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Analysis of Climate Change Perceptions, Effects and Adaptation Strategies in Raytu District of Oromiya Region, Ethiopia

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Abstract:
This study presents the perception, effects and adaptation of climate change and observed trends of the variability in temperature and rainfall from data collected in 2013.The results showed that there is a long term temperature (0.08°c per year) and rainfall change(-1.328 mm per year). The change in the main components of the climate system was also confirmed to be in line with the community's perception about the changing climate. Major climate related hazards witnessed were Livestock disease, Occurrence of drought, Pest infestation, Water stress and Pasture loss. The findings also indicated, in Rayitu district, changing seasonality was essentially explained by late onset and early offset of rainfall and increased temperature trends. Temporal migration, livestock mobility, herd diversification, rearing of shoats rather than cattle ,shifting to crop production, herd splitting ,tree planting , practicing non- farm activities, changing planting date, planting tree and use irrigation are dominantly being practiced as climate change adaptation strategies in the district. The finding indicated that better access to crop and livestock extension and credit services and farm and non-farm annual income, land ownership, household head sex and level of education are critical for helping agro pastoralist adapt to climate change. Generally, the findings suggest that all efforts in the study area must support these diversified adaptation strategies, if these communities are to be resilient against climate related hazards.

Keywords*: Climate change, adaptation strategies, Perceptions*

1. Introduction

The impacts of climate change are already happening and Adaptation and mitigation strategies are major response measures taking the frontline as policy and intervention response to date worldwide. Development efforts have faced these challenges, and it is manifesting quite adversely to the agricultural and pastoral sector of which many of the developing world's lives and livelihoods heavily dependent on. As it has been largely studied climate change adaptation measures are the key response measures to reduce the underlying vulnerability to the effects of climate related hazards (Easterling et al., 1993; Rosenzweig and Parry 1994; Smit et al., 1999; Mendelsohn et al., 2006; **Reilly** and Schimmelpfennig, 1999; Smit and Skinner, 2002). Therefore, adaptive capacity is always at the center of any development effort, if it is meant to reduce the impacts of climate change and create resilient society in the face of climate calamites. The degree to which a pastoral system is affected by climate change depends on its adaptive capacity. Indeed, according to IPCC (2001) adaptive capacity is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damage, to take advantage of opportunities, or to cope with the consequences.

In Ethiopia, GDP and RF are highly related; the shortage and improper seasoning of it will totally decline the country's GDP (World Bank, 2006). Production and productivity in pastoral and agriculture sector have been severely threatened for long years causing loss of land, pasture loss, water shortage, shorter growing seasons, and uncertainty on what to grow and when. The changing climate and extremities is impacting Ethiopia and has been fueling up the food insecurity situation and hunger and livestock composition and stock at large (UNFCCC, 2007).

In history, the people of Ethiopia have accumulated enormous indigenous knowledge in the face of shocks /hazards ranging from day to day risks to the larger and massive complexities (disasters) that can be tapped and integrated as relevant intrusion to the larger country's Disaster Risk Reduction and Climate Change Mitigation and Adaptation efforts. These lessons have been overlooked for long years. The impacts of climate change followed by their complexity could potentially have an increased risk effect upon the social and environmental welfare as well as the economic drivers in Ethiopia in general and the region Oromia in particular.

Despite the growing interest researches in the field of climate change, little has been done on the local perceptions, coping and adaptation strategies in the country in general and the study area in particular. Now days, the research community in climate change issues are focusing on worldwide impacts and status of climate change dealing with coupled atmosphere, land, oceans interactions and models of specific interest with dynamic modules to achieve the realism necessary for climate studies. Most of the studies to date have shown us the long term changes which have been occurred at continental, regional and national levels in temperature, wind patterns, rainfall resulted from consequence with extreme events like, drought, tsunami, cyclones and other

hydro meteorological hazards. In Ethiopia we have been facing various kinds of climate related hazards, inter alia, drought, and flood, pest infestation, which are esteemed either from natural or anthropogenic origin. Oromia pastoralist region is repeatedly being called for it is being affected by climate related hazards. The above climate related extremities directly affects production and productivity of rural households. This research looked into the local community's perceptions, knowledge, believes, coping and adaptive capacities by contextualizing profound historical, economical, socio-cultural, policy and wider structural perspectives in the study area.

2. Methods

2.1. Description of the study area

The study was conducted in Rayitu district, in Bale zone, south eastern Ethiopia. It covers an area of about 6 139.39 km^2 of land. As it is indicated in Figure 1, the district is bordered by Sewena and Ginir districts in the north, Sewena district in the east, Goro in the west and Somali Regional State and Goro district in the south. The northern and Southern tips are dominated by mountainous terrain, while the remaining part of the district is flat plain land. Wabi Shebele, Weyib and Dinikte are the well known perennial rivers bordering the district. About 5% of the district is semi desert, 90% is tropical and 5% is sub-tropical agro-climatic zone. The three most common types of soils of the district are Solonchaks, Fluvisols and Xerosols. Xerophytes, bushes and shrubs are the common plants that grow in the district. Xerophytes grow on the lower altitudes and bushes & shrubs on relatively higher altitudes. Warthog, Hyena, Hare, Gazelle and Antelope are the most common wild animals in the district. There are no parks, reserved areas or sanctuaries for wildlife in the district.

