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Drought Adaptation Strategies among Karrayu Pastoralists, Ethiopia

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Abstract

This study aims to explore the drought vulnerability and adaptive strategies among the Karrayu pastoralists. Three pastoral *gandas* were selected purposively. The study relied on key informant interview, in-depth interview, and focus group discussions to collect qualitative data from purposively recruited informants. Content and thematic analysis were used to organize the data. The result showed that though livestock keeping is the main livelihood strategy of the Karrayu pastoralists, some also pursue farming as a coping strategy against recurrent drought. Recurrent drought occurred in the area was found to have inter-seasonal effect; consequences of drought were reported to transcend dry season due to poor resilience capacity of pastoralists. Women were more vulnerable and affected by drought due to their multiple roles and limited mobility than men. The study showed that cattle were more susceptible to drought than browsers which often feed on leaves than grass. To reduce the effect of drought, participants practiced adaptation strategies such as communal land enclosure, increasing the frequency and distance of trekking, herd diversification, haymaking, and livelihood diversification. Supplementing these adaptation mechanisms, the study shed light on traditional weather forecasting which was identified as indigenous drought mitigation mechanism. Not all adaptation activities were perceived as positive. Diversification to labor employment and farming were reported to halt the viability of pastoralism as a way of life. Therefore, the study suggested the integration of indigenous adaptation strategies and knowledge to pastoral development policy to mitigate drought impacts, enhance the resilience capacity of pastoralists and ensure rangeland sustainability.

Keywords: /Adaptation/Drought/Diversification/ Karrayu/ Mobility/Vulnerability/

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1. Introduction

Climate change remains an unabated environmental concern and a challenge to humanity in the 21st century (Arbuckle, Morton, & Hobbs, 2013; Harun, Jamalani, Elawad, & Fallah, 2014). Growing shreds of evidence attribute increasing in temperature, distorted rainfall pattern, aberrant wind currents and changes in water volume to global climate change (Ajuang, Abuom, Bosire, Dida, & Anyona, 2016). Though climate change is a global phenomenon, in developing regions of the world, it is often regarded as a major factor affecting food security and wellbeing because people largely depend on rain-fed agriculture. The world's poor people are disproportionately vulnerable to loss of livelihood and assets, dislocation, hunger, and famine in the face of climatic change in general and drought in particular (UNFCC, 2007; IPCC, 2012).

Drought is a condition in which precipitation is less than the annual average and results in severe water scarcity over an extended period of months or years (Opiyo, Wasonga, Nyangito, Schilling, & Munang, 2015). Drought remains the major threat to human beings and continues to be so particularly for the sub-Saharan Africa, where people depend more on climate-sensitive economies than any other region (Nassef, Anderson, & Hesse, 2009). Of the most droughts vulnerable households are communities and countries that have the weakest institutional capacity and the smallest amount of resources to respond. Pastoralists are socioeconomic groups, which pursue a livelihood, which is directly and significantly affected by climate variability and change (Sileshi, 2017; Galma, Menfese, & Ayana, 2017).

Pastoralism is a complex livelihood system or way of life seeking to maintain an optimal balance between pastures, livestock and people in uncertain and variable environments (Okoti, Kung, & Obando, 2014). Pastoral communities constitute 200 million of the world total population, and majority of them live in developing countries. Globally, pastoralists inhabit zones where the potential for crop cultivation is limited due to low and highly variable rainfall conditions, steep terrain or extreme temperature. Within this uncertain, vulnerable and dynamic environment, they have developed successful mechanisms of adaptation to maintain an ecological balance between themselves and the natural environment (Rota, 2009). In the Horn of Africa, arid and semi-arid areas account for more than 60 percent of the total surface area with a pastoral population estimated between 12 million and 22 million people (World Bank, 2014).

Ethiopia is a home for about 12-15 million pastoralists which reside in 61% of the nation's landmass (Müller-Mahn, Rettberg, & Girum, 2010). The country ranks fifth in the world in terms of the pastoral population. Pastoralists in Ethiopia are mainly found in four regions with lowland agro ecology: Afar, Oromiya, Somali and the Southern Nations, Nationalities and People's (SNNP) regional states. Pastoralism is the main source of livestock, which is important to the national economy. The livestock sub-sector contributes about 16.5% of the national Gross Domestic Product (GDP) and 35.6% of the agricultural GDP (Sara 2010; Metaferia et al. 2011). However, attention to pastoralism as a way of life is low (Zelalem & Aynalem, 2009). Pastoralists are socially and politically marginalized social group in Ethiopia (Ayele, 2016). Pastoralists inhabit the lowland areas of the country, with the harsh and precarious condition. They have limited livelihood choices, and thus become increasingly vulnerable to persistent poverty. This is mainly due to the effects of climate variability and change effects (Wassie & Fekadu,

2015; Melaku et al., 2017). Climate change coupled with relatively low attention to the sector worsened the living situation of pastoralists.

In Ethiopia, while climate change and its resultant effect, drought, affect both pastoralism and crop farming, the impacts are more severe among pastoralists. Drought is quite common in the pastoral areas of Ethiopia, which seem to translate into famines due to sole dependence on livestock production (Wassie & Fekadu, 2015). Synergic effect of inadequate infrastructure, poverty, inadequate health services, and lack of alternative means of income amplified the level of vulnerability of pastoral communities to drought as compared to crop producers (Herrero et al. 2016; Ayalew, 2012). Indeed, there is an acknowledged diversity even among pastoralists in terms of their level of vulnerability to drought and resilience capacity. Pastoralists in the Ethiopian rift valley are more vulnerable to recurrent drought, which resulted in a loss of many million livestock (Aklilu & Alebachew, 2009). The magnitude and impacts of drought in these areas have been intensifying over time (Dula, 2013). The vulnerability of pastoralists can be indicated by the death of livestock, shortage of water, loss of other option of livelihood and loss of pastureland among others (Ayalew, 2009).

The livelihood system of Karrayu pastoralists has attracted the attention of several investigators. Studies conducted on the marginalization of Karrayu pastoralists (Alemmaya & Hagmann, 2008; Müller-Mahn et al., 2010; Ayalew, 2012; Ayele, 2016) showed that pastoral livelihood is increasingly under pressure due to an expropriation of prime grazing land for investment and conservation. This has forced pastoralists to change their livelihood activities. Sileshi (2017) assessed the general livelihood vulnerability of pastoralists emphasizing drought and paid less attention to the communities' adaptive strategies to drought. Pastoralism is a way of life, which demands adaptation to a constantly changing climate. Hence, the way Karrayu pastoralists adapt to the changing environment needs to be investigated. Different researches were conducted on pastoral areas concerning vulnerability to ever-changing climate in Borana and Guji (Zelalem & Aynalem, 2009; Wassie & Fekadu, 2015) while less is found about Karrayu. Pastoralists are not homogenous socio-economic groups. Variations exist in terms of resources, opportunities, and hence resilience. Adaptation choices of diverse pastoralists are thus not uniform. Hence, a context-specific investigation into less studied pastoral communities would be vital not only to broaden the scope of pastoral studies but also to inform development policies.

