



# Drought Vulnerability and Impacts of Climate Change on Pastoralist and Their Adaptation Measures in Southern Ethiopia: A Comprehensive Review

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**Abstract:** Drought is a complicated natural hazard has far-reaching social and Environment impacts. In Ethiopia's diverse agro-ecological zones, drought remains severe challenge and problem. Pastoralists on the southern on the Ethiopia Kenya-Somalia border endured extreme suffering, including the loss of more than 75% of their cattle and huge migration out of drought-stricken areas. Drought has greatest immediate effects of on pastoralists, including depletion of water resources, rising deforestation, crop failure, and an increase in food price, ill health, livestock output losses and death, and a decline in livestock prices in the Borana Zone. Ethiopian pastoral system is almost all rain-fed livestock production system, which is becoming more vulnerable to the effects of climate change and variability. Current climate variability is already imposing significant challenges by preventing the struggle to reduce poverty and sustainable efforts. The review was showed in southern Ethiopia to understand the drought vulnerability and impacts of climate change and variability on pastoral community and their adaptation strategies. Moreover, based on the drought classification, seven annual droughts occurred in the reviewed area from 1986-2018. While their perception of declining annual rainfall are not supported by actual records. More over the result indicated that the significant increment of maximum and minimum temperature, high inter annual and seasonal rainfall variability have caused effects on their livestock's wellbeing. The prominent adaptation strategies by the pastoralist are area enclosure herd mobility supplementary feeding livestock destocking. Nevertheless, the adaptation strategies are not practiced in full capacity constrained by different socio economic and institutional factors. Therefore, it is important to provide training and improved livestock's which drought tolerant. Drought and impacts of climate change adaptation and mitigation measures depending on geography and livestock system may improve the study's trajectory in the future if further review is done. Also, intervention is needed to address water shortage and up scaling water harvesting technology to conserve water during drought season in the study area.

**Keywords:** Adaptation Measures, Climate Change Impacts, Drought Vulnerability, Southern Ethiopia

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## 1. Introduction

The Climate change and variability postures a countless deal of challenges to all human kind and the environments' [17]. Above the years occurrence of climate change and variability in terms of rain fall and temperature has been changed [7]. The variations occur mainly because of increasing concentration of green gases emitted from various activities of human anthropogenic causes and recognized as

one the most serious global trials with numerous effects on rudimentary human provision systems such as agriculture and the ecologies [3]. Even with, universal attention of climate change influence, it also predictable to have thoughtful ecological, economic and social effects particularly on pastoral communities in the Ethiopia, livelihood those are depends on the use of natural resources [16]. Ethiopia is facing the possessions of climate change including the direct effects such as an increase in average

temperature or a change in rain fall decorations [13]. There is general trend of increasing temperature decreasing precipitation and increasing incidence of drought and floods [24]. The ecosystem in the area is delicate with an increasing tendency of natural resources degradation while the pattern and distribution of rainfall has altered and become changeable [22]. The pastoralist and agro-pastoralist people who be located in in the arid and semi-arid environments of Ethiopia are susceptible to the bearings of climate change and variability precisely to the recurring drought, floods, conflicts and variability of climate condition year to year which amplified the load of those who are already poor and susceptible by touching their livelihood decoration and plans and activating water, feed, food and social uncertainty [9, 19].

The insight of climate variability, its effect, influences and needed reply mechanism to survive with climate calamities are important for any population in given community. Low consciousness will make interference device to be very slow and untargeted. Pastoral households have been familiarizing to climate change for periods. Though, lately, due to growing trends of recurrent droughts, high spatial temporal-rain fall inconsistency along with the prevailing unfortunate socio-economic features, pastoralists have been attractive little adaptive to climate change and variability [11]. Though climate induced surprises are predictable to be more plain in pastoral communities, the reviews on the effects of climate change and variability on pastoralists and their adaptation are very imperfect which is predominantly true at local level analysis. So, this review result aims to determine perceived effect of climate change and variability on pastoralist and its adaptation lively by pastoral households and the barrier for the ineffective application of adaptation measures.