The rainfall pattern is bimodal with erratic distribution; the main rainy season extends from March to end of June and the short rainy seasons usually extending from September to end of October. The production system in the woreda is pastoral (PADS, 2004). The district is dominated by hot, dry climate and is considered pastoral area. The area experience hot climatic condition with mean annual of 26 ^{o} & a maximum to of 40 ^{0} and less than 300ml average annual rainfall. While the minimum required for agriculture 700mm. The woreda lies within an altitudinal range between 500 to 1,785 m.a.s.l (meter above sea level).

Regarding land use of the district, 17.0% was arable land, of which only 15% was cultivated. About 39% was grazing land, while vegetation covered 37%. Teff, maize and sorghum are the major crops cultivated in the district. About 90% of the district's production comes form Belg season. Cattle, camels, goats, sheep and donkeys are the important livestock of the local community (Socio economic profile of Rayitu district, 2011). The livestock population in the area is estimated to be 34,863 to 35,560 cattle, 57,005 goats, 30,879 sheep , 12,320 camels, 7,473 donkeys, 414 horses 154 mules, and 4,053 poultry . The human population of the woreda is a total of 33,163, of which about 4.6% were urban residents. About 49.4% of the population was economically independent (15-64 years). The economically dependent age groups of 0-14 and above 64 years were 48.7% and 1.9% respectively. Females accounted for about 47.9% of the total population in the district (46.9% of the urban and 47.9% of the rural). The crude population density of Raytu district was 6 persons per km2 (CSA, 2008).

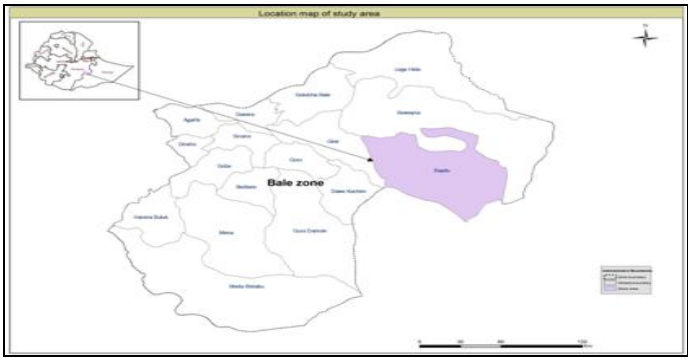

Figure 1: Description of the study area

2.2. Sampling Procedure

The primary data was obtained through administration of structured questionnaire on pastoralist in study area. The Data collection included the household socioeconomic and production characteristic, actual adaptation strategies adopted by the respondents as well as determinant factors to adaptation faced in the study area. A sample sizes of 241is the pre- determined by researcher using scientific formula (Yamane, 2001). However researcher due to financial and transport limitation 155 sample were collected from one kebele. Systematic random sampling technique used to select the households in which every k^{th} subject on a list of selected households for inclusion in the overall sample. The "K" refers to the sampling interval and that was every 4^{th} (K=4) households. The value of K is determined by dividing total households in the kebele N = 647 (male =447, female =200) by the sample size. The first stage of sampling will be a purposive sampling of woreda as well as kebele in consultation with the concerned bodies. The researcher selected one kebeles, because of accessibility to socioeconomic resource, natural resource, frequency of climate related hazard, etc.

Sample Size (n) = $N.t^2*p.q$

$d^2N+t^2.p.q$

Where N = is the number of Household in Gurrura kebele in Rayitu Woreda

- t = is the number which is the required confidence interval (for 95% CI, t=1.96;
- p= is the Probability for and event to occur (the rate of population choose that particular adaptation strategies P = 0.5)
- q= is the possibility for an event not to occur (the rate of population not choose that particular adaptation strategies q = 0.5)
- d= is the an acceptable error rate during sampling (0.05 again associated with 95% CI)

3. Data Collection and analysis Techniques

Data for the study was collected from both primary and secondary sources. The secondary data source were livelihood baseline data, woreda risk profile of the woreda and other survey conducted by Disaster Risk Management and Food Security Sector (DRMFSS) and Metrological data from National metrology agency. The data collection tools are explained below:

- **Household survey**: A cross-sectional interview survey was conducted among households they were selected by using systematic random sampling technique. First, one kebele among 19 kebele in the Woreda were purposively selected by the pattern of the accessibility to socio-economic, natural resources, occurrence of climate related hazard etc. Within one kebele a total of 155 households were selected for the response to what adaptation measures is taken and are they adapting the change or not. Moreover the Household questionnaires were collected information about on physical, human and economic resources, income from livestock, perception on climate change, constraints to adapt the changes and relevant adaptation strategies, beside regular information on household demography and educational levels of pastoralist communities of Rayitu Woreda.
- **Focus Group Discussion**: In one selected kebele of the Rayitu woreda two (2) focus group discussions comprising twelve men or women in mixed gender and age groups were achieved. The discussions in the groups revolved around the perceptions of climate change; trends in weather patterns; challenges of climate change to their livelihoods, what are the constraints to adapt and how each group was adapting and coping with the effects of climate change. The emphasis on gender and age aggregation allowed to full participation of all sections of the community members given that due to their gender roles, the impacts of climate change were experienced differently and therefore their responses and adaptation approaches were likely to vary accordingly. The focus group discussions was clarify subjective issues within the findings of the quantitative part of the study and to benefit from the group interactions in getting further insight on the determinants of climate change adaptation .
- **Key informant interview:** A total of four Key informant interviews were conducted with specific members of the government bodies like Development agency, kebele leaders and head of pastoral office (Woreda Disaster Prevention and Preparedness Bureau) and local and international NGOs staffs in the woreda. They were therefore well placed to understand community norms and culture and kinship and social-economic systems and structures that bound the community. These individual interviews were taken an in-depth approach where by the respondents freely discussed their perception of climate change, the challenges to their livelihoods and the determinants factors which influence adaptation strategies. A check-list of questions was used to guide and narrow the discussions to relevant issues around the main research questions.

Collected household data from the field were analyzed using SPSS (Statistical Package for Social Science) Version 16.0. Descriptive statistics such as mean, percentage and standard deviation were used to present the results. Metrological data were also analyzed by trend analysis to see the historical dynamism on the major variables of temperature and rainfall taken from the study area.

4. Results and Discussion

4.1. Household Demographic Characteristics

4.1.1. Age and Sex composition of the households

From 155 sampled households the average household size was about 7 persons with a minimum of one person and a maximum of 15 people per household. As it is illustrated from the below Table, the average household size was reported to be with a standard deviation of 2.71.

The household family size is important household demographic variables which has influence on the pastoralist choice of adaptation strategies. Larger family size is expected to enable farmers to take up labor intensive adaptation measures (Nyangena, 2008; Dolisca *et al.*, 2006; Anley *et al.*, 2007; Birungi, 2007). Alternatively, a large family might be forced to divert part of its labor force into non-farm activities to generate more income and reduce consumption demands (Tizale, 2007). In this particular study it was found that large family size usually implies availability of labor provided that majority or all of the family members are within the age range of active labor forces (15-64). This study presented that most of families above the average family size of the region that studied by CSA (6-10 number of families) however the age composition of about 65.2 % of the families fall under non productive age (1-15 years old) .

Age of the household head is one of the factors to some of the important factors contributing to the information given by early warning official through Medias, communicated with the government official and educated people and to take adaptation measure for climate change. The household age categories 18-32 years old in the study area were the first dominant age categories followed by 33-46 taking 39.4 % and 36.1%, respectively. The average age was 39, of the sampled household heads, 85 years was the oldest and 18 years was the youngest. The more years they stayed, they would have greater possibility to judge the dynamic temperature and rainfall situation; hence they could also have better climate change adaptation choices driven from their experience. Old and literate household heads are more likely to adapt climate change adaptation measures than others (Maddison,

2006). In contrary, Ofuoku et al. (2012) indicate that a negative relationship between age of the household and adoption of improved agricultural technology as an option of climate change adaptation strategy.
As illustrated in Table 1, of the total sampled household's majority (62.6 %) were female headed households, while 37.4 % of them were found to be male headed households.

Demographic variable	Frequency	Percentage(%)	Mean	Std. deviation
Age(year)				
18-32	61	39.4	39.39	14.17
33-47	56	36.1		
48-65	30	19.4		
>66	8	5.2		
HH head sex				
Female	97	62.6		
Male	58	37.4		
HH Age composition(year)				
1-15	101	65.16		
16-65	54	34.84		
>65	0	0		
Family size				
1 to 5	42	27.10	7.14	2.71
6 to 10	101	65.16		
>11	12	7.74		

Table 1: Households Demographic information

From the figure 2, it can be concluded that majority (60.65 %) of the total sampled households are illiterate and the rest are at least have got basic education. About 38.06 % of them were included under primary category (1-8 grade level) and very few of them less than 0.7% have completed above secondary (9-10 grade level) and technical school. Perception and adaptation to climate change is subject to numerous understandings and information and knowledge which entirely seek respondent's level of education to interpret and use it. Therefore, adaptation is related with the ability of an individual, family, and community to adjust to changes or take advantage of the threatening situation and further signifies the relevance of level of education as a basic human capital to achieve the expected adaptive capacity to the changing climate and its negative consequence (IPCC, 2007). According to Schipper (2004), improved education and information are described as crucial determine factors for adaptive capacity and sustainable development. Current research does appear to validate such a view that households with at least have got basic education are likely to be prompt enough to respond against the changing climate and are not resistant for innovative climate change adaptation technologies.

