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**Review Article**

# The Adaptation and Mitigation Strategies for Climate Change in Pastoral Communities of Ethiopia

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**Abstract:** The world's drylands are home to 2 billion people, many of whom depend on natural resources, biodiversity and agro-biodiversity for their livelihoods. The vulnerability of pastoral communities to climate change is higher than those who depend on agriculture (crop production) due to the synergic effect of inadequate health services, inadequate infrastructure, poverty (especially among rural communities), lack of alternative means of income (especially in marginal areas), inadequate public awareness of disease risks, illiteracy, and so on. As a result, this review focuses on the adaptive and mitigation strategies for pastoral communities to climate change and variability in Ethiopia. The objective of this review is to identify different adaptation and mitigation strategies (both traditional and modern) to climate change that should be used in different Pastoral communities of Ethiopia. In other words, it helps those pastoral communities to share the information about applicability and benefits of the new adaptation and mitigation strategies, and/or improve the implementation process of previously existing strategies (measures). Consequently, the loss of human and livestock life, damage of buildings by wind, reduction in production and productivity, extra cost for cure, inappropriate (sudden migration), and disturbance of overall activities of pastoral community can be minimized by sharing the important information about the future occurrence of disasters. The appropriate measures either used by local communities and/or recommended by different researchers after their findings are: keeping or improving animal health, de-stocking and re-stocking livestock depending on weather conditions, keeping the sustainability of livestock feed and water, diversifying livelihood, seasonal migration, using alternate energy sources other than fire wood and charcoal, improving human health (sanitation) and clean water supply, market and infrastructure development and improvement, using integrated natural resource management, and sound policy and Conflict resolution methods.

**Keywords:** Adaptation, Climate Change, Conflict Resolution, Mitigation, Pastorals

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## 1. Introduction

### 1.1. Background

The world's drylands are home to 2 billion people, many of whom depend on natural resources, biodiversity and agro-biodiversity for their livelihoods. A substantial portion of these 2 billion are urban dwellers, reliant on ecosystem services for clean water, air and food. Many more are rural residents who depend on biodiversity for food production, fuel provision and other resources that are essential to survival [1]. According to [2], Drylands in Ethiopia cover about 75 percent

of the total land mass of the country. Drylands consist of a wide range of agroecologies, including arid, semi-arid and dry sub-humid. Drylands are most prevalent in the north, east, central Rift Valley areas, south and southeastern parts of the country where diversified agricultural environments prevail.

It is estimated that about one-third of the populations in Ethiopia live in drylands. The human population in drylands is continually increasing as more people are moving from the highly-degraded highland areas to the fertile lowlands. As the population increases beyond the carrying capacity, the land

resources are poorly managed and land degradation follows. The agricultural production system is largely rain fed, with rainfall distribution being highly variable due to climate change and variability. This is the major challenge of production systems, even though the lowland drylands are naturally rich in various resource bases. Most of the oil crops and livestock for the export market come from the drylands.

The statement of 80 years old man which was used in [3], touched my heart, and here we have included it for your information. 'In my 80 years living as a pastoralist it has never been like this. The rainfall pattern has been unpredictable and there is a migration of pastoralists from this community to the urban centers of Nairobi, Uganda and others. The few animals we have that have survived the drought are plagued by new diseases that we do not know about. Our livestock is dying and we do not know why. We are even afraid to eat some of the livestock as we fear the diseases might be transferred to humans.' This shows that the effect of climate change and variability is more severe in dry lands than other humid areas. There is a long record of practices to adapt to the impacts of weather as well as natural climate variability on seasonal to inter-annual time-scales. These include proactive measures such as crop and livelihood diversification, seasonal climate forecasting, community-based disaster risk reduction, famine early warning systems, insurance, water storage, supplementary irrigation and so on [4].