To this end, few attempts were made to identify the vulnerability situation of Karrayu pastoralists. Beyond studying the vulnerability to drought and its consequences, exploring local adaptive strategies is very crucial for sustainable pastoral livelihood development. Hence, this study explores drought vulnerability and local adaptive strategies among Karrayu pastoralists with particular emphasis to upper Awash River pastoralists.

1. Review of Related Literature

2.1. Pastoralism

Pastoralism is a way of life. It is a traditional land management and production system which, through its dynamic, flexible and complex structure, has proved to be the most adapted to changing environmental conditions (Hartmann, Sugulle, & Awale, 2009). Pastoralism is defined as the "unsettled and non-commercial husbandry of domestic animals" (Dula, 2013). The term 'pastoralism' is used to describe societies that derive some, but not necessarily the majority, of their food and income from livestock. In this sense, pastoralists can be conceptualized in the economic (i.e. those who earn part of their living from livestock and livestock products) and also in the cultural sense, in which livestock do not form the main source of income, yet people remain culturally connected to a pastoralist lifestyle in which the significance of livestock is more cultural than economic (Nassef et al., 2009). As a livelihood system, it is tied to ecosystem services with complex systems of social, political and economic organization (Alefu, Dalga, & Samuel, 2017).

Though pastoralists depend on livestock production, they are not entirely homogenous (Wako et al., 2017). Mobility is a key feature qualifying pastoralism. The term nomadic is used when mobility is high and in irregular patterns; transhumant when there are regular back-and-forth movements between relatively fixed locations, and sedentary for the rest (Rota, 2009).

Pastoralists are people who live mostly in dry, remote areas (Hartmann et al., 2009). Pastoralists inhabit zones where the potential for crop cultivation is limited due to low and highly variable rainfall conditions, steep terrain or extreme temperatures (Herrero et al., 2016). Their livelihoods depend on their intimate knowledge of the surrounding ecosystem and the well-being of their livestock (Rota, 2009). The types of livestock kept by pastoralists vary according to climate, environment, water and other natural resources, and geographical area. Pastoralists have developed successful mechanisms of adaptation to maintain an ecological balance between themselves and the natural environment (Wassie & Fekadu, 2015). Pastoralism is, therefore, an economic and social system well adapted to dry land conditions and characterized by a complex set of practices and knowledge that has permitted the maintenance of a sustainable equilibrium among pastures, livestock, and people (Okoti et al., 2014; Rota, 2009).

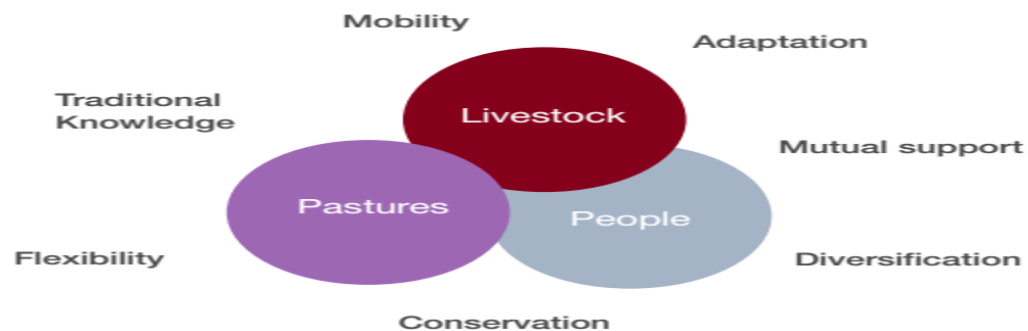


Fig: Pastoralism: A sustainable natural resource management system

Source: (Rota, 2009)

2.2. Drought, the Pastoral system and Adaptation

Climate change is the main risk factor of the pastoral system (Wassie & Fekadu, 2015). Seasonal variability of vegetation and vulnerability caused by recurrent droughts has been a common phenomenon, regularly witnessed by for centuries (Hartmann et al., 2009). Due to dependence on variable climatic vagaries, pastoralists experience the deepest threats of emerging and continuing climate change (Nassef et al., 2009). Different reports projected that climate change in much of the tropics will be manifested in increased frequency and severity of droughts. Regardless of the difference in conceptualizations, drought is generally an extended period of months or years in which precipitation is less than the annual average and results in severe water scarcity (Opiyo et al., 2015). Droughts are usually upsetting the delicate balance on which the pastoral production system depends (Galma et al., 2017).

Drought affects the living of pastoralism in different ways. Among the effects of drought are the following: drying of many sources of water, a manifestation of diseases, loss of pasture, increased mortality of livestock, loss of land to agricultural encroachment as the rise in rainfall raises the productive potential of the dry land and further migration to places occupied by other pastoralists (Zelalem, Aynalem & Guernebleich, 2009; Okoti et al., 2014). Increasing rainfall variability affects rangeland productivity. This may have significant negative effects on herd dynamics, stocking density and the productivity of pastoral production system (Herrero et al., 2016). Mobility due to drought pushes them to end up in geographical conflict with other pastoralists (Okoti et al., 2014). In Ethiopian Upper and Middle Awash Rift Valley inhabited by Karrayu, Afar, Argoba, Ittu and Issa pastoralists and settler groups, territorial encroachments, cattle raids and associated small scale warfare between these groups have been ongoing since the 1960s (Alemmaya & Hagmann, 2008).

This not only affects the short-term food security situation but it also compromises the future of pastoralists by eroding their livelihood base (Gutu, Bezabih, & Mengistu, 2012). Aforementioned corollaries of drought will continue to victimize pastoralists. This scenario suggests that pastoralists should be well able to adapt to a changing climate (Herrero et al. 2016). Indeed, pastoralists have a long history of adaptation to climate change based on their indigenous knowledge (Melaku et al., 2017). Pastoralists are capable of dealing with climate change by making best use of patchy vegetation, erratic rainfalls and coping with increasing droughts (Ayele, 2016).

Adaptation is about reducing the risks posed by climate change to people's lives and livelihoods. It involves adjustments people employ to lessen the impacts of climate change on humans and to the environment (Okoti et al., 2014). Available evidence shows that adaptation strategies pursued by pastoralists involve, among others, herd diversification, increasing mobility, livelihood diversification, and increasing drought-tolerant livestock (Mworia & Kinyamario, 2008; Ayele, 2016). However, not all adaptation strategies are available for all pastoral communities (Mworia & Kinyamario, 2008). For instance, in addition to livestock rearing, in the current years, particularly up to 1980s onwards, the Karrayu have also begun to practice small scale farming and charcoal production as the response to the scarcity of their former vast grazing land and for the declining of their pastoral means of livelihood (Ayalew, 2012; Ayele, 2016).