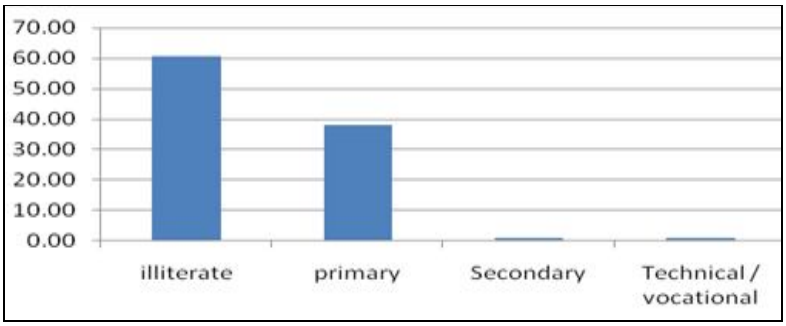

Figure 2: Household Head Level of Education

4.2. Household Socioeconomic Characteristics

4.2.1. Livestock ownership and composition and Land ownership
As shown by the table 2, pastoralists owned 1 up to 5 donkeys and cattle, which clearly illustrate their productive asset ownership, help to reverse the impacts of climate change. In pastoralist area livestock ownership is one of the asset households have as proxy indicator for wealth and for social prestige value as well as better adaptive capacity in the face of climate related shocks. Similarly it is included under the productive asset within the pastoralist community. Livestock ownership is particularly important for increasing the resilience of vulnerable, poor people, who are subjected to climatic, market and disease shocks, through

diversifying risk and increasing asset (Krishna *et al*., 2004; Freeman *et al*., 2008). Similarly, findings from this study lend support to the claim that households which have high number of livestock are better adapting than the poor household. The wealthier households are also more likely to adapt to perceived climate changes (Bryan et al., 2009).

Type of livestock	Number of livestock			Mean	Min	Max	Stand. deviation
	1-5	6-10	>11				
Cattle	63.87	5.18		1.75	1	3	0.55
Camel	18.71	0.65		1.2	1	3	0.42
Goats	49.02	20	4.52	2.03	1	4	0.81
Sheep	25.16	0.65	0.65	1.28	1	4	0.51
Donkey	65.8	0	0	1	1	1	.000

Table 2: Livestock ownership (n=155)

4.2.2. Land Ownership

The major land use systems in the study area are agro-pastoralism, the main rain filed crops cultivated are Teff, sorghum and maize with the mixed livestock production. From the total sampled households the minimum land registered was 0.5 ha and the maximum was 15 ha with a mean of 2.203 ha and a standard deviation of 1.86. Majority of the households' (56.1 %) land ownership falls in the range of 0.5 to 3 ha; about 18.7 % household own rang of 3.5 to 6 ha of land and less than 1.3 % of the sample households that own more than 7 ha of land. The data yielded by this study provides convincing evidence that land is a key economic resource as factors of adaptive capacity and being repeatedly represented as indicators of wealth of rural households and localities on which every critical activity is based. This finding is supported by DFID (1999), land is one of the basic natural assets which households make use of to build and diversify their means of living which in turn believed to influence the existing and potential climate change adaptive capacity.

4.2.3. Main Source of household income

According to the survey, 49.03 % of households were reported that the main source of income is combined livestock and crop production (agro-pastoralists), 47.10% were purely livestock producer(pastoralists) and the remaining few percentages(3.87 %) of household were get their incomes from other non-farm income source such as Trader, casual labor etc.

Income is something which makes households living from whichever the source it comes. Obviously, this income is subject to countless of economic, social, environmental, political and institutional factors. The average household annual income was reported to be 10,548.8 with a standard deviation of 8840.57. The maximum annual income were reported to be 50,000 and 500 is the minimum figure responded.

4.2.4. Access to Water

The total water coverage of the Rayitu district is 33 % (Rayitu district water and energy office planning document, 2012). On top of this, there are different water schemes rehabilitated and constructed by development actors (PCDP & RCDP) working in the district. According to the household survey result such water sources like public tab (communal tab) and pond water (rain water collection) were identified as major water sources. From the total respondents 58.06 %, and 14.84 % of them have identified tab (communal tab) and pond water respectively as major water sources which bridge the dry period water gaps. However climate change and variability place additional and unique burdened on different part of the peoples particularly women. As drought becomes recurrent small and locally available ponds tend to dry up first forcing women to travel farther to fetch water each day. As the result presented here about 84.5% respondents mentioned the adult women are the responsible to fetch water the study area and the women travel in average of 75.39 minute (1:25 hr) every day to get water.

