difference among districts. About 86 per cent of the respondents perceived decrease in precipitation over the years.

4.5 Community Perceptions on the Causes of Climate Change Risks

Factors like environmental degradation, deforestation, pollution, death of indigenous knowledge custodians and lack of reliable source of financial support constituted the main causes raised by pastoral and agro-pastoral communities in the study area. Table 7 shows the results of the causes for climate change

Table 7: Perception on the Causes of Climate Variability Impacts in the study area

Causes of climate change

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Environmental degradation	35	21.2	21.2	21.2
	Pollution	1	.6	.6	21.8
	Deforestation	32	19.4	19.4	41.2
	Death of IK custodians	24	14.5	14.5	55.8
	Will of Allah	73	44.2	44.2	100.0
	Total	165	100.0	100.0	

Source: own survey

As shown in the above table which shows local perceptions of the causes of climate change and variability in the study area. Most of the respondent listed well known and scientifically proven causes of climate change risks. More than half (44.2%) of the respondents associated the cause of climate change and variability risks with the "Will of Allah" as well as due to the increasing tendency of the community to disobey "Allah" as

the cause of climate change risks in the *woreda* and the region as a whole. The second major causes of climate change and variability risks according to the 21.2% and 19.4% of the respondents perceived environmental degradation and deforestation as the cause of climate variability risks. About .6% of the respondents perceived that persisting air pollution is the cause of climate change risks in the study area. However, a significant portion of respondents felt that there were supernatural causes of climate change risks. About 14.5% of the respondents felt that climate variability risks are caused by the death of the indigenous knowledge custodians.

Table 8: Univariate Results for Tests of between Subject Effects on Causes of Climate Change and Variability

Tests of Between-Subjects Effects

Dependent Variable: Causes of climate change

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	34.110[a]	14	2.436	.928	.534
Intercept	440.800	1	440.800	167.851	.000
Sex	.131	1	.131	.050	.824
EL	16.076	4	4.019	1.530	.203
Media_access	.000	0	.	.	.
If_Yes_Type	2.060	1	2.060	.784	.379
Sex * EL	10.202	4	2.551	.971	.429
Sex * Media_access	.000	0	.	.	.
Sex * If_Yes_Type	.485	1	.485	.185	.669
EL * Media_access	.000	0	.	.	.
EL * If_Yes_Type	3.444	2	1.722	.656	.522
Media_access * If_Yes_Type	.000	0	.	.	.
Sex * EL * Media_access	.000	0	.	.	.
Sex * EL * If_Yes_Type	.044	1	.044	.017	.897
Sex * Media_access * If_Yes_Type	.000	0	.	.	.
EL * Media_access * If_Yes_Type	.000	0	.	.	.
Sex * EL * Media_access * If_Yes_Type	.000	0	.	.	.
Error	175.951	67	2.626		
Total	1257.000	82			
Corrected Total	210.061	81			

a. R Squared = .162 (Adjusted R Squared = -.013)

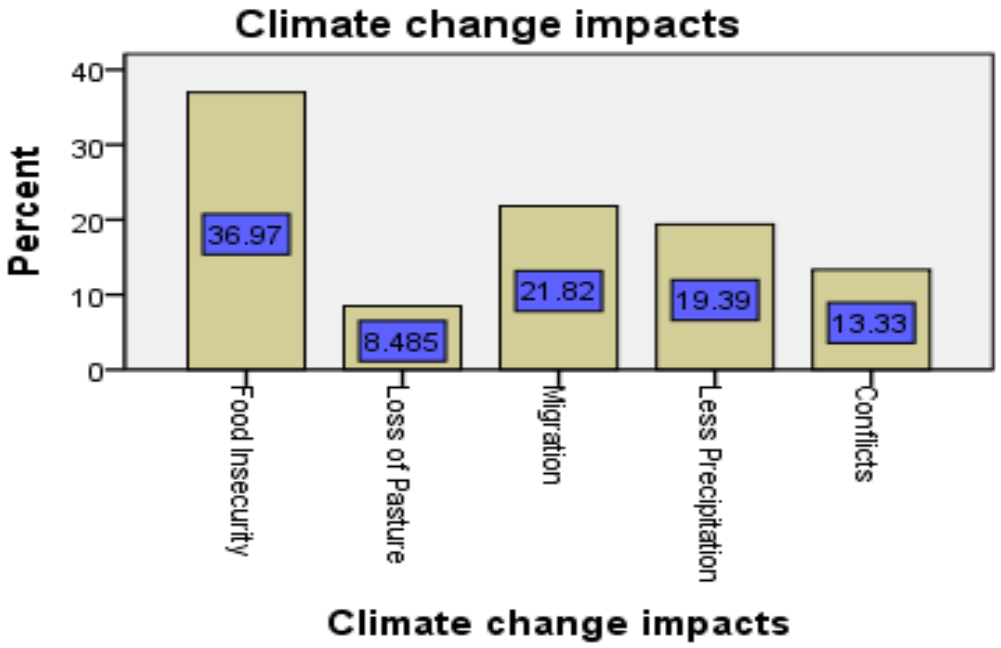
As univariate analysis results of causes of climate change shown in table 8 clearly illustrates, there has not been any between subject effects between respondents' gender,

educational level, their media access, type of media accessed and their interactions as well for the parameter cause of climate change.

4.6 Perceived Negative Impacts of Climate Change

The climate change impact level as perceived and stated by the communities in the study area is presented in the following fig (Fig.4).

Figure 6: Climate Change and Variability Impacts



Moreover, the climate variability is reported to have a significant adverse effect on food security, income, crop yield, biodiversity, food prices and other variables. Another commonly mentioned impact of climate change is on agricultural production such as crop failure and outbreak of crop and animal diseases. Increased pests and crop diseases leading to crop failures and reduced crop production are common in countries and areas where arable farming is predominant (Yesuf *et al.,* 2008; Akponikpe *et al.,* 2010; Nzeadibe *et al.,* 2011; Gandure *et al.,* 2013).

Livestock farmers reported that climate change and climate variability have led to decreased livestock weight and an increase in livestock death due to livestock diseases.

