

# Impact of Climate Variability and Vulnerability on livelihood

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**Abstract**— Climate variability and vulnerability have a range of impacts on livelihood. It is likely that food insecurity will progress more rapidly with rising temperatures and variable rainfall. Hence, the aim of this study is to assess to assess climate vulnerability on livelihoods, and coping Mechanism in selected three Woredas' of Bale lowland. The study was conducted in Six PA's of the Rayitu, Dawe Qachen and Guradamole Woreda .In order to achieve these objectives, the study collected data from primary and secondary sources. The primary data collected by using data gathering tools such as FGDs (6), key informant interviews (50) and household survey (436). The study finding showed that the fluctuation of climate makes the on livelihood of the pastoralist community vulnerable in affecting their crop and livestock productivity of the pastoralists' community. Furthermore, the finding of the study also showed that there have to be an appropriate adaptation mechanism to the changing and fluctuating climate as well as it increases pastoralists community awareness about Mechanism by which climate variability to reduce the impact and also to increase institutional involvement with different intervention Mechanism. The vulnerability of climate fluctuation exacerbated by lack of adaptation and commitment from both pastoralists and local institutions. Since pastoralists are prioritizing their immediate benefits rather than sustainable development. To cope with the vulnerability the societies use saving, migration diversification, dissemination of technology and provision of safety nets to some lowlanders and emergency aid is among the coping Mechanism provided by the government institution. Based on the findings and results of the study the following recommendations suggested to minimize the vulnerability of the pastoral communities. Improve agricultural production, build on existing people's knowledge and practices, strengthen local capacity to manage risks through local civil society organizations, foster institutional linkages for livelihood sustainability, and improve the coverage and quality of climate data.

**Keywords**— *Climate Variability, Livelihood, vulnerability, Coping Mechanism*

## I. INTRODUCTION

The world's climate is changing rapidly at rates that are anticipated to be exceptional in human history due to human actions. Variations in weather and climate with extreme events affect most socioeconomic sectors such as agriculture, water, health, transport, and energy among others (IPCC, 2007b). Climate describes the characteristic conditions of the earth's lower surface atmosphere of a specific location while climate change is defined as the long-term changes in average weather conditions. The impacts of climate variability are inevitable and

rural communities who depend on agriculture as a source of livelihood are more vulnerable to these impacts (IPCC, 2007b). Agriculture is highly sensitive to climate because crop yield depends on whether conditions; both crop growth and development are temperature related (Kurukulasuriya and Mendelsohn 2006; Easterling et al, 2007). Climate change is a threat to agriculture and food security because of the loss in food production through crop failure and increase in disease and mortality rate of livestock (Akpodiaga & Odjugo 2010).

IPCC (2007) report show that as a result of the two factors mentioned above global climate changes such as rising temperature about 0.74°C per annum, melting of polar icecaps, uncontrolled forest fires and annual average increase in sea level of 3.1 mm annually, are the major indicators. Such changes have already had some impacts on natural equilibrium and the risk of the survival of over whole human well beings.

In the same manner IGAD-ICPAC (2007) report reveal, the mean annual temperature across eastern African countries is projected to increase between 0.9 and 1.1 °C by the year 2030. Particularly in Ethiopia, it is assumed that the temperature has been increasing annually at the rate of 0.2°C over the past five decades. This has already led to a decline in agricultural production, and cereal production is expected to decline still further (by 12%) under moderate global warming (Ringer, 2008). This has inevitably led to a decline in biodiversity, shortage of food and increases in human and livestock health problems, rural-urban migration and dependency on external support.

It is recognized that, due to the fact that changes in temperature and precipitation occur unevenly and that climate change impacts will be unevenly distributed around the globe, countries, regions, economic sectors and social groups are differ in their degree of vulnerability to climate change. It is also recognized that even with in regions impacts, adaptive capacity and vulnerability will vary (IPCC, 2001).

The negative impacts of climate variability have been hitting poor people and poor countries disproportionately due to low adaptive capacity and higher vulnerability types of economic activities. Climate variability in rainfall patterns, both temporally and spatially poses particular risks to poor smallholder's Agro pastoral Communities in rural areas and pastoralists who endure a climate sensitive livelihoods and complete natural based lifestyle (UNCCC, 2006; GTZ, 2010).

Similarly, Ethiopia is one of the most vulnerable countries experiencing drought and floods because of climate variability

and change (MoWR, 2007). Vulnerability analyses for Ethiopia under climate change has got due attention by scholars or researchers now a day. The finding of Deresa, (2006) indicates that changes in rainfall patterns and increasing temperatures are expected to have significant negative impacts on environment and water resources, crops and livestock, human health and other farming livelihoods.