4.2.5. Access to health service

Human health is categorizing under the human asset and it is the major factors which influence household labor force and consequently impacted on climate change adaptive capacity. According to the third IPCC assessment report, climate change can affect human health directly (e.g impacts of thermal stress) and indirectly through changes in ranges of disease vectors (mosquito), water born, pathogens, air quality and food availability and quality. The result presented here about 94.84% of households have an access to health post this result show that the health coverage in the kebele seems better.

4.2.6. Market access

The present study result shows that 94.2 % of the respondents were reported that have an access for market and 5.80 % were otherwise. However the market place is far-away from their residence and the average time taken is 6.68 hr. Literatures argue that Market access is important factor which affects choices of climate change adaptation strategies. Basic information about the market distance and the times takes to reach are vital to a comprehensive understanding of the adaptive capacity situation that could potentially contributes to appropriate design of interventions and further programming .Information on market distance and others can make households to build up their confidence of where they can sell their produces and buy whatsoever.

4.2.7. Access to road and electricity

In the study kebele 53.55 % of households have access to road leading to their dwelling however it's dirty road or difficult for car. In average 50.88 minute takes to nearest paved road and maximum 420 minute. There is no any electricity access in the study kebele. Road and other infrastructure are categorized under the physical asset which helps the community to communicate with the urban centre and create opportunity to the household to have information about climate change and variability.

4.3. Pastoralist' Perception on Climate Change

This study reveals as to how farmers perceive changes in the major indicators of climate change (Table 3). In order to understand pastorals perception towards climate change in Rayitu woreda , pastorals and agro-pastorals were asked to indicate what they had noticed regarding long-term changes in temperature and precipitation. Perception of climate change is the precondition for the pastoralist commencement of adaptation practices. As many African studies indicate a large numbers of agriculturalists already perceive that the climate has become hotter and the rains less predictable and shorter in duration (Maddison, 2006).

Variable	% of Responses	
	Yes	No
Increase Temperature	84.52	15.48
Decrease Temperature	13.55	86.45
Change onset of rainfall	87.1	12.90
change in off set of rainfall	89.03	10.97
change in patterns of rainfall	97.42	2.58
change duration of rainfall	97.42	2.58
Frequency of drought	95.48	4.52
change in wind pattern/speed	78.71	21.29
Change in sunshine intensity	76.13	23.87
Change in season	77.42	22.58
Invasion of new species of plants & tree	56.77	43.23
Disappearance of some species of plants and tree	77.42	22.58
Reduced of quality of pasture	87.10	12.9
Drying up of streams	82.58	17.42
Land Degradation	64.52	35.42

Table 3: Pastoralist perception of Climate Change based on the last 20 to 30 years experience (% of respondents) (n=155)

In this survey pastoralist were asked questions about their perception of long term temperature and precipitation changes and what measures and practice they have typically opted for in order to cope with such changes over year. Summary statistics shows that about 96.13% of the respondents were have been observed some changes in the climate and 75.48 % of the respondent also heard about climate change over the 20- 30 years. This research result indicate that 84.52% of the surveyed pastoralists have observed increasing temperature over the past years as 77.42% of them have observed change the seasonality of rainfall over the past years. Meanwhile the focus group discussion participant have been observed the change and characterized by changing in season, increased in temperature, change wind pattern and disappearance of species of tree and grass. Similarly the household respondent characterized the problems of climate change and variability increased the frequency of drought, invasion of new species of plants & tree, disappearance of some species of plants and tree, reduced of quality of pasture, change in sunshine intensity, drying up of streams , change wind speed and land degradation.

As 78.71% of household respondent characterized the change in climate that the wind directions are the major cause and indication of changes of seasons and increasing droughts, since heavy dry winds would blow away the rain laden. This, however, does not only affect the rains, but also the fog. Nowadays the strong wind reduces the fog, and this impacting on early regeneration of vegetable before the start of the rainy seasons.

About 77.42 % and 56.77 % of respondent respectively, the disappearance of some species of plants and invasion of new plant species they mentioned as the major climate change problem the household facing in the study site. The disappearance of rangeland species gave room to bush encroachment and invasive of new species. The present study is comparable with Abate *et al*. (2012) findings that were about eighty six percent of the respondents in Rayitu district replied that compared to past 30 years; their grazing land was covered with bushes and shrubs such as Acacia tortilis, Acacia bussie and Commiphora erythraea were the encroaching woody plants in grazing sites.