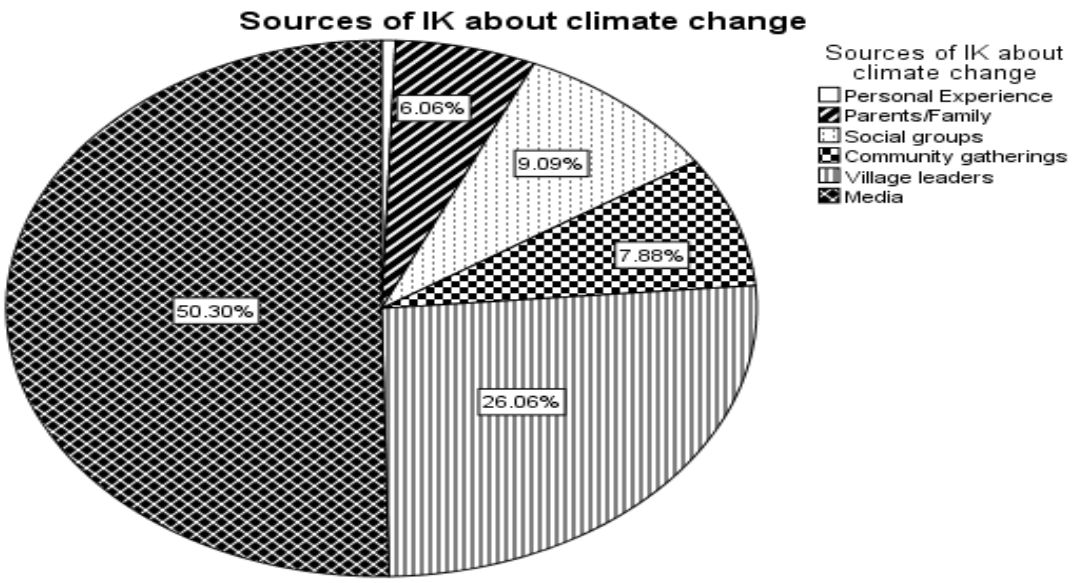
As clearly shown in the above chart, respondents said that climate change resulted food insecurity (36.97%), Migration in search of water and feed (21.82%), less precipitation (19.39%), conflicts (13.33%) and loss of pasture (8.5%). According to Shemdoe R. S, (2011), food security is a global concern because majority of the people in different

communities are starving particularly in Africa. In this study, communities indicated effects of climate change on food security as increased frequency of crop pests and diseases and poor crop harvests caused by poor rainfall and reduced soil fertility.

4.7 Sources of Knowledge Regarding Climate Variability Adaptation

The results of this study pertaining to how the pastoral community in the study area obtained the indigenous knowledge regarding climate changes is presented in the following fig (Fig5)

Figure 7 Sources of Indigenous Knowledge (IK)



As to how the pastoral and agro-pastoral communities in the study area gained their indigenous knowledge on climate change, majority (50.3%) of the respondents said that they developed their indigenous knowledge through personal experience and exposure whereas, the remaining 26.1%, 9.1%, 7.9%, 6.1% and .6% of the respondents said that they gained their indigenous knowledge from village leaders, social groups, community gatherings, parents/family and from media respectively.

4.8 Duration of using indigenous knowledge

Results for how far utilization of indigenous knowledge for climate change variability decision making existed in the pastoral and agro-pastoral communities in the study area is presented in the following table (table 10).

Table 9: ANOVA results for duration of using indigenous knowledge between genders in the study area

Genders	Descriptive Statistics for Duration of using IK				
	N	**Mean (SE)**	**Range**	**SD**	**CV (%)**
Male	114	23.66 (±1.079)	2-53	11.524	48.7
Female	50	23.26 (±1.647)	5-46	11.644	50
Total	**164**	**23.54 (±.900)**	**2-53**	**11.527**	**48.96**

As shown in the above table, generally results for the mean, Range, Standard deviation and CV for duration of using indigenous knowledge was 23.54 (±.900) years, 2-53, 11.52 and 48.96% respectively. However, there was no any significant difference of mean for the duration of using indigenous knowledge between male and female genders and the coefficient of variation for duration of using indigenous knowledge between male and female was found to be 48.7% and 50% respectively.

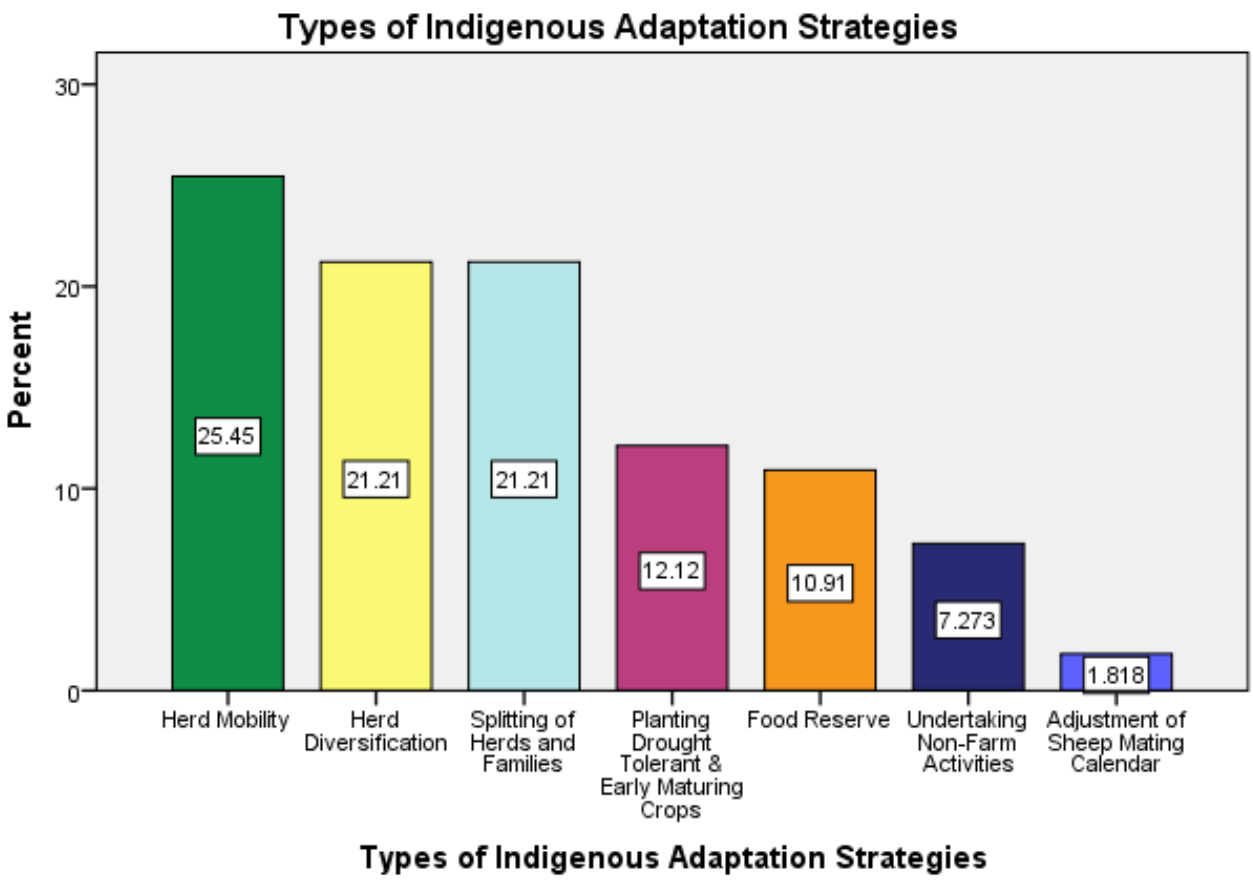
4.9 Indigenous Knowledge-Based Adaptation Strategies