Historically, Ethiopia's climate is characterized by extremes climate such as highly erratic rainfall, droughts and floods; and increasing and decreasing trends in temperature and precipitation. In recent times, this trend is further aggravated by the climate change happening all over the world, thus a significant number of people are being affected chronically by recurring droughts, leading to deaths and loss of assets and to an appeal for international support (Temesgen, 2010). The recurring changes are hindering the goal of the Ethiopian government in achieving food self-sufficiency, which is consistent with one of the MDGs of eradicating extreme poverty or hunger (MOFED, 2006).

Hence, there is a growing need to understand the impact of the climate change that is significantly affecting the agricultural society and their livelihoods.

The risks associated with climate change call for a broad spectrum of policy responses and Mechanism at the local, regional, national and global level. The UNFCCC (2001) highlights two fundamental response Mechanism: Mitigation and Adaptation. Mitigation seeks to limit climate change by reducing the emissions of GHGs (greenhouse gases) and by enhancing carbon 'sink' opportunities, while adaptation focuses on process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.

In connection to policy response toward risks associated with climate change, IPCC (2007) stated that the primary question that needs to be addressed is how adaptation to climate variability and change can be more fully integrated into development policies. The rationale for integrating adaptation into development Mechanism and practices is underlined by the fact that interventions required to increase resilience to climate variability and change.

In general, adaptation calls for natural resource management, buttressing food security, development of social and human capital and strengthening of institutional systems are the first step must be taken (Adger, 2003). Hence, the inclusion of climatic risks in the design and implementation of development initiatives is vital to reduce vulnerability and enhance sustainability.

However, rainfall variability currently costs the Ethiopian economy over one -third of its growth potential, and it is expected to reduce the rate of economic growth by 38 % per year and to increase poverty by 25 % over a twelve years' period (Kindie and Mulugeta, 2010). In general Ethiopia, therefore, has been seriously suffered hugely due to climate change and variability for 85 % of the population depends on agriculture,

which is mostly subsistence in nature with a high dependence on rainfall.

## II. PROBLEM STATEMENT

Africa is already a continent under pressure from climate stresses and is highly vulnerable to the impacts of climate change. Many areas in Africa are recognized as having climates that are among the most variable in the world on seasonal and decadal time scales (Mertz et al., 2009).

The Intergovernmental Panel on Climate Change (IPCC, 2009) indicates that rising temperatures, drought, floods, desertification and weather extremes will severely affect livelihoods of community, especially in the developing world. Scholars also believe that in developing countries like Africa particularly sub Saharan Africans where majority of the population relies on subsistence agriculture are highly affected by climate change and variability such as droughts, temperature and fluctuation of rain which need high concern. Sufficient evidence shows that the average temperature rise in Africa is faster than the global average and is likely to persist in the future (Hulme et al. 2000). The warming is definitely hazardous for agricultural activities in the continent as many of the crops are grown close to the thermal tolerance limits (Collier et al. 2008). The warming of few degrees and increase in frequency of extreme weathers will consequently strongly influences the agricultural production and make the society victim of the events and decreases the future adaptive capacities. Hulme et al., (2000) also showed that rainfall decreases 'significantly' in June-July-August (JJA) over parts of the Horn of Africa which is the main crop cultivation season in Ethiopia.

However, it was acknowledged that the level of information and knowledge on climate change impacts in several sectors of East Africa is exceedingly patchy, generally poor to moderate only (Thornton et al. 2006). Ethiopia is one of the Sub-Saharan countries situated at the Horn of Africa. Like many other developing countries, agriculture (with the largest number of livestock in Africa) is the largest livelihood of the population (CSA, 2008).

The vulnerability of Ethiopia to climate change impact is a function of several biophysical and socioeconomic factors. Agriculture is overwhelmingly dependent on the timely onset, amount, duration, and distribution of rainfall. The population growth and resource degradation in the highland and midland areas have induced population mobility into lowland and midlands areas, the areas that are vulnerable to frequent water deficit and prone to drought (Haile 2004). Coupled with those factors climate change is more likely to results in vicious cycle of poverty and resources degradation in Ethiopia. For instance, the finding of Temesgen (2010) reveals that more specifically; the agricultural sector in Ethiopia is dominated by small-scale crop-livestock production, which is susceptible to climate change.

Climate change and fluctuation has wide ranges impacts on the community exposed to it. The impact is strong on those communities rely on single means of living, such pastoral and agro pastoral livelihoods. For instance, the drought of 2011 in the Horn of Africa which was triggered by a deep and prolonged La Niña episode and resulted in a severe food security and

nutrition crisis that affected the lives and livelihoods of more than 12.5 million people living in the region's dry lands (USAID, 2011).

It is highly recognized that the degree of vulnerability to climate change is different from country to country or region to region due to different factors. Regarding this, IPCC (2014) identified that differences in vulnerability and exposure arise from non-climatic factors and from multidimensional inequalities often produced by uneven development processes. For example, people who are socially, economically, culturally, politically, institutionally marginalized are especially vulnerable to climate change and also fewer attempts made to take part in some adaptation and mitigation responses. Moreover, individual's educational level, gender discrimination, disability as well as agro-ecology they live in with respect to their livelihood activities determine the degree of vulnerability and adaptation capacity (FAO, 2010).