In addition to drought, the marginalization of pastoralists exacerbates their vulnerability (Alemmaya & Hagmann, 2008; Ayele, 2016). The expansion of large-scale irrigation agriculture and conservation schemes has over the years led to the expropriation of vast portions of prime grazing land. Unable to a large extent to practice their transhumant pastoral way of life customarily, the Karrayu have become compelled to resort to alternative livelihood strategies (Ayalew, 2012). As a result, pastoralists are caught in a dilemma. On the one hand, the pressure to cope with and adapt to a multitude of changes has never been as high as today. On the other hand, recent developments have led to reductions in spatial mobility, which have weakened the sustainability and resilience of traditional forms of pastoral production systems. Under these conditions, pastoralists are challenged to modify their livelihoods according to the ongoing changes, to search for new alternative strategies, to diversify their livelihoods and at the same time to maintain their adaptive capacities concerning future changes (Müller-Mahn et al., 2010).

2. Methodology

3.1. Description of Study Area

The Karrayu. The Karrayu are the indigenous inhabitants of the Metehara Plain and Mount Fentale. They are Afan Oromo-speaking transhumant pastoralists whose livelihood involves seasonal movement following a regular migratory pattern between dry and wet season grazing areas, with permanent settlements in each area. For the Karrayu, Pastoralism and Agro-Pastoralism are their main livelihood activities. Herding and a high degree of mobility facilitate the effective use of resources depending on the time of a year. The Karrayu keep mixed herds, which permits the use of a wide variety of fodder resources. Their herd composition includes cattle, camels, goats, sheep, and donkeys. Apart from livestock herding, the Karrayu pastoralists who inhabit certain home neighborhoods have also started practicing both rained and irrigated agriculture. This recent but growing tendency emerged in the early 1980s and continued to develop ever since. It began mainly as a response to the expropriation of their pastoral land and the subsequent weakening of the pastoral means of livelihood. Expansion of agriculture and associated changes in land tenure, mainly, in better-watered areas, triggered changes in the livelihood composition of the Karrayu (Ayalew, 2009). Afar, Argobba, Arsi and Tulama Oromo are from communities neighboring the study area and interacting with the pastoralists (Fentale District pastoralists and Agro-pastoralists Development Office Annual Report, 2012).

3.2. Geographical Information

Karrayu pastoralists inhabit eastern lowland arid and semi-arid parts of Ethiopia. Specifically, these areas include Metahara plain and the surrounding of Mount Fentale, in the Upper Awash River Basin (Dula, 2013). The study area is located in Eastern Rift Valley in Fantale District, East Showa Zone of Oromia Regional state, 198 Km from Addis Ababa capital of Ethiopia. Geographically it is located within 8° 45' to 9° 00' North latitude and 39° 45' to 40° 00' East longitude. Fentale District is demarcated, in the

North by the Afar regional state, in the South by the Arsi Zone, in the East by Hararghe Zone, in the west by the Argoba District and in the Northwest by Amhara regional state (Fentalle District Pastoralist Development Office, 2012). Fentale district and the Metehara plain had been the Karrayu pastoralists. However, eventually, the establishment of some irrigation schemes and the Awash National Park changed the traditional land-use patterns of the Karrayu.

3.3. Economic Activities and Land Use Pattern

Livestock rearing is the main source of living for the Karrayu. Pastoral communities depend on a diversified composition of livestock, which includes cattle, sheep camel and goat. The major source of feed for their livestock is open land grazing and browsing on the rangeland seasonally between dry and wet season grazing area (Fantalle District pastoralists and Agro-pastoralists Development Office, 2012). They also engage in rain-fed crop cultivation and other supplementary economic activities such as small-scale irrigation. In rain-fed farming, the dominant crops are maize and teff. The major areas of rain-fed farming are *Dambii*, *Warifattu*, and *Ajo*. The major product of irrigation is onion and followed by maize. Fruits like mango and orange are produced by private investors. The main irrigation areas are lower and upper Awash River. Metehara Sugar Factory and other private investors enclosed wide cultivable land formerly used by pastoralists.

The land use pattern of the study communities involves open grassland, riverine, mountainous, vegetation, and cultivated land. According to the Fentale District agricultural office estimation, dense woodland and shrubs accounted for 25.5% of the district. The open grassland covers the areas of *Bodda* and *Arolle* plains located west of the District, the gently sloping areas at the foothill of the Fentale Mountain and areas bordering Metehara Sugar Plantation (Ayalew, 2012). Shrubs are predominant on the rocky ridge. The major species of shrubs include *Acacia mellifera*, *Acacia Senegal* and *Acacia tortillas*. The most dominant riverine vegetation consists of *Acacia nilotica*; its pods and leaves are palatable to livestock. This land cover is found on alluvial soils mainly along the Awash River.

3.4. Study Design and Sampling Techniques

This study employed a qualitative approach to explore the experience of Karrayu pastoralists regarding drought and adaptation strategies. Experience of pastoral household and the way they perceive drought is better understood through an in-depth investigation of their livelihood and vulnerability context in which they make living than administering a structured survey. The study employed purposive sampling to select Fantalle District and gandas³. Purposive sampling was used based on the prior knowledge of the area and judgment of the researcher regarding the prevalence of drought in the study area. In Fentale District, there are 18 gandas. In consultation with Pastoral Development offices, three upper awash gandas of Dhaka Edu, Qobo'o, Banti were selected. Selection of the gandas was based on the level of vulnerability to

³The lowest administrative unit in Oromia.

recurrent droughts as reported by the district. Moreover, susceptibility to recent drought incidence was also taken into consideration to select these gandas.

3.5. Methods of Data Collection

Data for this study was collected using focus group discussion, key informant interview, and an in-depth interview. Focus group discussion (FGD) was considered important to obtain detail information on drought vulnerability, trends in livestock production and constraints. Accordingly, three FGD were conducted (one FGD in each ganda). While one FGD was conducted with 6 women, the other two FGDs involved 16 men. FGD was employed to get deep insights on drought experience of pastoral community, perceived severity, vulnerability and adaptation strategies employed to maintain the pastoral livelihood.

Key informant interview was used to generate data from local figures and government officials who were believed to provide adequate and relevant data regarding the theme of the study. Accordingly, seven elders, three women, five youths, two agricultural extension workers, and District pastoral development officer were purposively selected. The main theme of interviews involves prevalence of drought, trend, and pattern of drought, local responses to drought and challenges facing local adaptation strategies. Elders also provided oral history related to drought and local adaptive strategies among Karrayu pastoral communities.

Data about the experiences and impacts of recurrent drought, adaptive strategies and perceived long-term effects of drought on the livelihood activities of pastoralists were collected through in-depth interview. In-depth interviews were conducted in each gandas with purposively selected twelve households' heads (six male and six female) which were more affected by drought. Selection of these households was supported by the ganda chairpersons.