There are different adaptation strategies adopted in response to climate variability. These strategies are not mutually exclusive, some can be adopted simultaneously. The study result identified the most common types of these adaptation mechanisms.

Most farmers who claimed to have observed changes in climate over the years were subsequently asked if they have responded through adaptation to counteract the impact of the climate change. They indicated that they are using different adaptation strategies to adapt with the negative impacts of climate change. The most commonly used major adaptation strategies among set of options used by agro-pastoralists in the study area include (1) herd mobility, (2) herd diversification (3) splitting of herds and families (4) adjusting planting date and adopting early maturing drought tolerant crop verities 5) Food Reserve; 6) undertaking non-farm activities and 7) Adjusting sheep mating calendar as indicated on Figure 8.

The result from the household responses have revealed the highest percentage (42 households or 25.5%)of the households preferred herd mobility at times stress whereas herd diversification and spilling of herds and family members at times of hazards accounts 21.2% each while the preferences of the surveyed households during drought periods was planting drought tolerant and early maturing crops. Moreover, the adaptation strategies through traditional food reserves and undertakings of non-farm activities by the households accounts 12.1% and 10.9% from the total respondents whereas the adjustments of sheep mating calendar as an adaptation strategy to climate variability by the households accounts only 1.8% of the respondents accordingly.

Figure 8: Indigenous adaptation strategies to climate change in Harshin Woreda



Source: Own survey (2017)

4.9.1 Herd Mobility

Herd mobility is the first and most commonly used major adaptation strategy among the set of options where 25.5%) of the sampled households selected as an autonomous adaptation strategy in their life time. Moreover, the household see this as an alternative adaptation mechanism because of their perceptions regarding that an immediate solution in their hand is gathering information towards the direction of better pasture and water; then moving with their livestock to this area, in order to prolong the survival rate of their herds accordingly.

This assumption of the households is supported by the study conducted by (Ali, 2008:82). "The key strategy of pastoralists is the movement of their herds in response to seasonal and annual changes in pastures and water availability'. Different factors like imposition of 'modern' institution on customary one, expansion of farmlands, inappropriate settlement, regionalization, degradation in power of customary leaders and bush encroachment are among the barriers that were identified during the fieldwork and discussions with focus groups. Local adaptation strategies like herd mobility is considered to be a response for climate change and variability impacts (Boku, 2000:120).

4.9.2 Herd Diversification

Even though it is evolutionary, herd diversification is also the second most commonly used major adaptation strategy among set of options, which is drought-friendly to adapt livestock production system with climate change impact. The percentages of sampled households in the study area who selected this adaptation strategy were 21.2%. This adaptation mechanism mainly refers to the move from grazing animals to the drought tolerant browsers such as goat and camel. Sheep and Goat are more preferred for its easy management by children, women and for its immediate source of milk for children. Therefore, as indicated in the below, the herd structure is diversified to drought tolerant species, especially goat and camel as an adaptation mechanism to climate change and variability.

Women prefer sheep, for the treatment purpose of women affected by drought effect and infertile due to malnutrition. Agro-pastoralism production system is complimentary to go through both crop and livestock production for the synergetic effect. The herd diversification including grazers (sheep and cattle) has significant contribution for agro-pastoralism as crop residue and hey from the farm can be used for feeding animals; and

the cow-dung from the livestock can be used for the farm. The community members in the agro-pastoralist areas are well aware of the advantage of crop and livestock production systems for their complimentary effects and synergies accordingly.

Adaptation and risk avoidance are possible through maintaining mixed herds containing different animal species which can withstand different climatic and ecological conditions (Toulmin, 1994:95).

Due to climatic change and variability most of the Harshin Agro-pastoral communities have started diversifying their livestock herd. The diversity of livestock herds has ecological and economic implication. According to the household survey result from the livestock species rearing by respondent households, almost 48% of all interviewed households have rearing shoats, Cattle and Camel.

Table 10: Types of Livestock Owned by Households

Livestock types reared

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	shoats, cattle & camel	79	47.9	47.9	47.9
	Shoats	31	18.8	18.8	66.7
	Cattle	27	16.4	16.4	83.0
	Camel	20	12.1	12.1	95.2
	No Livestock	8	4.8	4.8	100.0
	Total	165	100.0	100.0	

4.9.3 Splitting of Herds and Families

During dry period when the access and availability of pasture and water was serious problem, pastoralists split their herds and families into different locations. Accordingly, about 21.2% of the respondent households have been practicing splitting of herds and families as one of the adaptation strategy to reduce climatic impacts. The splitting of herds and families depends on the types and condition of animals and labor availability and requirement for those particular animals in a particular location.

According to (Ali, 2008); "The splitting of herds and families are risk reduction mechanisms that have been practiced by pastoralists. "Animals may be kept in several different areas which reduce the effects of localized droughts, and disease outbreak".

4.9.4 Planting of Drought Tolerant and Early Maturing Crop Varieties

About 12.1 % of the sample households adopted adjustment of planting date and adopting early maturing drought tolerant crop varieties as the third commonly used major adaptation strategy among the set of options to reduce the adverse effect of climate change and variability. The climate change and variability effect resulted in the less tolerance drought and perplexing erratic rainfall, extreme warming, frost and unexpected accidental rainfall and flood are confusing the crop production for its effect.

The adjustment of planting date usually depends up on the indicators of rainfall situations used by means of traditional knowledge. The community through their life experience and living with their environment developed various kinds of adaptation mechanisms including the adjusting of planting dates (seasonal calendar) and improved, hybrid and/or locally available popular crop varieties of early maturing drought tolerant crop verities are adapted.