Even though the government recognizes vulnerability of the country to the impacts of global climate change, particularly, in the arid and semi-arid areas, there is limited research-generated knowledge on impacts of the change, locally available adaptation and mitigation measures and community response (Aklilu and Alebachew, 2009). Climatic shocks render an already vulnerable population susceptible to livelihood crises that force millions of people to turn to the government for emergency assistance and supported through safety net program each year to augment their own productive and coping Mechanism.

For instance, in recent years, emergency food and non-food aid to Ethiopia has averaged \$320 million per year, with some years costing considerably more (NCCF, 2009). These realities show the country's development goals are unachievable unless the root cause of the complex development challenges of the country caused by the impacts of climate change studied scientifically and solution is thought at local level.

The main intention of the researcher in accomplishing this research is therefore, the harsh situation in the study areas resulted from climate change. Lowland Woredas of Bale Zone remain one of the hot spot areas for emergency mainly because of recurrent drought hitting the area for decades, which make them among the 290-food insecure Woredas and recipient of PSNP in the country (UN-OCHA, 2012).

Another key issue that triggers the researcher to conduct this research is that, a number of studies have been conducted on the impact of climate variability and vulnerability on livelihoods and coping mechanisms at the macro-level. For instance, Deressa et al., (2008) have conducted an integrated quantitative vulnerability assessment for seven Regional States of the total eleven regions by using biophysical and social vulnerability indices of Ricardian approach. The study has found that decline in precipitation and increase in temperature are both damaging to Ethiopian agriculture. Furthermore, the result of this study has also further pointed out that Oromiya Regional State is one of the most vulnerable regions to climate change impacts and the authors have acknowledged as their study was highly aggregated and further study is needed at local levels, particularly at district and villages, one of a gap this study is aimed at filling.

This means there were very few studies dealing with the impact of climate variability and vulnerability on livelihoods at the micro-level rather they were conducted at macro level (national, regional and zonal). Unless, the vulnerability, the impacts of climate change are known and identified at the micro-level and understood by the local people and established from bottom-up, it would be difficult to convince and motivate local communities to actively engage in fruit full adaptation actions.

To fill all these gaps, this research is designed with the aim to assess the climate change vulnerability, impacts of climate change and the adaptation/coping Mechanism of the people in rural livelihoods of arid and semi-arid of Bale zones at micro level (PA level).

### III. OBJECTIVE OF THE STUDY

The general objective of this study is to assess the impact of climate variability on livelihoods, vulnerability and coping Mechanism on selected Woredas of Bale lowlands.

#### Specific objectives

- To assess the vulnerability of Pastoral communities to climate variability induced shocks
- To identify the coping Mechanism adopted by the communities to climate variability induced shocks;

### IV. DESCRIPTION OF THE STUDY AREA

Location: Bale zone is located between 50 22'-80 08' N and 380 41' - 40 044'E. In its relative location, it shares common boundary with Somali National Regional State of Ethiopia in the East, East Hararge zone in Northeast, West Hararge Zone and Arsi zone in North, West Arsi Zone in the West and Guji Zone in the Southwest. The study area is bounded from north to south by latitudes 5.87° N and 7.14° N, and from west to east by longitudes 40.27° E and 41.91° E. (Atlas of Bale zone, 2004). See figure 1.

Bale has a great physiographic diversity. Highlands, lowlands and rugged areas, incised river valleys, deep gorges, characterize it and flat topped plateaus. The surfaces rise from about less than 300m above sea level (Southeast Rayitu, Guradamole and Dawe Qachen) to high ranges culminating into mountain Tulu Dimtu (4377m), the highest peak in the zone. The high land plateaus embrace the Sannate plateaus (Bale Mountain National Parks-) and Mount Tulu Dimtu. The lowlands include flat plains, river valleys and gorges broken up by hills and ridges. The majority of the lowland characterized by scarcity of rainfall and nomadic activities (Atlas of Bale zone, 2004).

With regarding to temperature, Bale zone characterized by a great diversity of thermal zones because of its wide range of altitudinal extents. According to the socio-economic profile of the zone, the temperature summarized as Warm Temperature zone, Moderately Warm temperature zone, moderately cool temperature, and cool thermal zone.

In the study area, there are three climatic regions sub-tropical (Weine Dega wheat, teff, some corn, acacia savannah - max elevation 2,265 m.a.s.l. in Guradamole Woreda), tropical (Kolla, sorghum and teff, acacia bushes) and Bereha (Semi-desert and

desert, thorny acacias, Commiphora - min elevation 497 m.a.s.l in Rayitu Woreda). The mean annual rainfall of Bale zone varies from 200mm from extreme lowland up to 1200mm on highlands (Atlas of Bale zone, 2004).