To collect data, the study relied on interview checklists prepared in Afan Oromo for all participants. The interview checklists were examined and crosschecked by experts who conducted ethnographic study among pastoral communities and who have known terms and concepts used in the study area. One of the author is from the study communities and this eased field entry and data collection. This study was conducted after the department of Sociology, Jimma University, had provided official letter of collaboration for the leaders of the three selected gandas. All interviews were administered by the investigators after getting oral consent (both for being interviewed and their voice recorded) from the participants. All interviews were recorded and transcribed directly afterwards and this helped researchers catch an immediate impression of the participants. Notes were also taken at the moment of recording to assure the dependability of the data.

3.6. Data Analysis

This study used content analysis to generate a pattern in the data collected and link the findings to the main objective of the study. To this end, themes such as livelihood activities, challenges to livestock production, drought vulnerability, a gender dimension of drought effects and adaptation strategies were developed from existing literature. Then data collected were classified to these themes. Indeed, the study

integrated thematic analysis for the data collected beyond the predefined categories such as social support and traditional forecasting which were pursued as adaptation strategies. Methodological triangulation was employed to converge data collected from different participants using FGD, key informant and in-depth interview.

4. Result and Discussion

4.1. The Livelihood Strategies of Karrayu Pastoralists

The major source of living of the participants' was keeping livestock, which comprises cattle, goat, sheep, and camel. Participants were found as alien to farming practice. They showed a sort of filial reverence to the Earth, which is deemed sacred to be pierced by hoe or the plow. Elder noted that digging earth is not a norm particularly for men. Digging land was considered as "womanish" work. Among the Karrayu people, women are identified with the activities related to land or soil. Due to this fact, they identify earth with a feminine role. Gender differentiated role in the study area can be noted from an elder participant from Bantiganda saying, "Earth and women give you back what you gave them." They use this local saying to refer the fact that the land grows the seed sown and the women give birth to a child. Though farming was uncommon among the Karrayu over centuries, some pastoralists have started crop production to adjust their livelihood to changing circumstances.

The study also revealed that pastoralists attach different value to different livestock they raise. Cattle were highly valued among the participants. FGD participant indicated that cattle serve as a symbol of wealth and prestige. A person with more cattle called "Abbaaloonii" was reported as the most respected of all community members. Among the Karrayu, only cattle are slaughtered during the funeral ceremony. When she expresses the value of cattle, a woman said, "*Cattle die with and for us*". Camel was also regarded as the most important livestock. Beyond economic significance, a camel has an important social role mainly in restitution during settling conflict and crime. Indicating this, an elder informant said, "*A family who has male should have a camel.*" Whenever male members commit a crime or harm someone else in the community, they are obliged to compensate usually with a camel.

Small ruminants such as goat and sheep reported having higher economic significance for the Karrayu pastoralists who face serious financial constraints due to limited livelihood options. The following quote depicts the relevance of goat:

"Re'eenuffatajalaati, namniuffatajalaahinqabnegaraatokkoonhinrafu" meaning

Goats are like our underwear wear, the one who has no underwear cannot sleep confidently".

This is to mean that, a family, which has a goat, is better in dealing with sudden livelihood shocks. Informants pointed out that sheep and goat were sold frequently as compared to cattle. Key informants also alluded that the opportunity cost of selling small ruminants was higher among the pastoralists because replacing larger livestock such as oxen takes more time and would be difficult. Consequently, though cattle fetch more money than smaller livestock, for all FGD participants, selling them for household's

smaller cash needs was not economically viable. One participant strengthened this fact when he says, “*goat and sheep are money in the pocket.*”

Key informants reported an increasing shift from pastoralism to the cultivation of land. Of the main reasons behind their shift to crop cultivation articulated by informants were recurrent drought and increasing pressure on land. These variables were identified as the main external factors that put the pastoral mode of subsistence in crises. Diminishing communal landholding was attributed to the expansion of private investment and conservation scheme. According to elders who had served as communal enclosure leader of Qoboganda, these factors have compromised the livelihood activities of pastoralists by limiting herds and mobility. Gradual shrinking of land not only constrained mobility, which is an integral part of pastoral livelihood but also forced them to adopt sedentary agriculture, which pastoralists did not pursue. Hence, livelihood diversification to farming was not due to attractive return in the farming sector rather it was due to the pushing factors.

Irrigation was reported as an emerging option for agro-pastoralists in Karrayu. Onion and maize were the major products of irrigation agriculture, which supplement the consumption of the pastoral community. In addition to household-level production activities, there were irrigation schemes by investors. These were also increasingly claiming grazing land of pastoralists. In addition to this, irrigation projects employed some young people in the area. However, youth informants commented that labor wage and benefit did not commensurate their contribution. Despite the irrigation projects' goal to reduce the pastoralists' climate-induced problems, according to key informants, irrigation projects were not fruitful due to different challenges facing the project. District experts mentioned that of the main challenges affecting the viability of irrigation projects were, water shortage, drainage system problems, land use related issues and market-related challenges due to homogenous production. Daily labor employment in Metehara sugar factory was reported mainly for young people.

4.2. Declining Livestock Population

Participants have indicated that livestock population was declining though the pattern was not uniform for all livestock types. Discussions with the FGD participants showed that the cattle population was the most droughts vulnerable of all livestock. As a result, pastoralists were increasingly diversifying their herds more than ever. Considered an effective alternative to responding to drought effects and the resultant shortage of fodder was rearing more goats and camel. Pastoral communities were grappling with natural and human-induced factors to maintain their way of life, pastoralism. FGD participants, key informants, and drought-affected informants identified the major constraints to livestock rearing. Recurrent droughts, feed shortage, expansion of Lake Besaka, conflicts with neighboring pastoralists, and replacement of natural grass by bush were mentioned as constraining factors for livestock production. Elders accentuated that recurrent drought, which resulted in massive mortality of pastoralist's livestock with a maximum interval of one or two years, was the main constraint of livestock production in the area.

Participants reiterated Lake Basaka as a critical constraint of the livestock production in the area. Pastoral development officer reported that Lake Basaka (locally

called *Nogoba*) overflow and encroach large pastureland every summer season. The lake is salty and undrinkable by livestock (except camel). The volume of the lake was increasing more than ever. This was reported to affect communal land enclosure and mobility. The Lake was rapidly covering a plain at the right side of Metehara town, where the pastoralists keep their livestock for the two months of the mountainous part enclosure. Simultaneously, the Lake overflows grazing land along Awash River where the community resides during a dry season to depend on sugarcane residue from Metehara Sugar Factory. Key informants argued that the Lake has changed the land use of the area. *Nogoba* does not only affect communal land enclosure and pattern of mobility but it also causes the drying of palatable grasses and leaves except *Juliflora*, which is not palatable for cattle. Women informants indicated that even during the season where the volume of the lake decreases, flooded areas rarely regenerate grasses or shrubs to be grazed by cattle.