Among these varieties, *Malkasa-II* improved maize, *Digo* and *Kufakasa* of local maize are the best preferred by the community for this strategy. The communities prefer *Malkasa-II* maize which is adapted with the environment (soil, air, disease etc.) depending on the purchasing from local farmers who cultivated in the year before.

4.9.5 Food Reserves

Long drought seasons mark the onset of food insecurity (locally known as ***Abaar***) within the study area. It was reported during the focus group discussions that food insecurity has been felt in the area during the drought seasons due to crop failure. In responding to this situation, local communities have developed different mechanisms using their indigenous knowledge to enhance food availability within the community.

The findings from this study reveal that during a good season, characterized by sufficient rains and high crop yields, it was imperative for the households to store extra harvests such as drained maize and sorghum that could serve a purpose during drought season. Local communities acknowledged that saving food for future use was helpful for households to adapt to food insecurity during the drought season.

Different observations were made by Songok et al. (2011) in a study conducted in Nandi and Keiyo, Kenya where households overcome food insecurity by, limiting the portion of their meals or even going an entire day without food during times of serious food shortage.

4.9.6 Undertaking Non-Farm Activities

Recurrent long drought seasons and the decrease of rains in the study area have reduced agriculture production. Thus, many local community members have started to engage in non-farm activities such as small-scale trading, and selling local chat (Khat).

Almost all the farming activities in the study area were done by elders and mostly women. Many felt that farming was a financial challenge as household savings had to be spent in order to replant to make up for lost yields. This caused majority of local communities to involve themselves in non-farming activities.

As stated by (Shayo, 2006) that in areas where climate change has resulted into recurrent crop failure, it is obvious to find local communities involved in non-farm activities such as business, wage labor, construction works and services to adapt to long drought seasons.

The sampled households of 7.3% took off/non-farm activities as their fourth major choice of adaptation strategy among set of options for tackling the adverse impact of climate variability in the study area.

Even though undertaking non-farm activities during dry seasons and drought periods, most of the focus is put on generation of additional sources of income and the utilization of the scarce resources from the forest (browser pasture) such as the production of charcoal by burning tree, sale of woods for fuel purposes. Currently due to the awareness and sensitization trainings given by NGOs in coordination with the government line bureaus including the environmental protection agency on the effects; those income generating activities and acts that leads to deforestation, have now decreased significantly.

Furthermore, the households with large family usually send their children (school drop-outs) to the major cities including Jigjiga and Wachale as well as to out of the country to neighboring countries including Somaliland and Djibouti for labor work so as to earn some income and feed their families and younger siblings accordingly back in the country while sometimes, women are more engaged in petty trading including purchase and re-sale of sheep and goats through the local markets.

This strategy is the backbone of economy for the poor families who are dependent on forest product sale and labor work in the study area; but it needs to be supported to divers their income by restocking, credit facility and other mechanism for rebuilding their asset.

Furthermore, for the livestock owners it helps as an asset protection of households not to sale their livestock to cope up with the climate change effects. This strategy also helps for increasing the household food quantity and quality; purchase of veterinary service and livestock feed; decreases student drop out; minimize migration; and increase livestock asset of the community.

In this strategy petty trading of women plays great role to rebuild women economy and their vote to utilize the income freely. As further stressed by Ayalew, (2001) that pastoralists have been involved in a variety of economic activities and drive their sustenance from other alternative sources of income to diversify their income sources. Engaging in alternative sources of income by the agro-pastoralists may reduce the degree of climatic impact on their livelihoods. To deal with climate change and variability risks, different strategies need to be sought by household members without assessing their feasibility in advance. Through trial and error some long lasting strategies would be found and become major sources of income for the households. Engaging in alternative sources of income reduces the impacts of climatic change on the livelihood of the households.

4.9.7 Adjustment of Sheep Mating Calendar

Usually, Somali pastoralists keep rams and ewes apart throughout the year, to control mating in a way that the ewes do not give birth to new born lambs in the dry season, when the feeding resources will not be enough for the next generation. *"Dambasame"* is the night, when Somali nomads let loose the rams with the ewes for mating, because it was about 150 days – the time the sheep are pregnant – until the beginning of the Gu rains. Dambasame night occurs exactly 120 days following the *Dabshid (Nouruz or Meskel in Ethiopia)* which marks the first night of the Somali year.

Sheep and goats typically stay pregnant for about five months, they average 150 days for each pregnancy. Some deliver as early as 142 days, and some take as long as 155 days. (Rob Harris, 2016).

According to Hartmann & Sugulle (2009), while the night of "Dambasame" is still used to calculate the beginning of the Gu season, nowadays pastoralists are well aware of the changes of season and the unreliability of the onset of the Gu season, which is expected now to start about 30 days later than before (around May 15th earliest, sometimes even on June 15th).

Therefore, from recent local experience, showing that Gu' rains shifted roughly around 30 days, mating of the rams and ewes are not any more organized at Dambasame night, but 30 days later, meaning around December 15th. This shows the adaptive capacities of this traditional decision making system.