Concerning the demographical aspects, the total population of the Zone is about 1,402,492 (CSA, 2007). The rural population accounts for about 88.6 percent (1,243,072) of the total population of the zone. Population is unevenly distributed in the zone. There is a high concentration of population in rural areas of the zone than urban areas.

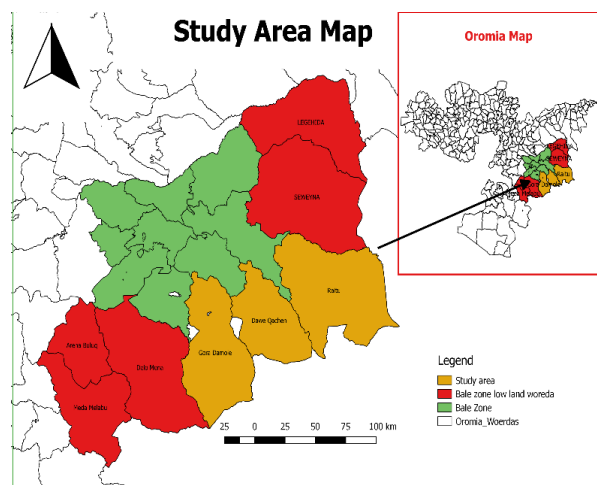


Figure 1 Locations in Bale Zone, Bale lowlands and Study area

## V. RESEARCH METHODOLOGY

### Research Approach

The quantitative survey research enables to draw representative and unbiased samples from the study population and helps to describe the existing conditions of climate variability and its adaptation Mechanism. Moreover, it helps to analyze the description between different variables collected from the sampled respondents. On the other hand, the qualitative approach used to understand the socio-cultural and economic aspects of the change and variability by looking at the variables in the natural setting in which they are found.

### Types and Sources of Data

In order to achieve the objectives of the study, both qualitative and quantitative data were collected from primary and secondary sources. The primary data collected from households and Developmental Agents (DAs) of the localities with the help of structured questionnaire, interview and focus group discussion. On the other hand, secondary data collected from different relevant offices like Pastoral development, Disaster plan and preparedness office and NGO as well as pastoral community offices at district and village administrative levels and CSA reports. Moreover, scientific journals, books and articles were reviewed extensively.

### Sampling Design and Procedures

In this study, a combination of purposive, stratified and probability-sampling techniques was used. The purposive sampling method applied to select representative Woredas (i.e. Rayitu, Dawe Qachen and Guradamole Woreda) and PAs. These

Woredas and PAs purposefully selected based on recently hotspot and the high severity of the magnitude for climate variability impacts.

Then the study used Stratified Sampling techniques with Proportion Population Size (PPS) to allocate representative Sample size from each of the three Woreda and PA from their respective total size of population as described. A list of households and DAs in PAs of the three Woredas (Rayitu, Dawe Qachen and Guradamole) used as the sampling frame for the study. Then from the sampling frame (list of Pastoralist HH and DAs) of the PAs the study identified the sampling units / the households and developmental agents / via Simple random sampling for data collection.

### Sample Size Determination

Sample size determination is one of the most important steps in any investigation. There is no magical solution and no perfect recipe for determining sample size. It is rather a process of compromise in which the precision requirements of the estimates are weighed against various operational constraints such as available budget, resources and time. Sample size determination is a process of making practical choices and trade-offs amongst the often-conflicting requirements of precision and such operational constraints. To determine sample size for this study, we used the following formula taken from Yemane, (1963).

$$n = \frac{N}{1 + N(e^2)} = \frac{43493}{1 + 43493(0.05^2)} = \frac{43493}{109.7325} = 396$$

Where N is population size and e level of precision and the size of our population is 43,493 or 7248 HHs. Determining our level of precision to be 5%, we get the size of our sample to be 396. Adding 10% the probability, that individual will not respond to the questioner we get 436.

To allocate the population of the three Woredas, the study used the following equation. The method of proportional allocation selected because of the sizes of the samples from the different strata is being kept proportional to the sizes of the strata (C.R. KOTHARI, 2004).

Here sample size for different strata was determined by the equation below:

$$\frac{n_1}{N_1} = \frac{n_2}{N_2} = \frac{n_3}{N_3} = \frac{n_4}{N_4} = \dots = \frac{n}{N}$$

Where, N = Total population size, n = Total sample size,

N1= population size 1, n1 = Sample size 1,

Furthermore, seventeen from each of the three Woredas were identified from the sampling frame (list Developmental agents) from the Woreda Pastoral Development offices for each of the PAs used to select ultimate sampling units with the use of Simple random sampling to identify the respondents for data collection

Validity and Reliability of Data Collection Instruments

In order to assure the validity and reliability of the data, different actions were taken. The validity of the instruments (questionnaires) assured with the help of pilot testing by taking 10% of the size of sample respondents'. In addition, an action was made to avoid non-return questionnaires by engaging adequate enumerators. On the other hand, since reliability is a necessary precondition of validity, data collected with different instruments i.e. questionnaire, FGD and interview were crosschecked and triangulated.