Replacement of grass with bush is another constraint of livestock production for the Karrayu. Participants also mentioned that the replacement of tree grasses by new invasive thorny tree species compromised fodder availability. For instance, tree species like *Juliflora* (locally called *Woyane* or *shoolaa*) and *Parthenium* (locally called *Aliware* or *Ali Wario*) were highly replacing the other livestock feeding grasses and tree species. Especially, *Juliflora* was reported as the most widely spreading tree species, which invades palatable grasses. The quote from a woman informant from DekaDhebu illustrates this: *once, grown it never dries, unlike other tree species which rarely cope with drought. No grass grows under it. Before it spread to our area, we had some plots from which we used to make hay. Due to invasion of Juliflora, now we have to travel long distance for finding hay. Juliflora is a devil tree!*

4.3. Vulnerability Context: Incidence of Drought

Recurrent drought was reported as the main vulnerability context affecting the livelihood of pastoralists according to Fantalle District pastoral development office. The most recent major drought that hits the pastoral community and remains in the minds of many respondents was the 2015 drought. Narrating the trend of drought occurrence elders stated that before some 15 years, the interval between droughts periods was relatively longer and patterned. This had helped pastoralist to anticipate drought occurrence and enabled them to undertake mitigation activities to reduce the consequences of drought. The current situation was reported as unique for the participants. A victim of 2015 drought corroborated this saying, *the frequency of drought was increasing more than ever and we have to grapple with the unbearable consequences of drought many times within five years*. Delaying onset of rain, erratic and low precipitation, and unseasonal rainfalls were mentioned as prevailing indicators of climatic variability affecting the livelihood of pastoralists. However, it was noted from FGD that the frequency and impacts of the drought were not evenly distributed across the study gandas with some gandas affected more than others were.

Pervasive water shortage was a common phenomenon affecting the livelihood of the participants. Impacts of recurrent drought involve, among others, death of livestock, declining pastureland quality and coverage, loss of harvest, fall in the livestock market,

rise in crop price, frequent conflict with other pastoralists, food shortage, and also drying up of water sources.

For district experts interviewed, declining precipitation not only affected livestock production but also the livestock market. Poor market price for the livestock was indicated as the major factor exacerbating food insecurity. The study revealed that vulnerability to food security manifested in two ways. First, low rainfall resulted in the death of cattle which were the main source of milk and hence food for the household. Thus, drought directly affected the food availability dimension at the household level. Second, it also curtailed access dimension of food security. Death of livestock means that households have no ruminants to sell and get cash to fulfill their basic need. Since pastoralists are not the main producers of the crop, loss of livestock directly affects access to cash, which could be invested for purchasing food. One of the FGD participant, male, age 56, in Qobo'o ganda narrated his experience of drought vulnerability as follow:

I was the most affected of all pastoralists [in] my neighborhood. I have lost almost more than 40 cattle and goats due to drought in 2016. I had witnessed a bitter truth ever. Consequently, my two wives left home with some children. My children had quitted education and experienced the misery of drought with me. Nothing is more painful than losing means of living and love of family simultaneously.

This quote indicates that beyond resulting in the death of livestock, drought resulted in family disorganization, which will further minimize the labor allocated to livelihood activities. Elders mentioned that the level of vulnerability to drought vary among livestock type. During FGD, cattle were ranked as easily susceptible to drought compared to goats and camels. The effects of drought transcend dry season. Cattle were reported to die from the effect of prolonged drought even during summer (rainy season), which was perceived as good season by participants. For the severely affected participants involved in this study, the effect of drought extends to summer season because the already affected cattle rarely bounce to their normal condition soon after rainfall starts. The resilience of livestock which was already severely affected by drought was reported to be lower even during the rainy season that follows a drought period.

Water Scarcity as a manifestation of drought. The main water sources for the pastoral communities selected for this study are rivers and open ponds, which dry up when the rain stops. Drying up of many water points were also reported as among direct effects of drought. This enforces pastoralists to travel over a long distance to access water for their livestock and themselves. This appeared to affect pastoral livelihood in two ways according to participants. First, lack of water was reported to be very severe for cattle and thus lead to the death of many livestock. Second, lack of water also weakens pack animals such as donkey, which support the family through collecting sugar cane residue and transporting water for household consumption. Unavailability or drying up of water sources further forces the community to migrate to areas along Awash River. However, as the number of pastoralists who settle along the Awash River increases, competition for water and sugar cane also ignites. In addition to this, the decreasing volume of Awash River during the winter (dry) season was reported to affect the water access of pastoralists.

Drought inducing conflict among pastoralists. As its latent dysfunction, drought also induces conflict among Karrayu, Argobba, and Afar pastoralists. Deteriorating pasture and water sources discussed above, in turn, ignite conflicts among pastoralists. Though conflict among these pastoralists was influenced by different factors, key informants underscored that it always becomes intense during the dry season. Under limited pasture, pastoralists have to compete to secure fodder for their cattle. FGD participants also stressed that conflict sometimes involves killing people and raiding. In addition to this, conflicts constrained the mobility of herds between available pasture plots. Elders commented that due to the security dilemma, pastoralists usually underutilize pasture, which could have rescued their cattle. Due to ingrained uncertainty related to raiding and killing, pastureland bordering Karrayu and Afar pastoralists often remain ‘buffer zone’ or simply a boundary left unused; no one uses that pasture as it might cause conflict. For instance, the area around *Bulga (Kessem)* River is observed to demarcate among the three pastoral communities. A terrain ranging from Awash National Park to *Calalaqa* open grassland serves as a joint point for Afar and Karrayu pastoralists. This land is owned neither by Afar nor by Karrayu pastoralists. This would have accommodated the need of many pastoralists if peacefully utilized by both pastoralists. Yet, when one party tries to graze that buffer zone, pastureland conflicts arise. In the words of local leader:

We take our livestock to graze that buffer zone pasture from our side. The ‘opponent group’ also comes to the area from the opposite side. We often push each other from opposite sides of the pasture. If we perceived that the aliens are breaking to our border, we start looting their livestock and threat them to turn back. They also do the same to us. Here conflict erupts. This occurs mainly during the dry season.

Participants underscored that conflicts are more intense during the dry season. Though conflicts occur between pastoralists during other seasons, it may not be due to pasture shortage, according to key informants. An FGD participant elaborated this idea: “*during a prosperous (no drought) year or season, the Afar and we are allies. We share the same market. During such period we reconcile and give back livestock raided during the conflict*”. Elders argued that pasture shortage is simply an immediate cause. The root cause is drought, which resulted in a pasture shortage.