4.4. Climate Related Hazards Experienced

The household prioritized the three hazards which have been affected as far the households remember were drought (86.45%), conflict (27.61 %) and livestock disease (26.09 %). However the already happening climate change bears exceptional dynamics on the customary hazards which the community has been experiencing since the creation of mankind. In the study area climate change has been posing exceptional change like; drought, heat waves, livestock and human epidemics by large. These extremities have been explained by the households themselves in the study area; as the table illustrates below the frequency of drought was increased with 92.21 % of the respondents compared to as far back households have been experienced. Similarly about 48.9 %

respondents put as the first reason for the herd size reduction is the recurrent drought occurrence. This finding similar with that of Kaimba *et al.* (2011) which report the significant influence the coefficient of drought and disease, has on herd size, implying that those that have lost livestock to drought and disease previously are more likely to own smaller herd than those not affected.

Hazard type	Frequency as far as you remember	Frequency last five year	Percentage as far as you remember	Percentage last five year
Drought	134	143	86.45	92.21
Livestockepidemic	24	44	26.09	37.61
Conflict	37	-	27.61	-
Heat wave	-	24	-	30

Table 4: Types of Disasters in the kebele (n=155)

5. Climate Change Impacts on Livestock Holding Status and Livestock Diseases Incidence

The impacts of climate change and variability become serious on natural resources and then reflect on livestock and people. Due to different factors and exposures the pastoralists have started to diversify their herds. Almost all of the respondent households in the study area are rearing different species of livestock. Despite rearing different species of livestock, the livestock holding status of respondent households has shown decreasing trend over time. About 95.3 % of the respondent households have confirmed about this reality.

The study assesses the perception of pastoralist household of the interrelationship between climate change and incidence of livestock disease and access to veterinary service. Pastoralist and livestock populations in semi-arid grass land regions are extremely vulnerable to climate change. Climate change drive alterations in rainfall will likely have direct impacts on livestock productivity through water and pasture availability and significant indirect impacts by altering disease dynamics and incidence. As this reason the households were asked to give a list of the four livestock disease which is locally increased incident due to climate change and variability. Subsequently the four diseases perceived to have been most prevalent were determined through descriptive statistic frequency and percentage of the respondent. The reason for occurrence of list of livestock disease in dry season may be the potential congregation of animals from different herds at watering point. About 56.13 % of the respondents have no access to veterinary service however the remaining has veterinary access. In addition to the occurrence of drought to lack of veterinary service has an impact for the increments of diseases prevalence.

Types of livestock Disease	Frequency	Percentage
Paturellosis	54	40.3
CCPP(contagious caprine Pluro pneumonia)	23	22.8
Anthrax	13	27.1
Foot and mouth disease(FMD)	32	23.9

Table 5: Prevalence of Livestock Disease

5.1. Pastoralist Adaptation Strategies

The pastoralist who claimed to have observed changes in climate over the past 20 to 30 years were subsequently asked if they have responded through adaptation to counterattack the impact of climate change. Adaptation methods are those strategies that enable the individual or the community to cope with or adjust to the impacts of actual or potential climate changes in the local areas. Adaptation measures help farms guard against losses due to increasing temperatures and decreasing precipitation (IPCC, 2007). According, those who responded that they have adapted the climate change indicated different adaptation strategies which include herd splitting, herd diversification , livestock mobility ,use sheep and goat rather than cattle ,change migration route , engaging in crop production, temporal migration, non-farm activities , irrigation, tree planting , changing planting date, lend money and other adaptation(Pray to Allah).

As summarized in table 6 different adaptation practices are employed in their farming practices by pastoralists in the study sites. Temporal migration is fundamental to pastoralists' strategies for coping with unpredictable rainfall, livestock diseases, and the sustainable use of scarce natural resources. According to Abate *et al*. (2012) research result the intensity of temporal migration compared to past years, has now increased in the study district because of shortage of rainfall, feed and water. In the previous year's December to February which are the most problematic months for the water and pasture availability but now a day due to the late onset of rainfall the problem extended to march to May (20.6% and 23.3% ,receptively).The findings in this study showed that about 63.9 % of pastoralists had adapted through temporal migration to the highland areas looking for seasonal agricultural labor works and searching pasture and water for their livestock.

Mobility is one of the indigenous adaptive mechanisms that have been practiced by pastoralists. "The key strategy of pastoralists is the movement of their herds in response to seasonal and annual changes in pastures and water availability'' (Ali, 2008).Similarly with others Rayitu district pastoralist in dry season (December to February) 55.5 % household head with boy age of above 15 years and all class of livestock, moved to distant place where water and feed were abundant and stay as Godaantu (migrant).

From the sample respondents, 63.9 % of household use sheep and goat rather than cattle's because the small ruminant and camel better adapt climate change or viabilities than cattle. Engaging in crop production has also increased in about 67.7 % of the sample households. The main reasons for such engaging in the crop production are increased frequency of drought and reduced the quality of pasture. Soil and water conservation practices are practiced on communal and individually allocated plots although promotion role is played by government offices and non-governmental organizations. For instance about 45.8 % of the agropastoralist planting trees and 20% of the household respondent use irrigation as climate change adaptation strategy .