### ***Sampling Procedures***

Finally, to get to the determined number of samples from PA of the respective districts, the name of all households in the PA obtained from their respective PA, and then recorded on separate pieces of paper and folded. Then through lottery techniques, sample respondent households are selected. Finally, contact made with them either at their home, or PSNP works and food aid distribution places.

### ***Instruments of Data Collection***

The primary data, both qualitative and quantitative collected through structured questionnaire, interview and Focus Group Discussion (FGD). To this end, both open and close ended format questions is designed to obtain information on the respondents' demographic data, socio-economic characteristics, climate vulnerability on the livelihoods and coping mechanisms of pastoral communities

#### ***i Questionnaire***

A wide range of data on climate vulnerability on the livelihoods and coping mechanisms of pastoral communities as well as the intervention measures taken by different institutions were collected with the help of questionnaire. After the instrument is prepared and tested, two-hour orientation was given to data collectors that means CDF (Community development facilitator) that are found in different NGOs (AFD, DCA and COOPI) that are supports researcher by data collection about the purpose of the study, the contents of the questionnaire, how they are going to approach and treat respondents and other related issues (local languages and culture). To this end 436 survey, questionnaires do in English language and translated to Afan Oromo language when survey is collected.

#### ***ii Interview***

Interview conducted with key informants, DAs in the field. During the interview, the interviewer was brief the interviewee the purpose of the interview and attempt to make the respondents feel at ease.

Moreover, information regarding their ability to detect climate vulnerability was collected through in-depth interview with the key informants from each PAs. The key informants were also resourceful people who stayed for long period in the locality. The interview was made in Afan Oromo. In general, 50 (17 from each Woreda) key informants was interviewed.

#### ***iii Focus Group Discussion***

Six FGD (one FGD at each PA) with a group member of 6-9 participants were arranged with purposefully selected households. Thus, data was collected on the existing

intervention Mechanism by different institutions, the benefits obtained from it and livelihood coping Mechanism during hard times at household level. The FGD were carried out by the researchers at the convenience of the participants with the help of guiding questions. Participants of the FGD were purposively selected from each Pas with a mix people with different age group, gender and economic status. Thus, elderly people, Religious people, young adults, men, and women, rich and poor were included.

### ***Methods of Data Analysis***

The analysis of data collected both from primary and secondary sources carried out with statistical methods i.e. descriptive statistics after cleansing and entry to computer program.

To examine the socio-economic and demographic characteristics of respondents' descriptive statistics like frequency, cumulative frequency, percentage and averages were employed. Moreover, descriptive statistics also used to analyze the dependent variables that is vulnerability of climate variability and coping mechanisms of pastoral communities

To this end, IBM SPSS version 20.0 soft- ware employed. The analyzed data displayed with the help of tables, graphs and charts. The qualitative data analyzed by thematic coding and narrating the response of the key informants obtained from interview and FGD.

## **VI. RESULTS AND DISCUSSION**

Data used for the study were collected through questionnaires, FGDs, interview and document review. The data analyzed by descriptive statistics in using Statistical Package for Social Sciences SPSS version 20-computer software. The research findings presented in percentages, graphs and tables for data illustration.

### **Demographic and Socio-Economic Characteristics of the Respondents**

With regarding to sex composition, in the study site the information gained from Rayitu Woreda reveals that 27.5 % (120) of the surveyed were males while 5.96 % (26) were females, Dawe Qachen Woreda reveals that 27.29 % (119) of the surveyed were males while 6.88 % (25) were females. The corresponding figure for Guradamole Woreda is 26.61 % (116) were males and 5.73% (25) were females (Table 1).

Moreover, 0.92, 1.15 and 0.23 percent of Rayitu, Dawe Qachen and Guradamole Woredas were between 15 – 19 years of age respectively. Whereas the majority (16.7%) and (16.51%) of surveyed Rayitu and Dawe Qachen Woreda respectively are found 40 and more years of age. Fewer households in Guradamole Woreda come from large households with 10 and more members (2.98%) as compared to 3-6 (19.5%) large family size. In the same manner, most Dawe Qachen Woreda comes from households of between 3-6 persons (26.61 %) as compared to 7-9 members (8.72%).

Source: Field Survey, 2017.

In terms of marital status, data obtained indicates that 27.06% of Rayitu Woreda ,25.23% of Dawe Qachen Woredas

and 28.4 % of the Guradamole Woreda were Married .Furthermore, the majority of the respondents (about 63.53%) are illiterates followed by 24.08 % of Primary and 9.4 % of

Secondary General in their educational status. Regarding religion, largest percentage, 85.78 % were Muslims, 5.05% Orthodox Christians and 0.69% Protestant

Table 1: Demographic and Socio-Economic Characteristics of Respondents across Woredas.