Women and children in the context of drought. The effect of drought is found more severe for women and children. Observing the gender roles of the study area, the study revealed that women are responsible for many different activities. Women participate in almost all economic activities including those executed mostly by men (such as keeping cattle). According to women FGD participants, they are responsible for caring children, looking after calves and weak livestock, milking, preparing food and fetching water. While children are assigned tasks of keeping newborn and weak calves, adult men are responsible to look after livestock such as camels, which are mostly away from the homestead. Key informants claimed that due to multiple burdens they shoulder, women appeared as more vulnerable to the effects of drought. During the drought season, women are obliged to travel over a long distance to fetch water for their house consumption. As a result, they appeared to be pulled between different tasks. The following quote from a 43 years old woman elaborates the contribution of asymmetric gender roles in exacerbating the susceptibility of women to drought:

I am a mother of four children. My husband is away from home to keep livestock. There is no water in our locality and thus I have to travel over 10km to fetch water for home consumption. As you can see, I have a two-year-old child with me because no one looks after him at home. My two other children have to look after calves and collect firewood. As a result, I have to carry the child and water. After dropping this bucket, I have to come back to collect crop residue. I left home early in the morning to search for a fodder and water for new calves and weak livestock at home. My child is crying now because he is hungry but I have nothing to feed him from my breast. Formerly we used donkeys to fetch water and collect grass. Due to drought, they have to migrate with other herds while others are weakened by drought and fail to carry a minimum load. Therefore, the only option I have is to carry by myself.

This case indicates that drought has a severe effect on the labor allocation of households. For women, in particular, drought has brought a unique challenge. Women cannot play their motherhood role during drought season as they are pulled between several roles while this has further effects on the development of children.

4.4. Drought Adaptation Strategies

Pastoralists practice different adaptation mechanisms to ensure the sustainability of their livelihood. While the majority of the adaptation strategies identified below seems similar to another setting, some appeared unique to the context of the study area.

Increasing frequency and scale of mobility. For transhumant Karrayu pastoralists, mobility is an integral part of their livelihood activities. Participants commonly reported that they move back and forth between pastureland (the edge of Mount Fentale), water source Awash River) and settlement village. Though mobility was noted as a normal strategy across all pastoralists, according to pastoral development officer, study participants reported that they increase their frequency and distance in search for pasture and water to reduce the adverse effects of drought. This might involve intrusion into the enclosure of neighboring pastoralist, which participants asserted as the main cause of conflict. According to key informants, mobility was not uniform across

seasons. Spatial and temporal availability of pasture and water were among the major factors determining the duration and distance of mobility. A local leader presented the path of mobility across different seasons as below.

During *OnaGannaa* or summer (June to end of August) pastoralists often settle at the edge of mount Fentale and Gobu plain, which is their permanent residence. During this season, every mountainous part of the study is protected by communal land enclosure mechanism. *OnaBirraaor* autumn (Mid-September to mid-November) is a period of little precipitation, which they call *Balgii* (a little drop of rainfall) when they reside in the middle of, not on the top, of mount Fentale. During this season, the land enclosure in summer is allowed or opened, which is locally called *HiikaaDheedaa*. *Ona Bona* or winter (mid-December to mid-February) is often a period of severe drought and no rain at all, which is locally referred to as *Abaar*. This is a time when pastoralists settle quickly along the edge of Awash River for easier access to water and residue of Metehara sugarcane as a source of feed for their livestock. Locally, spring season does not have a specific name, though some individuals call it as *OnaBadheessaa or Arfaasaaor* spring (mid-March to mid-May). This marks a transition period when people slowly migrate from Awash River area to their original residence, the edge of Mount Fentale. During this time, mobility is usually due to the onset of the rainy season which results in the declining supply of sugarcane residue (the factory is closed during summer) and growing of cattle-killing grass species in the area. Elders call this period as *Dagduu or Ebeloo (meaning sudden)* because it is the time when erratic rainfall and flooding result in a loss of livestock.

Participants underscored that shortage of water and deteriorating pasture were making mobility frequent and draining more than ever. Indicating the vitality of mobility, a local leader from Bentiganda used the following Afan Oromo saying:

Bara

Abaarhammaateeqalmilooniibaay'atetakkaagaarattitakkaagaarittiirkadhumaleeGaraanl afahinqabin.

Meaning: *Whenever drought turns out severe and cattle slaughtering (because of drought) mounts, let you rely either on Mountain (for pasture) or cart (for collecting) instead of simply staying at one place and facing problems.*

This denotes the temporal and spatial alternatives participants should rely on to reduce the catastrophe of drought.

Herd diversification. As stated above, of all livestock, cattle were reported as the most susceptible to drought. To reduce the adverse effect of drought one of the mechanisms that pastoralists devised is herd diversification. Herd diversification as claimed by an extension worker has climatic, ecological and economic importance. When cattle population is affected by drought, rearing diverse livestock types (cattle, sheep, goat, and camel) by pastoral households enable them to have an alternative. This has a vital contribution in consumption smoothing efforts of pastoral communities. Reportedly, goats are the most drought-tolerant livestock while cattle are the most

susceptible. The following local saying indicates the simultaneous importance of all these livestock.

Re'een fi hoolan qarshii korojoo keessati (goat is just money in the pocket" to mean that a person can sell goats and get money at any time he/she wants). This indicates that goats and sheep are sellable in the local market frequently.

Loon funyoo fuudhaa heerumaati, (cattle is a means of marriage because only cattle are counted on for bride wealth/ price.

Gaalli tiksituu lubbuu dhiirati (camel saves the life of men because only a camel would be paid as compensation during conflict and murder crimes.

The above local saying indicates that goat is the immediate solution to an emergent problem because unlike other livestock goats could be sold even without waiting for a regular weekly market day. Besides, although camel and cattle fetch more money, selling them for a smaller household stock is not economically viable for the participants. As a result, pastoralists take their goats with them during mobility, no matter how severe the drought is. Hence, such diversification allows participants to use the advantage of different livestock to reduce the effect of the prevailing drought in the study area.

Making a communal land enclosure. Participants noted that pasture shortage is the immediate cause for the loss of livestock each time drought occurs. To lessen the effect of drought, the Karrayyu practice communal land enclosure which is the major indigenous adaptation mechanisms. The pasture is often enclosed during the last two months of the summer season. The following case by community elder describes an arrangement of communal land enclosure.

The first summer month, June is mentioned as the time for the recovery of drought-weakened livestock through feeding enough pasture. Hence, usually, there is no enclosure during this time. Communal pastureland enclosure is often made during July after the local meeting (locally *korabiyyaa*) is held among the pastoral communities at the presence of local community elders and with the collaboration of ganda structures. These structures involve *Korelafaa* (land management committee), *Koreegodaansistuu* (committee to announce the trekking time), and *Koreeadabbii* (penalty committee consists of elders). After meeting, the established announcement committee announces the pastoralists to leave the mountainous part to the edge of Fentalle. As a result, pasture around mountainous part of the Fentalle and Arolle plain (western part or Argoba special District boundary) is protected from intrusion for a winter season.