### 1.2. Significance of the Review

Climate change is expected to exacerbate the occurrence and intensity of future disease outbreaks and perhaps increase the spread of diseases in dry lands (pastoral communities). The vulnerability of pastoral communities to climate change is higher than that of humid or rainforests (Highlands) due to the synergic effect of the following factors. These factors are inadequate health services, inadequate infrastructure, poverty especially among rural communities, lack of alternative means of income especially in marginal areas, inadequate public awareness of disease risks, illiteracy, lack of appropriate marketing for their product, poor management of natural resources, deforestation and widely practiced harmful traditional practices. As a result, this review is needed to identify different adaptation and mitigation strategies (both traditional and modern) to climate change used in different Pastoral communities of Ethiopia. This in other words, helps those pastoral communities to share the information about applicable and beneficial adaptation and mitigation strategies that they have never practiced before and improve the implementation process of previously existing strategies (measures).

## 2. Methodology

This article is prepared by using secondary data sources (published and unpublished articles) and observation and experience with the pastoral community of Ethiopia.

## 3. Result and Discussion

The adaptation and mitigation potential of developing countries to climate change are weakened as a result of poor building designs, agriculture, food in security, and low income, deforestation, and conventional solid waste management system, in general [5]. Specifically, Pastoralists are on the frontlines of climate change and are currently the most affected population in the Horn of Africa [3]. The intensity, frequency and magnitude of weather related changes are proving a challenge to pastoralist communities. A better understanding of the implications is a key to early warning, which enhances the preparedness and builds much-needed resilience of vulnerable communities. The same study showed that Administration borders are being drawn without bearing in mind pastoralist mobility needs leading to inter-communal tensions, insecurity and conflict. Pastoralists are increasingly being pushed to the periphery as other livelihood systems encroach on their land. Most of the adaptation and mitigation measures used by pastoral communities and some recommendations by different researchers depending on their findings are discussed in detail in the following paragraphs.

### 3.1. Adaptation and Mitigation Strategies for Animals

#### 3.1.1. Animal Health

Animals can adapt their behaviors during drought and heat waves by timing their activities to cooler parts of the day restricting their movements to conserve energy and water or migrating to more favorable areas [6] Increased frequency or persistence of these conditions can significantly influence animal health or survival either directly or indirectly through loss of habitats food and water.

Livestock diseases cause rapid loss of livestock assets and reduction in milk and supply, reproduction and draught power during disaster incidence. During extended dry periods, there is less access to pasture and water for livestock. The physical weakness of livestock at this time makes them susceptible to different diseases. Among the critical infectious diseases, rinderpest, pasteurolosis, contagious bovine pleuropneumonia, foot and mouse disease, anthrax, bloody diarrhea, skin and lung diseases and internal and external parasites are some of the critical infectious diseases and pest attacking livestock during drought and flood hazards [7]. For instance, Proportions of different types of cattle in Borana herds are being reduced relative to goats and camels, which are more drought-tolerant and disease resistant. Livestock diversification has become one of the most adopted coping mechanisms in pastoral communities of Ethiopia [8]. The following are various possible measures recommended to improve and maintain animal health during and after climate change disaster in pastoral communities by different researchers and [9].

- a) Strengthen traditional breeding practices by establishing close relationships with communities to understand their systems and identify gaps, and train them
- b) Encourage and support regional governments to hire more veterinary technicians for health posts

- c) Allocate more funds for procurement of veterinary equipment for clinics and health posts.
- d) Identify the precise strains of diseases for effective vaccination and treatment.
- e) Allocate sufficient doses of vaccines to the districts
- f) Promote conservation of locally available feed resources through training of extension agents and pastoralists;
- g) Promote the use of drought tolerant browse, which should be supported with demonstrations, supply of planting materials and promoting the marketability of such feed in the area.
- h) Improve investment and veterinary services through increased budget for resources for the District's veterinary services;
- i) Proper flow of information throughout the different administrative and institutional levels
- j) Seasonal vaccination campaigns in times of disease outbreaks
- k) Regular follow up of animal and human health in drought prone area/pastoral community

### 3.1.2. De-Stocking and Re-Stocking

De-stocking is a means of reducing the total number of stocks, where as restocking is the means of reversing the trend towards the increasing impoverishment of pastoralists [7] and [8]. During dry period when the access and availability of pasture and water was serious problem, pastoralists split their herds and families into different locations. The splitting of herds and families depends on the types and condition of animals and labor availability and requirement for those particular animals in particular location. The splitting of herds and families are risk reduction mechanisms that have been practiced by pastoralists [10], [7] and [8]. According to these and other researchers, de-stocking has the following effects:

- a) It enables poor pastoralists to keep stronger animals in their herd, preserving a key household capital asset for post drought recovery by selling weaker ones.
- b) It improves the nutritional status of poor households and contribute to school and other feeding programs;
- c) Support the trading activities of women's groups; improves access to finance.
- d) Reduces overgrazing on areas

Re-stocking is related with the provision of either commercial loans or livestock from a similar agro-ecological location, provision of feed or transportation support to help households restock their livestock assets [7] and [8]. In Community-based re-stocking program local people permanently donate individuals from their herds to other Pastoralists who have experienced catastrophic loss (usually total loss of the herd). There is full transfer of ownership of the donated livestock [8].

### 3.1.3. Livestock Feed and Water

Well-managed grasslands provide many co-benefits that are critical to adaptation. Risks associated with prolonged drought periods and unreliable rains can be offset by the increased water infiltration and retention associated with organic matter accumulation in the soil. Ethiopian pastoralists have been

practicing open grazing system for livestock grazing outside home, and for new born calves and weak animals women are making hay when pasture is available and feed them during critical period [10] and [8]. The following mechanisms of climate change adaptation in case of water stress and feed shortage recommended for pastoralists are:

- a) Facilitating livestock mobility: Provision of information where resources are available;
- b) Develop and improve water sources such as ponds, protect and manage dry season rangelands through customary institutions;
- c) Promote flood and rain water harvesting to address chronic water shortages,
- d) Develop small scale irrigation schemes for fodder production and livestock watering; as reported by Ethiopian ministry of agriculture, sugarcane production for sugar should provide feeds for livestock around the factory (EBC1, February 2008EC)
- e) Identifying and fencing dry season grazing areas;
- f) Support in the development of fodder banks to increase the availability of fodder for livestock;
- g) Feed conservation (hay), rotation grazing and changing of the traditional feeding practices (cut and carry system).



Figure 1. Hay Making Practice in Higo Kebele. Source: [10].

## 3.2. Adaptation and Mitigation Strategies for Human Beings

### 3.2.1. Health and Clean Water Supply

Scarcity of potable water is a serious problem among the Pastoral communities. Households largely depend on unprotected water sources such as rivers, lakes, springs and traditional wells for their water needs. Poor access to water of good quality increases the incidences of waterborne diseases to both human beings and livestock [11]. As a result, apart from their vulnerability to water borne diseases, women and children are forced to travel long distances to fetch water. This results in the reduction of children in schools and less participation of women (play key roles in the mitigation and adaptation of climate change) in social activities. In order to reduce the vulnerability of the rural poor to the shortage of water and health problem, the following are recommended by different researchers [11] and [7].

- a) Water sources such as boreholes, springs and shallow wells should be developed and improved;
- b) Human health facilities (health centers, health posts, etc) should be kept and improved;

- c) Malaria protection and prevention campaigns should be deployed;
- d) Solar power drilling system for sustained source of water should be introduced; and existing water structures should be improved.

### 3.2.2. Livelihood Diversification

Given the recurrent and critical impacts of climate change on the highly livestock dependent pastoralist communities, diversifying livelihood options is becoming a question of survival than choice. Diversification is a proven strategy to build household resilience through spreading risk. Livelihood diversification can be engaging in any income generating activity such as crop farming, handicrafts, petty trade, labor sale, seasonal labor migration, saving and others [7]. Agro-pastoralism could be considered both a response to food insecurity and economic diversity. For example, Kenyan Farmers grow maize, green grams (mung beans), pigeon peas, beans, and others in addition to livestock, which is currently in the way in Ethiopian pastoralists [11]. To support the introduction and expansion of crop cultivation in pastoral areas, the following support mechanisms are recommended:

- a) Create enabling environment and support the construction of small scale irrigation facilities like micro dams, ponds, diversion canals and dikes;
- b) Provide agricultural skill training;
- c) Conducting research on stress/ drought and disease resistant as well as early maturing crop varieties;
- d) Improve agricultural extension service provision;
- e) Use improved inputs, adapt improved farm technologies, strengthen disease and pest control mechanisms;

Integrate the recommended activities with those recommended in animal health, de-stocking and re-stocking, livestock feed and water, migration, energy sources, human health and clean water supply, market and infrastructure development, natural resource management, and Policy and Conflict resolution.