## 2. Literature Review

### 2.1. Definition and Concepts

*Climate change:* climate change is change of climate w/c attributed directly or indirectly to any human being or human anthropic that changes the composition of the atmosphere climate which attributed directly or indirectly to any human activity that alters the composition of the global atmosphere. Climate change is long-term continuous change (increase or decrease) to average weather condition or range of weather.

And it is considers changes that occur over longer period of time, typically over decades or longer.

*Climate variability:* Climate variability denotes to variation in the mean state and other statistics (such as standard deviations, the occurrences of extremes, etc.) of the climate on all spatial and sequential scales outside that of individual weather events [17]. It is looks at changes that occur within over smaller time frames, such as a month, a season or a year.

The climate variability is the method climate alters yearly above or bellows a long-term average value.

In essences, A key difference among Climate change and variability is in the perseverance variability of “anomalous” conditions.

*Adaptation:* adaptation the alteration in natural or human systems in reply to actual or predictable climate stimuli or their belongings, which curbs injury or feats beneficial opportunities [31]. Adaptive capacity is the capability of the schemes to adjust to climate change such as climate variability and extreme to sensible possible compensations, to take benefit of chances, or to cope with the significances [18].

*Pastoralism:* pastoralism is a socio-economic status of pastoralist adopted in the Dry and semi-Arid area of southern Ethiopia those are look for to preserve a viable equilibrium among their livestock, pasture and people and also by him Pastoralist keep different types of livestock like, Goats, Sheep, camels, Horses Cattle, Yaks and llamas those were dependent on environment, climate disorder, pasture, topographical range water and natural resources like Forest, soil and others etc. [28].

*Vulnerability:* Vulnerability is the degree in which the system is susceptible to and unable to cope with adverse the effects of climate change like climate variability and extreme and it is function of character, magnitude and the rate of climate change and variability in which the system is exposed, its sensitivity and its capacity of adaptive [17].

*Drought:* drought is denoted as impermanent decrease in moisture availability knowingly below the normal for a quantified period and it is also over protracted period, frequently a season or supplementary is also called drought. It is also related to the timing [26].

### 2.2. Trends of Climate Change and Variability in Ethiopia

According to Christy et al; the reviews showed that trends of temperature have been rising in average throughout in southern Ethiopia have usually increased from 1-3°C over the past fifty (50) years [8]. In addition, changes in exciting of temperature events have been perceived in southern of Ethiopia and the evidence showed that the duration of warm spells, dangerous maximum and minimum temperatures have been swelling [21]. According to specified rising trends of the annual mean temperatures by 1.0°C since 1960 at a mean rate of 0.21°C every ten (10) years in southern parts of Ethiopia like Borona zone and somale region state [20]. Though, this reviews exposed the incidences of high intra seasonal and inter-annual rainfall variability, shadowed by hazards of drought and floods and Remarkable increases of temperatures and rain fall variabilities were predicted across the Southern of Ethiopia borders to Kenya and Somali in the East parts of Africa including some parts of Ethiopia.

### 2.3. Communities Perception on Effects of Climate Change and Variability in Ethiopia

The Pastoralists' performance is communal more than them perceptions of climate change and climate danger, slightly than by the real climate decorations as measure logical approaches [2]. Perception powerfully disturbs in what way pastoral contract with climate induced dangers and opportunities, and the precise nature of their behavioral responses to this Perception will figure adaptation options,

process involved and adaptation outcomes [2]. Principles and approach towards climate change depend on contextual issues as well as access to climate information and experiential learning. The review on the rainfall of climate change and variability were both in developing [16]. According to found that household already professed climate change and its negative influences on agricultural and considered climate change as a salient danger to the upcoming livelihoods and economic development [29, 22].