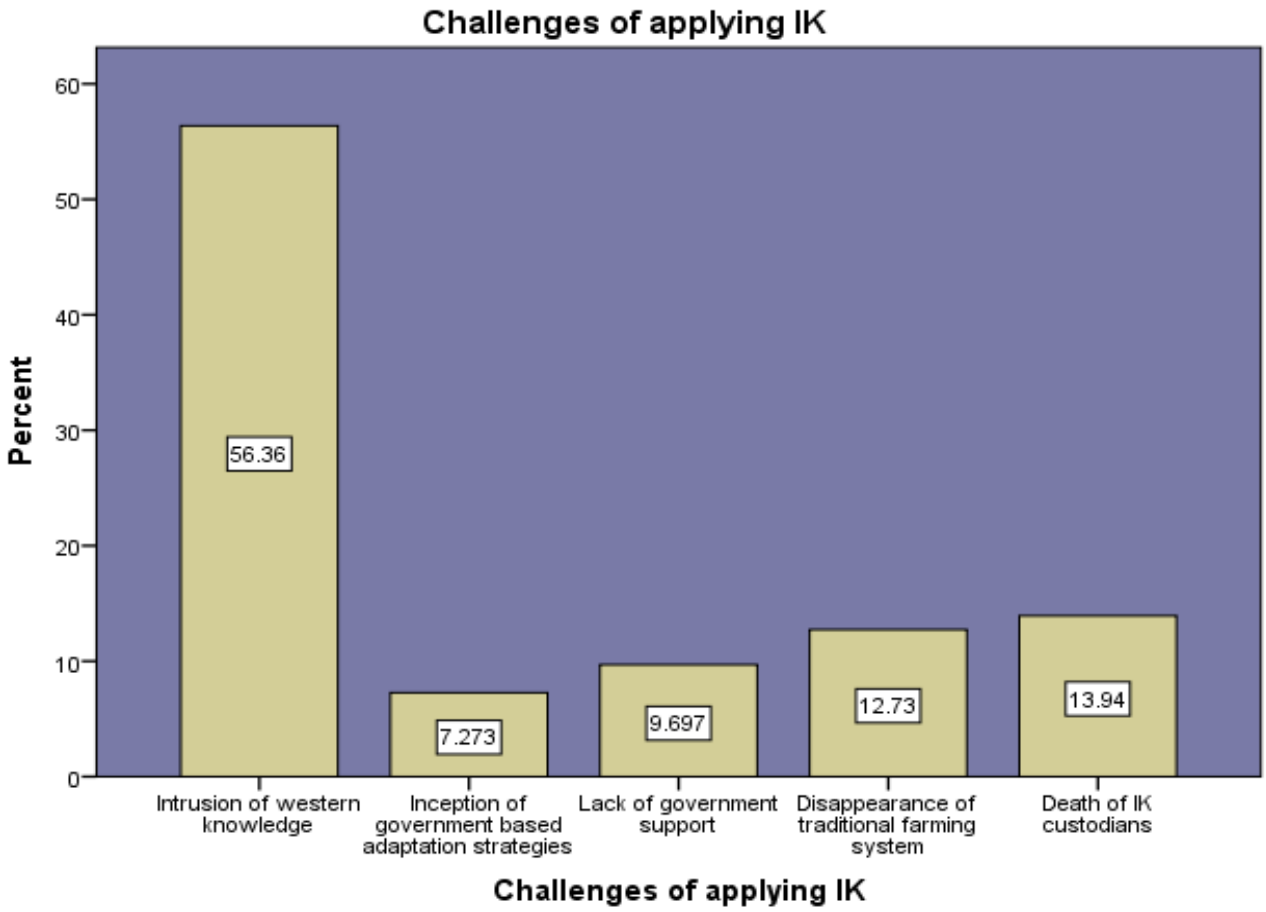
Table 11: Summary of Major Indigenous Adaptation Strategies

Types of Indigenous Adaptation Strategies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Herd Mobility	42	25.5	25.5	25.5
	Herd Diversification	35	21.2	21.2	46.7
	Splitting of Herds and Families	35	21.2	21.2	67.9
	Planting Drought Tolerant & Early Maturing Crops	20	12.1	12.1	80.0
	Food Reserve	18	10.9	10.9	90.9
	Undertaking Non-Farm Activities	12	7.3	7.3	98.2
	Adjustment of Sheep Mating Calendar	3	1.8	1.8	100.0
	Total	165	100.0	100.0	

4.10 Challenges for the Application of Indigenous Knowledge

Figure 9: Challenges of Indigenous Knowledge to the Impacts of Climate Variability



challenges for using indigenous knowledge for climate change impact minimization was the infusion of western knowledge, whereas the remaining 13.94%, 12.73%, 9.7% and 7.3%

It is misleading to think of Harshin indigenous knowledge as always correct or sustainable. The data of this study reflects the theoretical perspective of this thesis that indigenous knowledge has a number of weaknesses. The results of this study have revealed a number of different challenges that have been encountered by the local people regarding the use and application of indigenous knowledge in climate change and variability adaptation. These challenges include: intrusion of western knowledge, inception of governments based adaptation strategies with the exclusion of indigenous knowledge and lack of government support, the decrease (death) in the custodians of indigenous knowledge and disappearance of traditional farming systems, the poor reputation of indigenous knowledge; the absence of knowledge sharing culture; the on-going socio-economic transformation; the loss of traditional culture and practices; unevenly distribution of indigenous knowledge; disappearance of indigenous seeds, plant species and traditional medicine.

of the respondents said that intrusion of western knowledge, inception of governments based adaptation strategies with the exclusion of indigenous knowledge and lack of government support, death of IK custodians and disappearance of traditional farming systems, respectively challenged their ability to make use of their indigenous knowledge as climate change affects their livelihoods and inflicts on irreplaceable damages accordingly.

4.10.1 Intrusion of Western Knowledge

One of the main challenges for indigenous knowledge is its poor reputation within the community as a result of the intrusion of western cultures and education as it is widely perceived as being outdated. During interviews and focus group discussions participants would often associate this knowledge with little due attention. Different cultural practices and taboos embedded in the indigenous knowledge such as rain seeking, and stopping strong winds are still performed by a few individuals, generally the elders, within the community.

Different factors which contributes to vanishing of traditional culture and practices within the community were mentioned by the local communities during the interviews and focus group discussions. These are: modernization/westernization and the adoption of formal education as well.

The poor recognition of indigenous knowledge has caused increased demolition of all important traditional sacred places used for worship in the past such as big indigenous trees, in which all traditional rituals and worship activities were carried out. In years past, traditional healers were highly respected by the community; however this is no longer the case. Similarly, due to the lack of respect for the traditional culture that exists in the communities, most of the elders who are the custodians of this knowledge are less willing to share this knowledge with the younger generation. It was found that the current generation is not interested in indigenous knowledge due to number of factors including: modernization and the intrusion of formal education system.

Most youths who were interviewed were of the opinion that indigenous knowledge is outdated, and cannot solve contemporary problems. However, on the other side, the government has failed to recognize and support indigenous knowledge, because there is no political will to do so and there are no state mechanism to document indigenous knowledge within the communities and disseminate it across the generations.

Moreover, the use and application of western knowledge in different farming and livestock keeping activities had undermined the importance of indigenous knowledge of Harshin *Woreda*, particularly those practices related to climate change adaptation.

4.10.2 Inception of Governments Based Adaptation Strategies

The data has shown that indigenous knowledge is not sufficiently integrated in the formal climate change adaptation strategies in Ethiopia. As a result, the pivotal role of this knowledge in climate change and variability adaptation at local level is not well known. It was noted during interviews with Development Agents (DA) staff at *kebele* levels, that during their work with local communities, indigenous knowledge was rarely considered. For example, one of the extension staff members in Garabeldan *kebele* advised the farmers and the livestock keepers as well as the community at large to use modern knowledge to adapt to different pitfalls, water shortages, pests and diseases which attack crops and livestock accordingly.