### 3.2.3. Alternative Energy Sources

There are substantial energy resources, including gas, petroleum and geo-thermal sources in the Rift Valley, as well as mineral resources in several parts. Energy reserves have a high potential for economic development, but these reserves have barely been explored and tapped [2]. Rural and peri-urban communities obtain energy from wood, charcoal, twigs, bark, chips, salvage harvesting (thinning) and agricultural residues as energy sources to meet their basic needs (because of shortage or lack of alternative sources of energy), and it leads to the deforestation. In order to reduce the exerting pressure on forest, the alternative energy sources like animal dung, solar radiation, wind energy, hydropower (on areas where water resource is available) and geothermal energy should be used. Without access to efficient and affordable energy sources, they have very limited opportunities for economic and social advancement [7].

### 3.2.4. Seasonal Migration

Raising livestock on drylands through seasonal migration is

a uniquely efficient way to make use of lands that are unsuitable for other forms of agriculture [12]. Rangeland resources are typically heterogeneous and dispersed, with their variation tied to seasonal patterns and variable climatic conditions. Migration or Mobility is one of the climate change adaptation strategies used in pastoral communities identified by different researchers, and summarized as follows.

- a) Transhumant nomadism, Traditional range management practices, and Maintaining the local indigenous strain of livestock which can survive prolonged dry conditions
- b) Village based micro enterprises (house hold businesses, and Venture into small business enterprises based on livestock marketing
- c) Subsistence agriculture to deal with food insecurity and dietary diversification to improve nutrition.
- d) Engaging on formal employment and manual labor to increase family per capita income.
- e) Keeping of specific and manageable herds of livestock in accordance to availability of pastures and water in times of hardship to take advantage of heterogeneous nature of their environment.
- f) Provide the advantage of selling artifacts to tourists making expeditions in their land them, earning subsidies to boost house hold economies

### 3.2.5. Market and Infrastructure Development

The primary source of income for pastoralists is obtained from the sale of livestock and its products [7]. In order to improve the marketing and market information systems through formation of local marketing co-operatives; the following activities are recommended.

- a) Facilitation and promotion of cross boarder livestock trade with controlled illegal trade (inter regional and abroad);
- b) Establishment of the community-based cereal banks to stabilize cereal prices at all times;
- c) Improvement and maintenance of access road, transport, communication access and improve road network between Kebele, District and market centers;
- d) Facilitation of the establishment of market centers and media programs for market information;

### 3.2.6. Natural Resource Management

Dry land forests of Ethiopia are facing a great challenge of deforestation and degradation due to both natural and manmade factors. The severest factor affecting is human induced problem like deforestation of agricultural land expansion, construction purpose, charcoal production, fire wood, for browser, over-grazing, and by introduction of invasive species leads to degradation of forest. However, Grazing opens up pastures, stimulates vegetation growth, fertilizes the soil and enhances its water infiltration capacity as hoof action breaks up the soil crust, aids in seed dispersal to maintain pasture diversity, prevents bush encroachment and enhances the cycling of nutrients through the ecosystem [13]. Consequently, appropriate forest management strategy is necessary to maintain and improve the status of the forest. Some of the management activities are discussed below.

Invasive alien species are animals, plants or other organisms introduced by humans, wind and erosion into places out of their natural range of distribution, where they become established and disperse, generating a negative impact on the local ecosystem and species [1] and [14]. Alien invasive species are a significant threat in many dry lands of Ethiopia, often assisted in their expansion by the destruction of indigenous habitat as a result of land-use changes. In some cases, exotic plants have been introduced to combat perceived (although not always real) environmental problems such as desertification. Invasive plant species are often unpalatable and sometimes even toxic to herbivores, which have an adverse effect on livestock production and productivity, crop production, water abundance, human health, local economy, labor, and biodiversity. According to [15], 32 invasive plant species classified under 18 families in were identified in Telalak District, Afar National Regional State. Of these, 11 were trees and shrubs, and 21 were non-grass herbaceous invasive species. This study also concluded that 80 percent of the sampled areas were invaded by invasive species.