Characteristics/ Variables		Rayitu		Dawe Qachen		Guradamole		Total	
		N	%	N	%	N	%	N	%
Sex	Male	120	27.52	119	27.29	116	26.61	355	81.4
	Female	26	5.96	30	6.88	25	5.73	81	18.6
	<b>TOTAL</b>	<b>146</b>	<b>33.49</b>	<b>149</b>	<b>34.17</b>	<b>141</b>	<b>32</b>	<b>436</b>	<b>100.</b>
Age	15-19	4	0.92	5	1.15	1	0.23	10	2.3
	20-29	17	3.90	20	4.59	11	2.52	48	11.0
	30-39	52	11.93	52	11.93	42	9.63	146	33.5
	40 and more	73	16.74	72	16.51	87	19.95	232	53.2
	<b>TOTAL</b>	<b>146</b>	<b>33.49</b>	<b>149</b>	<b>34.17</b>	<b>141</b>	<b>32.34</b>	<b>436</b>	<b>100</b>
Marital Status	Single	14	3.21	12	2.75	6	1.38	32	7.3
	Married	118	27.06	110	25.23	124	28.44	352	80.7
	Divorced	6	1.38	9	2.06	10	2.29	25	5.7
	Widowed	8	1.83	18	4.13	1	0.23	27	6.2
	<b>Total</b>	<b>146</b>	<b>33.48</b>	<b>149</b>	<b>34.17</b>	<b>141</b>	<b>32.34</b>	<b>436</b>	<b>100</b>
HOUSEHOLD SIZE	1 to 3	3	0.69	5	1.15	5	1.15	13	3.0
	3 to 6	121	27.75	116	26.61	85	19.50	322	73.9
	7 to 9	11	2.52	22	5.05	38	8.72	71	16.3
	10 and more	11	2.52	6	1.38	13	2.98	30	6.9
	<b>TOTAL</b>	<b>146</b>	<b>33.49</b>	<b>149</b>	<b>34</b>	<b>141</b>	<b>32.34</b>	<b>436</b>	<b>100</b>
RELIGIO N	Muslim	123	28.21	118	27.06	133	30.50	374	85.8
	Orthodox	11	2.52	8	1.83	3	0.69	22	5.0
	Protestant	0	0.00	2	0.46	1	0.23	3	0.7
	Others	12	2.75	21	4.82	4	0.92	37	8.5
	<b>TOTAL</b>	<b>146</b>	<b>33.49</b>	<b>149</b>	<b>34.17</b>	<b>141</b>	<b>32.34</b>	<b>436</b>	<b>100</b>
EDUCATION STATUS	Illiterate	111	25.46	98	22.48	68	15.60	277	63.5
	Primary (Grade 1-8)	9	2.06	43	9.86	53	12.16	105	24.1
	Secondary (Grade 9-12)	15	3.44	8	1.83	18	4.13	41	9.4
	Vocational/Higher	11	2.52	0	0.00	2	0.46	13	3.0
	<b>TOTAL</b>	<b>146</b>	<b>33.49</b>	<b>149</b>	<b>34.17</b>	<b>141</b>	<b>32.34</b>	<b>436</b>	<b>100</b>

**Vulnerability of Pastoral communities to climate variability**

As shown in figure 2, 2.75 % of Argo pastoral Communities revealed that yields over the past ten years have been increasing and 3.67% of Argo pastoral Communities said it is difficult to estimate over the years. Whereas, 75.52 % and 15.14 % of the Argo pastoral Communities replied that yields over the past ten years have shown great variation and has been decreasing, respectively.

The majority of all respondents confirmed that climate Variability and fluctuation are the main challenges for the fluctuation of Livestock and crop productivity over the years in the area. Table 2 illustrates that 77.52% of the Agro pastoral Communities replied that there is a decline in livestock/ crop production while the reaming 22.48% of the Agro pastoral Communities not.

With regard to the causes for agriculture production decline, from the total number of 338-sample survey who said yes, 84.32% of respondent from Community survey and 84 % of

developmental agents replied that climate variability is the principal factors for the fluctuation of livestock and crop productivity over the years.

While some of the respondents told, the change was due mismanagement (7.40% of Agro pastoral Communities' and 12 % of developmental agent). The remaining 4.14% and 3.55% of Agro pastoral Communities' respondents agreed that fluctuation was due lack of access to agricultural input and soil infertility Climate change and fluctuation as the causes for crop production decline, respectively. Furthermore, the 285 sample respondents who said climate variability as reasons for decline of crop production were also asked which Climatic Parameters Influence Production and Productivity.