5.2. Time series analysis results of Temperature and rainfall

5.2.1. Temperature

The Rayitu district experience hot climatic condition with mean annual of 26 ^{0}C and maximum of 40 ^{0}C temperature. The analysis indicates that mean maximum temperature was increasing between 1982 to 2012 at a rate of 0.08°c per year .The linear equation (Y= 0.086X+17.76) with (R^2= 0.5) in the figure shows the predictable increase of temperature with the yearly tend. "According to the National Meteorological Agency (NMA, 2007), from 1951- 2006 the average maximum temperature in the country has been increasing by 0.37^{0}C per decade". All of the respondents of the household survey, key informants and focus group discussions participants have confirmed that the trends of temperature have been increasing over time in Rayitu pastoralist area.

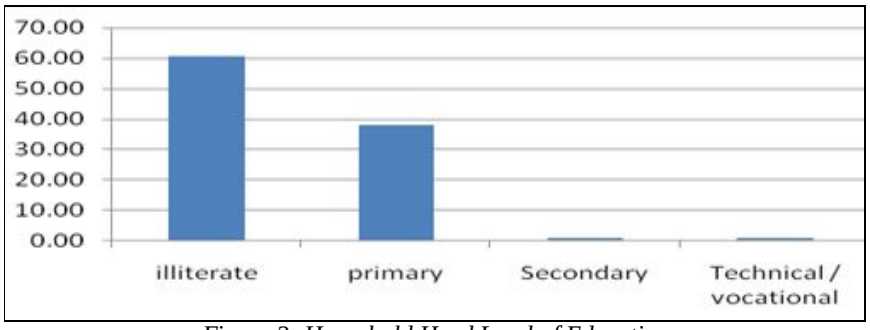

Figure 2: Household Head Level of Education

5.2.2. Rainfall Variability

The pattern of rainfall in the Rayitu district is bi-modal in nature and the average annual rainfall in the ranges from less than 300mm. All interviewed respondents confirmed that the trends of rainfall have been decreasing over time and there is inter_ annually variable for past decades in their locality. The rainfall pattern is extremely erratic in nature with variable of late onset and early cessation. Morton (2001) confirmed that dry lands are characterized by not only low rainfall, but also unpredictable nature of rainfall, slow onset and early cessation.

The weather station data seems accurate at recording what happening at the ground level but only in the immediate vicinity of the station. However the Rayitu district weather station established recently in 2007 and the rainfall data doesn't collected in a regular basis for this reason this study used satellite rainfall data from LEAP (livelihood economic assessment protection).

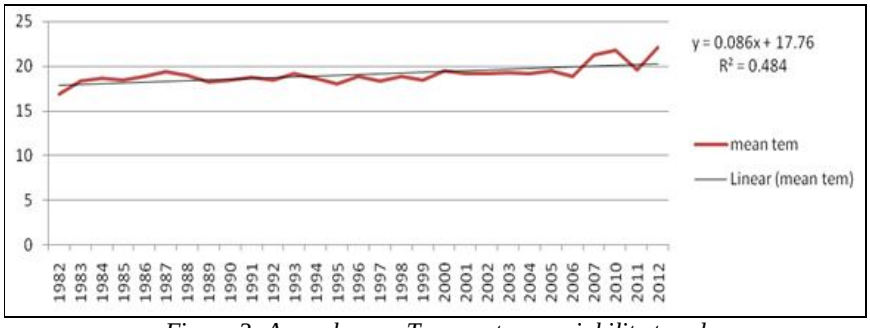

Figure 3: Annual mean Temperature variability trend

Figure 3. Shows the inter-annual rainfall variability of Rayitu district 18 years (1995 – 2012) satellite rainfall data taken from LEAP soft ware by dividing into main rain season from March to May and short rain season from September to November. Average annual rainfall is decreasing at the rate of -1.328 mm per year.

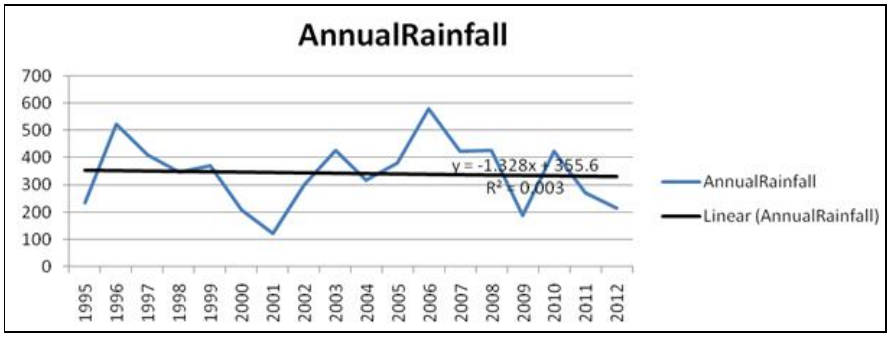

Figure 4: Annual rainfall variability study area (1995-2012)