Conservation ditches and contours that have been constructed preserved water loss from runoff and reduced soil erosion [16]. Generally, appropriate management of natural resources boosts up the adaptive and mitigation potential of pastoralists by improving the overall life status of them. In order to be successful in natural resource management the following activities are recommended for pastoral community.

- a) Implement soil and water conservation programs and projects that promote local community participation;
- b) Focus on rehabilitation and reclamation of degraded land, reforestation, conservation, management and protection of natural resources;
- c) Rehabilitate and manage dry season rangelands;
- d) Implement measures to control aggressive weeds and other invasive plants
- e) Implement planting of multipurpose trees at house hold level in areas where water is available from irrigation structures.

### 3.2.7. Policy and Conflict Resolution

The increase in frequency and length of drought cycles in Ethiopia has forced herders to move more frequently, often to new destinations for extended periods [3]. This adaptive trend has gone hand in hand with an increase in inter-communal conflict. Unlike certain categories of migrants, such as refugees, pastoralist communities are the only group of people whose migration has never been formally recognized and/or protected. Pastoralism is a livelihood system tied to ecosystem services with complex systems of social, political and economic organization. Centralized decision-makers are often unaware of the challenges pastoral communities face in achieving and/or maintaining sustainable livelihoods as there are few mechanisms for local communities to transmit their knowledge to outside decision makers. When managing pastoralism for biodiversity conservation and poverty reduction, it is important to ensure that the appropriate policy framework is in place to support

and preserve indigenous and local knowledge, institutions, innovations and practices [14].

Policymakers and other stakeholders can play a role in local adaptation, and trigger a process of recognition and reflection. At local level, pastoralist might be able to benefit from knowing what other pastoralists are practicing to cope up with climate change, then introduce and implement these to their own situations [17]. For example, Borana customary institutions have a responsibility for natural resource management and other societal issues. According to Borana customary institutions, herders, firewood collectors and even a passerby have to report to their close supervisor when they observe anyone committing illegal exploitation of their common resources. Then the supervisor gives balanced judgment on the case in accordance with customary laws [10], [8] and [18]. Another example is Medaa Aba of Afar region, which is traditional institution that makes decisions on the proper management and fair utilization of rangeland [17]. Through this traditional institution, responsibilities are assigned to young people in the community to undertake the assessment responsibilities of available water sources and pasture for livestock during the wet and dry season. They report back to the community about the situation with due consideration of the availability of feed both in quality and quantity, and estimate for how long the feeds and water sustain the livestock. After the assessment, the decision making body decides the number of livestock and the duration of stay at a particular place. Failure to respect the Medaa Aba's instruction results in a penalty of slaughtering female animals, regarded as highly valuable assets.

## 4. Conclusion and Recommendation

The severity of climate change in Ethiopia is due to poor building designs (living standard), agriculture (seasonal production), food insecurity and low income, deforestation, conventional solid waste management system, less adaptive capacity, limited financial resource, skills and technologies and others, in general. The problems are exacerbated in pastoral communities than agrarian (crop producing communities) due to relatively more exposure to the synergic effect of inadequate health services, inadequate infrastructure, poverty, lack of alternative means of income, inadequate public awareness of disease risks, illiteracy, and so on. As a result, keeping or improving animal health, de-stocking and re-stocking livestock (depending on weather conditions), keeping the sustainability of livestock feed and water, diversifying livelihood, migration, using renewable energy sources (except fire wood and charcoal), improving human health (sanitation) and clean water supply, market and infrastructure development and improvement, using integrated natural resource management, and sound policy and Conflict resolution methods, and the integration of the aforementioned activities are recommended for the adaptation and mitigation of climate change in pastoral communities of Ethiopia.

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