They also found that pastoralists' perception of climate change was important connected to the age of the head of the family, wealth, facts of climate change, community capital and agro-ecological settings. Although Pastoralists' insights are based in part on past remark, some studies have recommended that households place superior emphasis on recent climate events in forming their perception of climate danger and in making decisions about adaptive performance [16]. According to improved thoughtful of how households' supposed climate change, ongoing to adaptation events, and the issues manipulating the decision to adapt practices is needed to craft policies and platforms aimed at encouraging successful adaptation and the idea of pastoralists sits by him to adapt successfully to climate change, they must have precise awareness about the state of the climate and conceivable future trends [6]. In practices of the households take decision in the setting of their own atmosphere, and alterations may exist between professed and actual environments.

#### **2.4. Trends of Climate Change and Variability Observed in Ethiopia**

The rainfall and temperature are measured whether condition by every high levels of the climate change and variability over the past 50 years [1]. Moreover, reviews showed that the occurrence and spatial coverage of drought have increased over the past few decades and this is predictable to continue in the future. According to the Southern part of Ethiopia has come across both in the drought & rain season for the past 50 years [1]. Although models predicting rain give inconsistent submissions of increasing or decreasing rainfall, most climate forecast models agree the temperatures in Ethiopia and East Africa will increase over the coming years. Additionally, forecasts specify that temperatures in Ethiopia will increase in the range of 1.7-2.1°C by the year 2050 and 2.7- 3.4°C by the year 2080 [1].

#### **2.5. Effects of Climate Change and Variability on Pastoralist Communities**

The frequent of drought practiced over last thirty (30) and current effects of El Niño in eastern Africa countries and in the southern parts of Ethiopia in particular have ended millions of people food insecure and in the current decades, the effects of climate change has convert insistent in agricultural sector in Ethiopia [29]. Furthermore, it has run to a failure in biodiversity, shortage of food and rises in human

and livestock healthiness problem, Urban-rural immigration and dependence on outside provision [19]. Pastoralism is a multifaceted livelihood system seeking to preserve an equilibrium between pastures, livestock and people in uncertain and variable environments. The prolonged droughts, combined with environmental degradation and increasing sedentarisation, have led to deterioration of pastoral livelihoods. Thus, change in climate factors such as temperature, rainfall and the occurrence and severity of dangerous events like drought directly affected livestock yields [5]. The spatial distribution, quality, quantity and availability of pasture and water are highly dependent on the patterns and availability of rainfall [3].

The Changes in the amount of rainfall and ranges of temperature affect feed availability, grazing ranges, feed quality, weed, decreasing pasture and water accessibility, pest and disease incidences [9, 30]. That reviews in poor growth performance, extended reproduction period and decreasing market prices of the livestock [9, 10]. The climate change and variability on pastoral communities and its effect in the south western of Ethiopia suitable feed and water, increase of pests and diseases and increased livestock-wildlife conflicts are pretty much significant Journal of Earth science and climatic change [14]. The effects of climate change on livestock production includes shortage of water, reduce in quality and quantity of feed, heat stress and livestock disease and vectors [30].

#### **2.6. Climate Change and Variability Adaptation in Ethiopia**

Adaptation to climate change and variability take place in a dynamic socio, economic, technological biophysical and political context that varies over time location and sector. This complex mix of condition regulates the capacity of system to adapt. In the climate change setting adaptation is commonly seen as a set of action and decision making process [25]. Adaptation is therefore serious and of anxiety in developing countries, particular in Africa where susceptibility is high because aptitude to adapt is too low. In other words, adaptation to climate variability is a ways of life and nothing new to Ethiopians. Ethiopia has been characterized by climate variability and change and, out of necessity; the local people have developed different adaptation strategies.