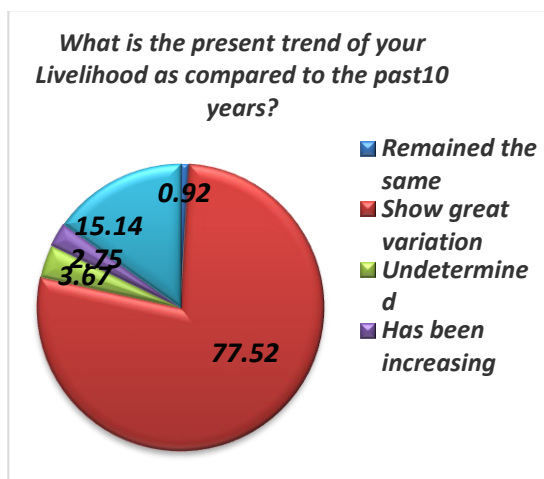


Figure 2: Respondents View of trend on their Livelihoods for the last 10 years.

As table 2 shows that, the conserving the climatic factors of rainfall type in general, all Agro pastoral Communities and developmental agents were asked to reply which types of Rainfall Influence Production & Productivity in the study area as the result shows above table, that most of the factors that influence agricultural production are seasonal variation and erratic rains. About 76.23% of the Pastoral', 46 % of DAs and selected agricultural expert of sample survey verified this concept. While 9.82% and 8%, of Agro pastoral Communities', and DAs and selected agricultural expert respectively consider annual fluctuation as the major for the decline of Livestock and Crop production and productivity in the study area.

Further about 8.27% and 42% of Agro pastoral Communities' and DAs and selected agricultural expert replied that Decline of rainfall throughout the year is the factors that determined Crop and Livestock production and productivity in study area. Whereas 5.68 % Agro pastoral Communities' respondents support Intensity of rainfall during summer and storm as one of the factors and the majority, 76.23 % replied Seasonal variation and erratic rain (Table 2).

From general point of view, one can understand that climate variability can positively and negatively affect agriculture in general and crop and livestock production and productivity in particular. The result of interview and FGD also support that

climate shows variability in the study area. Because majority of key respondents have said that climate has been fluctuated.

The survey result shows that the highest percentage of the respondents 77.75% estimated that trends of climate in locally have been varies from time to time. Only 7.57 percent of respondents were perceived as trends of climate in locally have been improved.

The above table 2 shows that the main environmental problems in the study area that retard agriculture production in generally and crop and livestock production and productivity in particular are replied as climate variability (71.33%), climate related disease (6.42%), soil erosion (4.13%), drought and floods (16.28%) and desertification (1.83%).

Hence, Climate variability are the major environmental shocks that adversely vulnerable that affect livestock and crop in different ways and in turn affect the livelihood of the community as shown in the above results.

### Pastoralists' Climate Vulnerability Coping Mechanism

As presented in the Table 16 below, 66.41 % of the respondents' income did not sustain their family all the year round. In contrast to this 71.10 % of household respondents' income was enough to sustain their family all year round. Only 1.61 % of them reported that their income was more than enough.

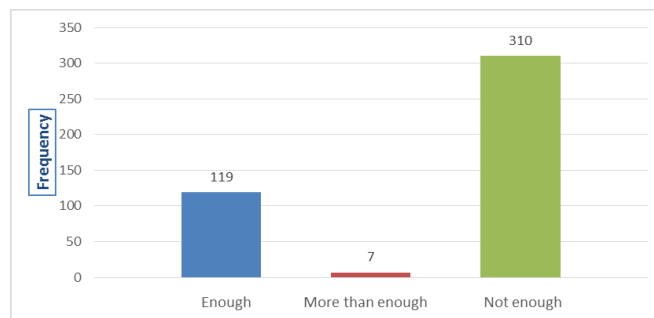


Figure 3 : Pastoralist' respondents whether their income sustained all-round the year

### Source: Field Survey, 2017.

Pastoralist respondents were asked to mention how they are surviving since income did not enough all-round the year. Thus, some of the respondents sustain all year round by using the previous saving in various forms. On the other hand, about three-fourth (71.10 %) of them replied as not enough.

Majority of them reported that "selling our livestock and other assets, renting our land and selling labor. Meanwhile some of them, especially young generation those had land scarcity used temporal and permanent migration to near village (To Delomena during coffee production time) or to Arab country.

Therefore, the researcher concludes that the only appropriate coping Mechanism of the study community are credit from rural financial institutions. But the rest of coping Mechanism the interviewees discussed cannot bring sustainable change because

they focus on immediate response and it is fuller of demerit. Here the other constraints they mentioned during the interview period was inadequate and in unfair rural credit financial institutions. In addition to this, you need house or other material's that could be granted to get the credit. However, most of the pastoralists are very poor to bring that granted material to borrow the money.