Variability and trend in the short rainy season (September to November) there is decreased (negative) trend if compared with main rainy season from March to May. During some years, there was a complete fall down of both main and small rainy seasons. Maddison (2007) confirm that rain in Africa is less predictable and shorter in duration. It has also become erratic with extremes that normally lead to flooding and drought. According to Figure and on average the trends of rainfall have been decreasing overtime and this is convergent with community's perception.

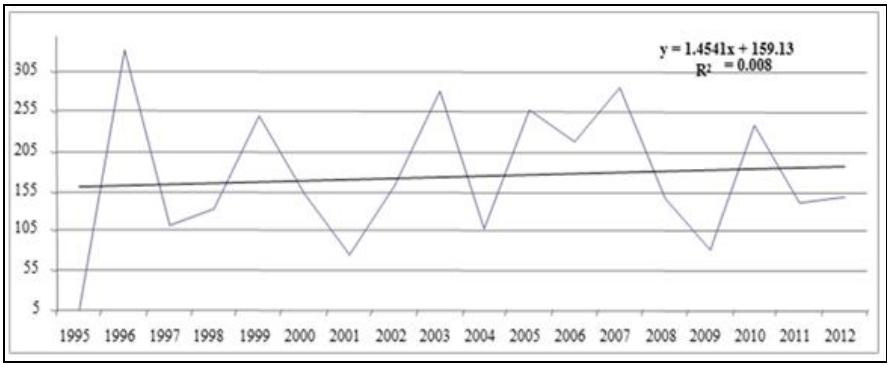

Figure 5: Seasonal variability of main rainy season

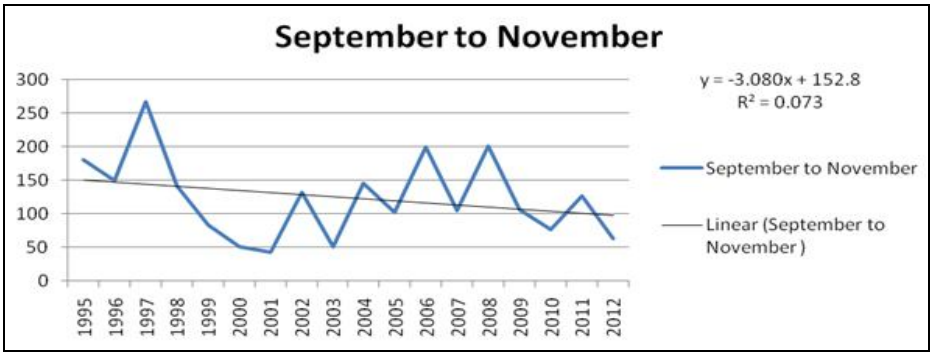

Figure 6: Seasonal variability of short rainy season

6. Conclusion and Recommendation

The results showed that pastoralist believes that they have witnessed a long term changes in temperature and precipitation. There has been rising temperature and change patters and duration of rainfall. Late onset and early offset of rainy seasons and increased frequency of drought occurrence has also been observed. A trend analysis showed that also there has been a significant increment of temperature and decline in rainfall over a defined time period in the study area. This study also witnessed that there has been a decreased livestock holding status of the respondents in the study areas. Changes have also been observed in livelihood practices, that the community who used to only livestock rearing is now engaging in crop farming activities.

Moreover, among the objectives of this research was to identify climate change adaptation strategies pursued by pastoralist community**.** In responses to the changing climate, pastoralist and agro pastoralists have been adjusting their livelihoods through strengthening already existing farming practices and climate change adaptation strategies. Descriptive statistic was used to summarize and traces climate change adaptation strategies .The results showed that for the changing climate household promoted adoption of temporal migration , livestock mobility , herd diversification , rearing of shoats rather than cattle ,shifting to crop production , herd splitting ,tree planting , practicing non- farm activities , changing planting date and use irrigation.

On the basis of the conclusions made above, the following recommendations are suggested:

- The study revealed that low level of literacy and when the overall level of education increased the household adaptation to changing climate is increased therefore, the findings suggest that pastoral and ago-pastoral level of understanding on the basic factors of climate change is low and there is a need to educate and show the available adaptation options.
- Lack of information and awareness on the issues of climate change and adaptation options or strategies were identified as main constraint. Improve access to climate information (incorporating climate info within the extension service and providing location specific meteorological info via radio and other communication pathways available to pastoralist)
- As the study revealed a significant similarity between metrological data analysis and community's perception further study can be recommended as to how these two can go together in the future.

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