Some attempts have been made to analyze how households adapt to climate change in Ethiopia [4, 29]. In dry and semi-arid areas, pastoralists have developed some strategies to handle with it, such as movement, livestock species diversity, mutuality in use of resources, territorial fluidity and social safety nets. However, rendering to many applied research findings, the susceptibility of pastoralists to drought is very complex and diverse. It is demanded that drought such is not making pastoralists vulnerable to climate change and their perception of adaptation the in Ethiopia but rather the increasing marginalization of their drought reply mechanisms [12, 15]. Under climate variability the community has been practicing various adaptation choices including investment in livestock species resilient to drought (there was a general shift towards camels); migration in probing of pasture and

water; livelihood diversification; livestock off take previously a major drought; restocking and increase in the watering interval for all livestock.

The diversification livelihoods; business; allowances, relief provisions, growing the use of water and soil conservation techniques were Biological and physical soil and water conservation actions like Vegetation cover, Inter-cropping, alley-cropping, plantation, micro-trench, fungous, level bund, stone bund and shading/Mulching/ and shelter shortening the length of the growing season informal employment and selling wood fuel [27]. According to Zerga *et al.*: degradation of the range land problems and its ways of to promote rehabilitation of degraded area in the Ethiopia in the case of central rift valley of Ethiopia are highly influenced ecosystems in the country [32]. In the Central rift valley have problems of range land and area highly degraded area due to low rain fall and area mostly loaded livestock by pastoralist in the country.

### 2.7. Barriers to Adaptation

Ineffective adaptation in susceptible communities has promoted research to gain a improved empathetic of the nature and form of barriers that constrain adaptation and identifying entry points for appropriate corrective action [23]. In particular, adaptation deficit in developing nation activated focused research on barriers [23]. Adaptation barriers can arise at diverse stages of the adaptation procedure and related to environmental, economic informational, social, attitudinal, or behavioral. Socio-cultural barriers may not always be recognized but in practices these elements play important role in limiting adaptive measurements and obstruct adaptation. The definite barriers as complications that can be overcome with concerted effort, creative management, change in thinking, shifts in resources, land uses and institutions and they also state that Barriers can be abated or mitigated using corrective measures through human action [23].

Barriers to adaptation are approximately gathered in to three major categories;

- 1) Natural-Biophysical process that govern ecological and physical constraints such as shortage of land degradation of rangelands and lack of access to irrigation water.
- 2) Social-local norms, behaviors values and their processes and
- 3) Human (information-low) levels of awareness, uncertainties associated with climate forecast and information available policy makers, research and practitioners by [2, 23].

These all present exclusive set of trials to effective adaptation Similarly, The reported that cultural barriers incomplete adaptation options by impeding a local group in northern Burkina Faso from involving themselves in a particular livelihood activity [23]. It is serious to comprehend and declaration the complexity of barriers at play to advance adaptive capacity and adaptation results under heterogeneous socioeconomic and biophysical setting.

## 3. Material and Methods

### 3.1. Description of the Study Area

This study was conducted in Borana pastoralist of Oromia Region, Ethiopia. Borana zone is geographically located between 3° 36'-6° 38' in the North and 36° 43'- 41° 40' in the East. Although the region has bi-modal annual rainfall ranging from 400 to 700 mm in the south to 600 mm in the north, this was mainly characterized by semi-arid climate. Borana pastoralist was located at a distance of 575km southeast of Addis Ababa, the capital city of Ethiopia and south parts of Ethiopia.

### 3.2. The Selection of the Specific Study Site and Households

The study followed a multistage sampling procedure where combination of purposive and stratified random sampling technique was employed for selecting study area and sampled households. Finally, simple random sampling (SRS) practice would be used to select sample households from pastoral communities.

### 3.3. Source and Method of Data Collection

In this study both primary and secondary data collection for this reviews. The primary data was acquired from primary source including, household survey, key informant interviews, and focus group discussions and field observation. The survey questionnaires were prepared to collect information Reviews on Impacts of Climate Change and Variability on pastoral Communities and Their Adaptation Strategies in the southern parts of Ethiopia.