Elders are responsible to set punishment for those pastoralists who deviate from the established norms of a communal land enclosure. According to elders, pastoralists, who are observed to feed their herds on the grass in the protected pasture, will be fined about 50 birrs per goat/sheep and 100 birrs per cattle. Only camels are allowed to graze in the enclosed pasture because camels feed on leave than protected grass. In this way, continuous monitoring is made by elders on the performance of each structure to run communal land enclosure until a period of *Hiikaa Dheedaa*, the time the enclosure is allowed for all (mostly in September). *Hiikaa Dheedaa* depends

on the availability and continuity of rainfall. If the rainfall is perceived adequate by Duree Biyyaa (*community leaders*), pastoralists are expected to stay on the edge of the mountain than on the mountain pasture and vice versa. Community leaders also manage pasture utilization among the pastoralists to control possible competition and overexploitation.

Participants indicated that the most important strategy that the Karrayyu designed for dealing with drought is the communal land enclosure. The practice of communal enclosure, according to the former Fentalle district pastoral development head, has also environmental benefits as it relieves grass and plant species from overgrazing. Communal enclosure has now been put under pressure due to various reasons. Among those factors, revealed in the FGD discussions held at DhekaEdu and Qobo'ogandas, are the expansion of farmlands, inappropriate settlement, development interventions (such as the failed Boset-Fentalle irrigation project) and bush encroachment. Moreover, according to key informants, irrigation projects and water canals compromised the plain pastureland, which could have been used for grazing land. Informants underlined that the canals constructed for irrigation scheme have diverted water and affected water retention for pastoralists instead of serving the pastoral communities.

Splitting of herds and families. Another complementing activity appeared in the discussion and in-depth interview was splitting of herds and families to reduce the effects of drought. During a dry season, when the access and availability of pasture and water are scant, pastoralists split their herd and families into different locations. Elders enunciated that split of animals depends on types, health conditions of animals, and labor availability among others. Accordingly, goats and cattle are often separated from calves and weak (milking) animals. The Karrayyu often take drought-tolerant livestock to areas with a bit higher temperature, enough pasture but where water is rarely available. Youth males shoulder the responsibility for mobility and keeping this livestock. Calves and the weak or easily susceptible animals are taken along Awash River and kept by women, children, and elders. Interviews revealed that splitting herds has been rescuing the life of livestock and people over a generation among the Karrayyu. Herd splitting was generally mentioned as an important strategy to reduce pressure on pasture and some water points. A quote from a 60-year-old man key informant, from Qobo'o Ganda strengthened this assertion.

During the 2011 drought, our community members had migrated to different areas of the District, which were assumed relatively less affected. They had also divided their livestock between different geographic settings, which were not affected by drought at least not uniformly. Those pastoralists who had wives and families at different places were advantageous to share their livestock to reduce the effect of drought. By 2011 drought, I lost more than 20 cattle and 40 sheep within one month. If I had adjusted the settlement of my family into different places and divided my herds, I would have reduced the loss. In 2014, I married two more wives. As a result, in 2015 I managed to share my livestock between my two families. I took some of the drought-tolerant livestock to my families who lived on the tip of Fentalle Mountain where getting water was a tricky task while some cattle were left with my another wife at another side of the Mountain where

both pasture and water were relatively good. The latter was less affected by drought. If I had not used such a splitting strategy, the same tragedy in 2011 would have happened to me.

Haymaking. Haymaking involves enclosing certain open grazing land around the homestead, which is privately made by every household. Hence, this is different from the communal land enclosure. A household needs to support weak animals through haymaking. Haymaking, especially for a newly born calves and weak animal is the responsibility of women. Different animal feeds such as sugarcane residue (from Metehara sugar factory), grass, and remain of crops (*Teff*, corn, and barley) were bought from agro-pastoralists to supplement haymaking practice of women according to FGD participants and in-depth interviews. Women participants indicated that early haymaking reduces the distance to be traveled by women to cut grass for their livestock during a critical period of drought.

Selling camel milk. Selling camel milk was reported as an emerging strategy to reduce the effect of drought among Karrayu pastoralists. The study revealed that traditionally, selling camel milk was not much appreciated for long. According to women interviewed in the past since camels were away from home in search of pasture milking camel was rarely possible. However, overtime camel milk has become a crucial source of money, which can be reinvested for different adaptation strategies. Women informants stated that money generated from camel milk is invested for, among others, buying different feeds for livestock including sugarcane residue during a period of severe drought. In addition to this, key informants indicated that income generated from milk selling supplements household income and hence contributes to household consumption smoothing. Therefore, women keep some camels around homestead for milking. Echoing this argument, a young household head said: *“since the price of livestock drops down during drought, income from selling camel milk is very important gap filler. Income from selling camel milk also contributes to saving which later covers medical and school expenses”*.

Farming as a livelihood diversification. As mentioned above, farming is not the main source of living for the Karrayu. However, according to key informants, due to recurrent drought occurring in the area, pastoralists are increasingly adopting farming as a means of livelihood diversification and alternative for consumption smoothing. Women participants noted that during the drought period the price of livestock drops down significantly but the price of grain usually increases dramatically. As a result, households were challenged to meet their consumption. They started to pursue crop cultivation as an alternative to livestock production. For elders, expansion of farming practice among the pastoral community reduces the size of farmland, which in turn, can affect the pastoral ways of life.

Charcoal and firewood selling. Charcoal and firewood sales are another emerging livelihood alternative for the Karrayu pastoralists. Women are the main actors in making charcoal and firewood for the market to generate cash for their household consumption. They reported that income generated from charcoal sales can cover their household expenses and some consumption requirements, which is otherwise covered by selling livestock. Observation revealed that participants make charcoal around their

homestead and take to Metehara town on their donkeys back. Indeed, it was reiterated that charcoal making was not an integral part of the livelihood of Karrayu pastoralist for long period. FGD participants mentioned that making charcoal was considered an indicator of poverty and the weakness of the husband to manage the household for a long period. With the increasing effects of drought and dwindling of household income sources, charcoal has become an important source of income. Understanding its role in addressing the financial need of household, male adults reported that they were attracted to charcoal making. *Juliflora*, invasive species that has covered uncultivated land around the edge of mount Fentalle, is largely used to make charcoal. Charcoal making from *Juliflora* was also indicated as one of the mechanisms of managing the effect of the weed, which is increasingly invading grassland.

4.5. Traditional Weather Forecasting as Drought Vulnerability Mitigation Strategy

Beyond adaptation, unique mitigation strategy employed by the participants to mitigate vulnerability to drought was explored. Traditional weather forecasting was mentioned as the most important drought mitigation mechanism reported by community leaders. According to elders, these strategies involve examining star, wind direction, weather, and stone. They claimed to use weather forecasting to predict the climatic condition, occurrence, and severity of drought in the forthcoming year and prepare themselves accordingly.

It was noted that the two most important coping strategies, mobility and herd diversification were inexorably linked to traditional weather forecasting. During a dry season, local popular leaders examine the condition of a star and decide the direction to migrate as to where to take the milking, new calves, and weak animals. Elders use the concept “*Foolee*” to reside in drought adaptive zone. *Foolee* refers to conduciveness of particular residence for a particular livestock. Where there is bad *Foolee* in a certain area, the death of livestock continues despite the availability of adequate pasture and water. Consequently, this *Foolee* is perceived to determine the direction of trekking, which is forecasted by experienced elders. Traditional weather forecasting by elders is also used to determine which year will be conducive for which livestock. This was perceived as crucial in taking proactive misusers such as trekking and communal land enclosure to rescue livestock.