The result of FGDs also revealed that majority of the participants were given the Productive Safety Net Programme (PSNP) and Pastoral Commission Development Program (PCDP) program. Furthermore, there are other governmental programmes besides the above-mentioned Nongovernmental organization. However, this government and Non-governmental can hold only a few households under their activities

Table 2 Respondents View on Main reasons for product fluctuation Assessment

Variables	Responses	Group of Sampled Respondents			
		Pastoralist HH		DAs(N=50)	
		N	%	N	%
Decline In Livestock Or Crop Production	Yes	338	77.52	50	100
	No	98	22.48	-	-
	<b>TOTAL</b>	<b>436</b>	<b>100</b>	<b>50</b>	<b>100</b>
Reasons For Fluctuation	Climate Variability	285	84.32	42	84
	Mismanagement	25	7.40	6	12
	Lack of Access Input	14	4.14	-	-
	Soil Infertility	12	3.55	2	4
	Market Fluctuation	2	0.59		
	<b>TOTAL</b>	<b>338</b>	<b>100</b>	<b>50</b>	<b>100</b>
Climate Parameter	Rainfall and Temperature	263	92.28	35	70
	Frost	12	4.21	15	30
	Moisture	0	0.00	-	-
	Evapo-Transpiration	10	3.51	-	-
	<b>Total</b>	<b>285</b>	<b>100</b>	<b>50</b>	<b>100</b>
Rainfall Influence Production & Productivity	Seasonal Variation and Erratic Rain	212	76.23	23	46
	Annual Fluctuation	17	9.82	4	8
	Intensity of Rainfall During Summer and Storm	19	5.68	2	4
	Decline of Rainfall Throughout the Year	15	8.27	21	42
	<b>Total</b>	<b>263</b>	<b>100</b>	<b>50</b>	<b>100</b>
Major Environmental Problems	Soil Erosion and Loss of Pasture	18	4.13	2	4
	Climate Variability	311	71.33	38	76
	Desertification	8	1.83	2	4
	Drought and Luck of Water	71	16.28	4	8
	Climate Related Disease	28	6.42	4	8
	<b>Total</b>	<b>436</b>	<b>100</b>	<b>50</b>	<b>100</b>

VII. CONCLUSION AND RECOMENDATION

The main purpose of this study was to assess climate vulnerability on livelihoods, and coping Mechanism in selected three Woredas' of Bale lowland. The study was conducted in Six PAs' of the Rayitu, Dawe Qachen and Guradamole Woreda.

Therefore, increasing climatic trends and seasonal variations led to a conclusion that the productivity of livestock and crop production in the study area has been negatively affected by rising mean temperatures and decrease of annual sum rainfall.

The finding revealed that agriculture in the study area is affected by climate variability especially inter annual and season variability which in turn affect the livelihood of the community.



Since livestock and Crop is the prime livelihood source for the study community, fluctuation in productivity strongly affect the wellbeing of community under study. The people interviewed for this study are worried because they are depending on the rain for their livelihoods. The change in temperature and fluctuation in rainfall also alter disease pressures and hence, Pastoralist will need to adapt their management practices.

The climate fluctuation creates vulnerability that is exacerbated the by lack of adaptation and commitment from both pastoralists and local institutions. Since pastoralists are prioritizing their immediate benefits rather than sustainable development. Almost half of communities still were not clearly identifying the cause and long-term consequences of climate variability on their activity and livelihood.

The pastoralists have been using traditional coping Mechanism such as selling their livestock's and other assets, credit from rural moneylenders while institutional coping Mechanism are rare.

In addition to this, they have been coping by minimizing their daily consumptions, engaging in off-farm activities such as peaty trade and temporal and permanent migration.

Thus, most of the coping Mechanism pastoralist have been using are destructive rather than constructive and depletive ones.

#### Recommendations

In light of the findings of the study, the following recommendations are suggested. Therefore, the researchers recommend the following options to overcome the problems.

□ Strengthen local capacity to manage risks through local civil society organizations such as pastoralists cooperatives, pastoralists field school, (pastoralists training centers), and others that can serve as forums for sharing information and experiences that allow pastoralists to take advantages of commercial production opportunities while also increasing production in a sustainable and climate resilient manner.

□ Research finding indicate that there were no strong linkage different institutions. Therefore, it will be critical to link pastoralists to relevant research institutions to promote access to innovative climate resistant and stress tolerant crops and livestock.

□ The result of this study indicates that majority of respondents engaged in agriculture in general livestock in particular, as source of livelihoods and income. These needs to diversify their engagement and source of income generating activities.

□ Even if most of the respondent pastoralists were aware that climate is changing depending on their life experience and indigenous observation of weather and climate, raising awareness on the implications of climate variability and sustainable coping Mechanism and adaptation options will be needed.

□ The result indicates that majority of the pastoralists community used traditional coping Mechanism. Therefore, institutional coping Mechanism should be incorporated for the

sustainability of their coping. Integration and effective collaboration of all sectors of stakeholders must be implemented

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