Despite such exclusion of indigenous knowledge in climate change and variability adaptation strategies, some of the extension staffs were very concerned with the government failure to incorporate this knowledge in climate change and variability adaptation strategies, particularly at the *kebele* level. They felt that it would have been worthwhile if this knowledge is researched, documented and validated that it can help in climate change and variability adaptation initiatives across the Ethiopia.

4.10.3 Lack of Government Support

The government has failed to recognize and support indigenous knowledge, because there is no political will to do so and there are no state mechanism to document indigenous knowledge within the communities and disseminate it across the generations

4.10.4 Death of Indigenous Knowledge Custodians

According to local community members in the study area, the custodians of indigenous knowledge within the community are decreasing quickly. Most of these custodians are elders who were are the end of their life. It was noted that if a community had a large number of elderly people available, it was considered an asset, because they could be consulted and give advice on how to respond to the different environmental uncertainties occurring in the *kebele*. Some of the participants of this study were concerned about whether this knowledge would continue to exist in the coming decades, since the

custodians of the knowledge were decreasing in number at an increasing rate and the knowledge is not well documented as well.

4.10.5 Disappearance of Traditional Farming Systems

Local communities in all study *kebeles* have stated that their respective traditional cultures and practices had been disappearing within the community for quite some time. This has negative impacts on the sustainable use of indigenous knowledge within the community.

One critical challenge to the use indigenous knowledge in the contemporary community is due to the disappearance of indigenous seeds, plant species and traditional medicine in recent years (Theodory T.F, 2016). It was reported by the participants of this study that, due to the increasing tendency of extension staff to discourage and ban indigenous seeds and plant species, it is difficult to adapt to a long drought season by planting indigenous drought resistant seeds and plant species.

Additionally, the local communities reported that indigenous medicinal plants had disappeared due to a number of factors, including: the recurrent drought condition; population pressure; and migration from one *kebele* to another. This makes difficult the application of indigenous knowledge in different farming systems and livestock keeping among the local communities. This in turn has caused disappearance of most of indigenous knowledge-based practices within the communities of Harshin *woreda* accordingly.

During the Focus Group Discussion with the community elders, it was confirmed that there are many reasons for not applying the indigenous knowledge so as to minimize the adverse effects of Climate Variability induced impacts which includes the community's intentional abandoning for the use of their indigenous knowledge because this kind of knowledge became ineffective to forecast the occurrence of droughts and other climate change adverse impacts on the livelihoods of the community.

Belaineh *et al.* (2013) reported same results. Owing to the differences in institutional settings, resource endowments and agro-ecology, different set of strategies are found to be effective in different areas accordingly.

As per the Focus group discussions and key informants interviews, it's confirmed that the climate change and climate variability adversely impacts the food security of the pastoral

households as the livelihood assets are impacted by drought. However, communities are observing significant negative impacts of drought and extreme heat events on natural resources such as pasture, water sources and trees. Pasture and water are the most important natural resource for the pastoral communities of Harshin *Woreda*.

Hazards are also affecting basic human infrastructures that are important to pastoral people's livelihoods, including education, health, human labor and other available various abilities/capabilities.

Moreover, livestock is key livelihood assets for the pastoral communities for fulfilling their multiple economic, social and risk management functions. Thus, the impacts of climate variability on livestock actually heighten the vulnerability of the community for climate induced hazard while at the same time reinforcing other already existing adverse factors that are affecting their livelihoods including recurrent droughts, scarce pasture which as a result leads to communal confrontations and intercommunity conflicts over scarce resources.

For pastoral communities, losing livestock assets could trigger a collapse into chronic poverty and have a lasting effect on livelihoods (Agrawal, 2008).

Based on the findings from the household interview, the livestock population has been decreasing dramatically because of the climate change and variability induced adverse impacts accordingly.

Moreover, during the FGD, the elders confirmed that indigenous knowledge were the only available means of knowledge that was available for them to use and it was considered as very important for sustaining their livelihoods as the IK has been in use from generation to generation. However, the community elders further emphasized that the indigenous knowledge has become less useful for their livelihoods which are attributed to several reasons by the community regarding the decreasing use of the pastoral indigenous knowledge such as western technology, the death of Indigenous knowledge guardians, disappearance of traditional pastoral way of living systems, government based adaptation strategies for recurrent droughts as well as the resettlement programs.

According to the key informant Interview and *woreda* experts, most of the key informants confirmed that the occurrence of recurrent drought trends in terms of severity and frequency has been doubled in recent years which as a result has adversely affected on the

effectiveness for the use of the indigenous knowledge since the IK has failed to predict the upcoming drought occurrences which has been happening consecutively by disrupting livelihoods and income sources, social structure network, as well as their ecosystem and natural resources for their livestock which their livelihoods depended on for generations accordingly.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Harshin *woreda* has a rich collection of Indigenous knowledge and if this knowledge is purposefully and logically applied with modern skills and technology, it can save the life of many people not only in the *woreda* but also across the country. It is very pathetic that under the pressure of modern science and technology traditional, the indigenous knowledge is dying without due recognition from community and the government in the Harshin *woreda* and other places where societies can play pivot role in fighting towards the vulnerabilities of climate variability and at the same time, the absence of literary sources about traditional skills is hindering the dissemination of indigenous knowledge as well.

Climate change adaptation (CCA) strategies; whether traditional/indigenous or modern; aims to reduce vulnerability of the communities to expected impacts of climate change. CCA strategies exist across local and global scales, from community level responses through to local, national and international government interventions. At the community level, strategies such as improvements to agricultural systems such as crop diversification or the introduction of hazard resistant crop varieties; risk assessments and associated plans; the protection of natural resources; early warning systems; education and awareness measures and protection of water resources are among the crucial steps for strengthening the resilience of community to climate variability resulted shocks.

When pastoral households are confronted with a livelihood shock that undermines their access to food, usually the households can react in a number of ways such as the means and methods to cope and respond to food insecurity related shocks in different ways such as those households that 'protect consumption' and those that 'diversify consumption' in reaction to the adverse impacts of climate variability. However, pastoral households in the study area don't have a strong indigenous functional coping mechanism for the climatic adverse and they are forced to migrate to other areas for search of feed and water.

The communities of the study area do not know very much about the cause and effect relationship between climate change and adverse impacts even though the pastoral communities witness the adverse impacts of climate change on their livelihoods and livestock production systems on a daily basis.