#### 3.3.1. Household Survey

Household was one of method of gathering primary data from horse mouth and household survey structured questionnaires with both closed and open ended questions would have been administered on representative sampled households to obtain primary data pertaining to information on pastoralists' perception of the patterns of climatic parameters classified into over 5 years, 10 years and 15 years for past 30 years.

#### 3.3.2. Focus Group Discussion

In this particular research, focus group discussion were conducted with purposively selected knowledgeable community members consisted of elders, youth and women to managed equal chance of gender with in the participations in each FGD issues related to perception of the community on climate change and variability.

#### 3.3.3. Key Informants Interview (KII)

Interview adopted as method for data collection partly due to its cost effectiveness and its strength of capturing empirical data were both informal and formal setting.

#### 3.3.4. Field Observation

Observation was made as supportive or supplementary

technique to collect data that can complement or set in perspective the data obtained by other means in this study.

### 3.4. Secondary Data Sources

Secondary data was done metrological data, in order to replaces missing data in stations 32 years' climate data on maximum temperature, minimum temperature and rainfall data were taken from Ethiopian National Metrology Agency (ENMA) to 1986-2018 for southern Ethiopian to determine annual anomalies and trends of temperature and rainfall as well as climate change and variability and its trends in the southern of Ethiopia.

### 3.5. Descriptive Analysis

This study employed both qualitative and quantitative data analysis techniques to analyze the data. The collected data were checked, corrected, coded in computer, which were then analyzed to extract meaningful information. Different data analysis techniques were employed since both qualitative and quantitative data were collected. The qualitative data were obtained through key informant interview and group discussion were narrated and summarized.

### 3.6. Meteorological Data Analysis

The climate data obtained from Metrological National Agency for Borana Pastoralists' at Borana Zone in the southern parts of Ethiopia to the period of 1986-2019 were analyzed using descriptive statistics. Coefficient of variation (CV) was calculated as ration of standard deviation to the mean in order to reviews impacts of climate change and variability of rainfall and temperature in the southern parts of Ethiopia.

## 4. Summary and Conclusion

This review results investigated perceptions of pastoralist on climate change and variability and its effect on their livelihood and adaptation measures. Smooth if there was reductions of rainfall in three decades the monthly, seasonal and annual rainfall variability was high in the southern parts of Ethiopia affected the livelihoods of pastoralists. Pastoralist communities' perception has been long-established with climate data analysis in the southern of Ethiopia that recognized a variation in the onset of rainfall season and variability in its amount and distribution with an increase in temperature. The livestock disease and death of livestock, shortage of water for livestock and human, reduction in prices of livestock, and immigration of families' members were the key belongings of climate change in the southern of Ethiopia. In Southern Ethiopia, pastoralist practiced various types of adaptation strategies. Among them mobility, change compositions of herds, income diversification, splitting of herds and making enclosure for calves and cows around village, supplementary feeding, construction of water points, off-farm activities and plummetering consumption were the

common ones. Herd mobility access to forage and water drought meeting were found to be the most important issues that affect local communities' choice of adaptation strategies in the southern Ethiopia.

To reduce the effect of climate change and variability and recurrent drought, diverse water collecting and irrigation technologies should be combined by governmental and non-governmental organizations with their local adaptation strategies. Additional meteorological stations are needed to precisely record the climate data and assist to regulate any changes in long-term climate variation with full confidence since; there is only one meteorological station in the study area. Thus, care should be given to management of grazing lands and controlling of invasive species including prosopis juliflora. Most of pastoralist communities have no access to production drought tolerable Livestock's. Accordingly, agricultural researcher's and experts should classify drought tolerable that livestock's are appropriate to their agro-ecology zone and do on extension works to access them for the local communities. Destocking is one of the greatest noteworthy adaptation mechanisms for climate change practiced by few households only. Supplementary research should be done on additional socio-economic issues affecting local communities' choice of adaptation practice and the standing of "Kaaloo" traditional rangeland management systems to adapt belongings of climate change.

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