As a result, majority of the respondents know nothing about climate variability while there are some respondents that are familiar and somehow know about climate change while some of the respondents from the study area know little and have some information regarding climate change and its very small group of respondents that consider themselves as having good knowledge and are well aware of the climate variability and its associated adverse impacts on the respective livelihoods of the pastoral community accordingly.

Pastoralists in the study area use various adaptive and flexible risk management strategies and resilience enhancement mechanisms to maintain food and livelihood security, but these are breaking down in the face of growing human populations and land use problems. Mobile pastoralism is vital for the conservation, flexibility, and ecosystem and health natural vegetation. Pastoral production system demand a detailed knowledge of the environment for efficient resource utilization, awareness of the climate and it is spatial and temporal variability, which are based on generation of observation and adaptive management

Moreover; the overall assumption is that most of the respondents actually know nothing about what climate change is or it's possible that they are ignoring the variability of climate change for deliberate various unknown reasons including religious factors and other beliefs as well accordingly.

As a result, the pastoral communities has been neglected by policy makers and development actors for decades as marginalized community and resulted in food insecurity but despite of all challenges, they used to manage their livelihoods through the application of ample indigenous knowledge and institutions generation after generation by practicing different indigenous adaptation strategies so as to mitigate the adverse impacts of climate change and variability accordingly.

Therefore, indigenous adaptive capacities which have been employed by Harshin communities for decades to adapt with climate variability induced hazards have now been threatened by external factors including western knowledge and technologies which eventually ended the indigenous knowledge that communities depended on for their livelihoods generation after generation but these external factors prevent the effective use of local knowledge as it was used once upon time by the community for their survival.

Finally, the research concludes that pastoralists whose livelihoods depend on pastoralism as sensitive to the adverse impacts of climatic factors with weakened indigenous adaptation mechanisms are the most affected households and alternative ways of improving their resilient capacity need to be sought. As the indigenous adaptation strategies used by the pastoralists are ineffective during the epoch of technological advancement backing to the root is found to be imperative to reduce compounded impacts.

It is important to note that not all current local strategies to cope with climate variability of drought hazards are efficient or appropriate for long term adaptation. Some strategies, based on short-term considerations, survival needs, lack of information or imperfect foresight, can worsen environmental degradation and thereby diminish future adaptive capacity and livelihood options.

Most farmers in the study area are aware that the area is getting warmer, precipitation has decreased and rainfall patterns have changed. The most pronounced effects of climate change are decline in income and yield, food insecurity, crop and livestock diseases and pests, and change in livelihood patterns of the households.

Important adaptation options being used by farmers in response to adverse effects of climate change include crop diversification, planting different crop varieties, changing planting dates and diversifying from farm to non-farm activities.

Robust evidence was found that adoption decisions of different adaptation strategies are interdependent because of complementarily or substitutability between the strategies.

5.2 Recommendations

The human relationship with nature has produced complex knowledge systems, which are responsive to change, self regenerating as well as being multidimensional in nature. The close knit association between this knowledge systems and ecosystems offers us the greatest opportunity to understand how humans respond to change.

- Therefore, the existence of well established indigenous knowledge and its contributions to the concerned communities' adaptation strategies in the study are needs to be properly documented as well.
- The researcher recommends that the sufferings poor pastoral households in Harshin *Woreda* are encountering as a result of the adverse impacts of climate variability, the government and nongovernmental organizations and actors should work together promote the use of indigenous knowledge together with the modern weather forecasting technology so as to integrate the indigenous knowledge with the science based facts while encouraging for the inclusion of the best indigenous knowledge into a national policy of disaster risk reduction of Ethiopia while at the same time the government should consider preparing and developing national policies that promotes and recognizes the role of indigenous Knowledge for climate induced risk reduction strategies accordingly.
- Moreover, the indigenous institutions should be considered as key partners in all development intervention that are devised to bring about social change, environmental protection, social and political issues as it is essential to link formal and indigenous systems from the project planning to its final implementation accordingly.
- Common understanding of all stakeholders would help for the effective and sustainable implementation of development projects, with respect to seasonal grazing areas, herd diversity and mobility.
- Also there is a need to empower these indigenous knowledge systems to enable and rebuild the capacity of the local communities to assume greater responsibilities in the management of natural resources and decisions regarding basic services.
- Strengthening efforts on enhancing farmers' adaptive capacity to climate change should be at the top of the agenda.
- Designing policies that aim to improve the barriers to adaptation for pastoral communities and small holding farming systems have a great potential to improve livestock and farmer adaptation to changes in climate variability.

- Programs aimed to reduce impacts of climate change and variability needs to encourage investment on soil and water conservation measures and development of disease- and drought-tolerant crop varieties.
- Supporting pastoralists and farmers through training on climate change and variability adaptation options such as soil and water conservation measures, changing planting dates and crop diversification can improve adaptation practices. It's also believed that better access to inputs like credit, fertilizer, extension service and information has to be improved.
- Targeting women groups and associations in smallholder rural communities can have significant positive impacts for increasing the uptake of adaptation measures by the community.
- Government policies need to support research, development and diffusion of appropriate technologies to help pastoral communities adapt to changes in climatic conditions.
- Increased diversification of crops, through the cultivation of crops that are drought-tolerant and resistant to temperature stresses, as well as activities that make efficient use of the prevailing water and temperature conditions will serve as an important form of climate insurance against rainfall or temperature variability.
- Growing a number of different crops on the same plot or on different plots also reduces the risk of complete crop failure, as different crops are affected differently by climatic events. It is important to note that these adaptation measures should not be taken as independent strategies but should be used in a complementary way.
- The government needs to include climate change adaptation policies in the development agenda. There is also the need for governments and non-governmental organizations to invest in climate-resilient projects.
- Further research is required regarding vulnerability of rural households to climate change and its adverse effects and the adaptation strategies they opt for increasing their adaptive capacity. In addition, further research is called upon the impact of climate-resilient projects and government's investment on climate change adaptation strategies on farmers' adaptive capacity and livelihoods.
- The need for a strong and organized early warning system is crucial for the agro-pastoral community to get information about the upcoming weather shocks and take actions accordingly in order to minimize the disaster as early as possible. This should be supported by proper weather forecast and quantitative data from meteorological

stations. Thus, it is indispensable to strengthen the meteorological station in Harshin *woreda* so as to provide reliable and timely weather information on a daily basis.

- Finally, strengthening the pastoral economy by reducing their vulnerability for sudden onset shocks while helping them build their communal resilience without adversely destroying their pastoral way of life
- Pastoral communities should be encouraged to enhance their capacity by using their indigenous adaptation strategies for crisis management and drought preparedness in light of recurrent droughts by ensure them access to media for grazing and water for livestock during dry seasons.

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APPENDIX

INDIGENOUS ADAPTATION STRATEGIES TO THE IMPACTS OF CLIMATE VARIABILITY: *THE CASE OF HARSHIN WOREDA OF SOMALI REGION*

ANNEX 1: HOUSEHOLD QUESTIONNAIRE

SECTION 1: General Information of the Respondents

Please Answer the Following Questions Openly and Circle the Correct Answer

1. **Sex:**

   a) Male b) Female

2. **Age:**

   a) 18-25 b) 26-33 c) 34-41 d) 42-49 (e) 50-57 f) 58 & above

3. **Education Level of The Respondents**

   a) Illiterate

   b) Adult education

   c) Primary education

   d) Secondary education

   e) Others

4. **Household Size**

   a) 1-3 b) 4-7 c) 8-11 d) 11 and above

5. What is your monthly average income?

   Birr: _____

6. Source of income of the respondent (multiple response allowed)

   a) Selling Livestock
   b) Milk marketing
   c) Remittances
   d) Employment salary
   e) Hunting
   f) Others, please specify……

7. What types of crops do you grow?

8. What type of livestock do you keep? ……

9. How many livestock do you

   possess? .....

10. Does your household have access to media?

    a) Yes b) No

11. If yes, what type of media your household has access to?

    .....

    .....

SECTION 2: **Knowledge and Perceptions of Climate Variability**

12. Are you aware of climate change?

    a) Know a lot
    b) Know
    c) Know little
    d) Don't know

13. How do you perceive the status of climate variables in the woreda?

    (Please tick your answer)

Local Perception	Tick
Increasing rainfall amount during rainy season	
Decreasing rainfall amount during rainy season	
Increasing length of rain season	
Decreasing length of rain season	
Early onset of rain days	
Late onset of rain days	
Increase of strong wind events	
Increasing temperature of the area	
Decreasing temperature of the area	

14. What are the causes of climate change in your area? (Tick as appropriate)

    a) Environmental degradation
    b) Pollution
    c) Deforestation
    d) Death of IK custodians
    e) Lack of reliable sources or financial income
    f) Lack of information on weather
    g) Disappearance of traditional seeds
    h) Shortage of Labor
    i) Extension advice
    j) Less effective
    k) Forgotten them
    l) Elders do not pass them on
    m) New generation refuse their use
    n) There is no hindrance to adaptation
    o) Others please specify……..

15. What are the major impacts of climate variability on your livelihood activities?

……..

SECTION 3: **Indigenous Knowledge & the Adaptation of Climate Variability**

16. Please mention different sources of IK concerning climate change adaptation? (Please tick your answer)

Sources of Knowledge	Tick
Personal Experience	
Parents/Family	
Friends/Neighbors	
Social groups	
Mosques	
Community gatherings	
Village leaders	
Media	
Extension staff	
NGOs	
Others specify	

17. For how long you have been using this knowledge in your everyday farming / livestock keeping activities?

    .....

18. Have you encountered in your lifetime periods of Disasters which are characterized by more or less favorable rainfall or temperature?

    1) Yes 2) No

19. If yes, what are the types of Disasters encountered by your community?

    1) Drought
    2) Animal Diseases
    3) Pests
    4) Human Diseases
    5) Others

20. What do you think is the temperature trend in this area?

    1) Increasing

2) Decreasing

3) Irregular

4) No change

21. What is the precipitation trend in this area?

1) Increasing

2) Decreasing

3) Irregular

4) No change

22. What is the frequency of drought occurrence in this area?

1) No drought

2) Every 1-2 years

3) Every 3-5 years

4) Every 6-10 years

5) 10-15 years

23. What are the most commonly used endogenous coping and adaptive strategies you have using to overcome the impact of climate variability in your area?

1) No adaptation
2) Mobility
3) Change in sheep mating calendar
4) Livestock diversification
5) Use of drought-tolerant species
6) Herd mobility to search for water & pastures
7) Off/non-farm activities
8) Splitting of Family members
9) Traditional food storage

24. Are there any behavioral changes as a result of climate variability adaptation strategies?

1) Yes 2) No

25. If Yes, What are the behavioral changes witnessed by your community?

1) Reduced grazing around water sources
2) Free grazing on farms
3) Eating one type of food

4) Improving traditional water streams
5) Less Meals per Day
6) No Behavioral Changes

SECTION 4: Challenges of Applying Indigenous Knowledge on Climate Change Adaptation

26. What are the challenges of applying indigenous knowledge and practices on climate change adaptation *(Please rank them as above in terms of importance)*
    a) Intrusion of western knowledge
    b) Inception of government based adaptation strategies
    c) Lack of government support
    d) Disappearance of traditional farming system
    e) Death of IK custodians
    f) Lack of reliable sources or financial income
    g) lack of information on weather
    h) Disappearance of traditional seeds
    i) Shortage of Labor
    j) Extension advice
    k) Less effective
    l) Forgotten them
    m) Elders do not pass them on
    n) New generation refuse their use
    o) There is no hindrance to adaptation
    p) Others please specify……..
27. What are your suggestions which you think will enhance the indigenous knowledge practices for effective adaptation to climate change? Comment freely:
    ……
28. Do you have any other opinion that you think will be beneficial to this study?

……

ANNEX 2: FOCUS GROUP DISCUSSION CHECKLIST
(For Community Elders, Traditional and Religious Leaders)

- What is climate change and how does it happen in your perception?
- What are the climate change impacts in your area?
- Is there any increasing trend of climate change impact?
- What are your most commonly used major adaptation strategies in your area?
- What is the best climate change adaptation strategy in your area? Why?
- What are the expectations from different organizations in relation to this problem?
- How is your satisfaction in using the adaptation strategy?

ANNEX 3: KEY INFORMANT INTERVIEW QUESTIONS
(For Woreda Officials, Kebele Administrations and DAs)

- What do you know about climate change and climate variability?
- What is your prospect about the climate change and its impact?
- What are the climate change impacts in your area?
- Is there any increasing trend of climate change impact?
- What are the most commonly used major climate change adaptation strategies in your area?
- What is the best climate change adaptation strategy in your area? Why?
- What are the challenges in using the climate change adaptation mechanism?