Elders perceived that not all conditions are uniformly good for all type of livestock. An FGD participant elder expressed the difference susceptibility condition for goat and cattle as follow: *Abaarre’eefdhufe loon gabbiseetre’eehuuqqisa*” (literally mean *the drought, which is forecasted for goat, fattens cattle and weakens goat*). This means once a particular drought comes to weaken goat, it becomes conducive to cattle though cattle are easily susceptible to drought. For elders what matters most is *Foolee*. Participants enunciated that there is an established system to communicate the forecasting to the wider community so that they take necessary adjustment to reduce the effect of drought.

5. Discussion

Pastoralists are a social group who make their livelihood under precarious external factor, climate. Within changing climate condition and occurrence of drought, pastoralists are the most affected of all livelihood groups (Herrero et al., 2016). This study was conducted to explore the adaptation mechanisms pursued among Karrayu pastoralists in Ethiopia, who are affected by recurrent drought. This study revealed that though the Karrayu are known for keeping livestock, nowadays the livestock population is declining due to recurring drought. Drought, through drying of water points and creating a shortage of feed, resulted in the loss of livestock and affected the livelihood base of pastoral communities. It is recurring nature worsened the situation by degrading the resilience capacity of the pastoralists.

Resonating this finding, Opiyo, Wasonga, Nyangito, Schilling, and Munang (2015) found that since pastoralists have limited livelihood diversification option to fall back upon, they are normally vulnerable to extreme drought events which resulted in, among others, drying up of water sources and declining pasture availability and access. Hence, increasing frequency of drought is positively associated with the death of the livestock population. Indirectly, drought heightens competition over resources among neighboring pastoralists, which in turn results in overexploitation of resources. Furthermore, the growth of invasive trees during the dry season means a replacement of pasture, which pastoralists depend on for feed. This has resulted in changing livestock composition. In line with this finding, Sileshi (2017) found that change in vegetation cover due to drought contributed to changing livestock composition and declining of cattle.

Karrayu pastoralists are pursuing different strategies to reduce the effect of drought. These strategies emanate from longstanding traditional practices for using resources and managing climate variability. The important adaptation mechanisms that the study revealed are the adoption of farming and livelihood diversification. Taking up farming is the result of land pressure and recurrent drought according to Ayalew (2009). Diversification to farming, charcoal production and selling milk are perceived to spread risk. In addition to this, diversifying income portfolio means, pastoralists have increasing access to income, which could enable them to deal with the effects of climate change. A similar study conducted among Kenyan pastoralists acknowledged diversification to labor employment, making charcoal and remittance as important relieves for pastoralists during the lean season (Okoti et al., 2014).

Though mobility is an integral livelihood activity of pastoralists, frequency and distance of trekking are increasing more than ever among the Karrayu pastoralists. Being transhumant pastoralists, the Karrayu have fixed homestead from and to which they move under different climatic situations. Shortage of water and deteriorating pasture are increasing the frequency of mobility. Flexible and responsive mobility is a vital strategy of livelihood sustenance in dry land pastoralism (Rota, 2009). The scale and frequency of pastoral mobility depend on spatial and temporal variations (Wassie & Fekadu, 2015). However, mobility has become a challenge due to conflict with neighboring pastoralists and land pressure attributed to the commencement of government projects such as irrigation and sugar factors. Ayalew (2012) noted that the expansion of large-scale irrigation agriculture and conservation schemes among the Karrayu has altered their land tenure system. This has already curtailed the mobility and adaptation strategies of the people.

Due to their longstanding experiences, the Karrayu also split their herds and families, rely on well-managed communal land enclosure and trekking. Not all animals are affected uniformly by drought. Cattle were reported as more vulnerable than browsers. Consequently, pastoralists separate and settle them in a different setting to escape the adverse effect of drought. Weak animals are kept near the permanent homesteads and fed with supplementary feeds and the strong ones are migrated to other parts (Mworia & Kinyamario, 2008; Okoti et al., 2014). The Karrayu applies the same to family members. While women are primarily responsible for keeping weak animals nearby home, young men are responsible for trekking and keeping livestock away from home. Women and children make supplementary hay around the homestead for weak animals. In contrary to the assertion of Sileshi (2017), this study found no evidence regarding women replacing men to keep livestock away from the homestead.

Notwithstanding the economic and social value of cattle, adopting browsers has become compulsory for the Karrayu to reduce the effect of drought. In agreement with this finding, studies show that Borana pastoralists are increasingly switching to camel management as an adaptation strategy due to exacerbating effects of drought resulting loss of cattle and pastoral livelihood (Galma et al., 2017). A gradual shift to camels and goats is also reported among Kenyan pastoralists (Okoti et al., 2014). The study also noted that traditional weather forecasting is an important mechanism for adjustments to be taken by pastoralists to reduce the probable effects of drought.

Limitation of the study. This study employed qualitative research design, and purposive sampling technique to select the participants. Thus, the findings are not generalizable to all Karrayu pastoralists. Since this study is conducted during drought season and for it is dominantly about drought adaptation strategies, it doesn't adequately shed light on the livelihood situation of pastoralists in seasons they perceive as 'normal'.

6. Conclusion and Recommendation

This study explored drought vulnerability and the various adaptive strategies Karrayu pastoralists are undertaking. The study found that the livestock population is declining over time due to a shortage of pasture and water scarcity, which are in turn resulted from recurrent drought. As a result, conflict over limited pasture and water is surging among pastoral communities. The effect of drought is not limited to a dry season. Its negative consequences extend to the rainy season because livestock, which is already weakened, could not recover easily. This indicates that livelihood sustainability of the pastoral community is tied to a single factor, climate, which can simultaneously affect their livelihood base. Karrayu pastoralists use their indigenous knowledge to reduce the consequence of drought. While mobility is a conventional adaptation strategy among pastoralists, the Karrayu also employ herd diversification and participate in non-farm businesses. Unique to the Karrayu is traditional weather forecasting, whereby elders use their longtime experience to mitigate the consequence of drought. Based on the finding, the following issues are suggested for sustainable pastoral development.

- The government should integrate local drought adaptation strategies to nationally endorsed climate resilient green economy initiative to reduce the impact of drought.

- Innovative projects such as stocking up of hay for use during dry periods and livestock banking which was demonstrated in Borana is of great importance to reduce the loss of livestock.
- Designating responsive livestock marketing is equally important to safeguard the livelihood of pastoralists.
- Since drought affects different people and livestock differently, rural development policies should support the most vulnerable group such as women through designing safety net.
- Drought has an inter-seasonal effect. Thus, pastoral development offices should focus on building the resilience of the pastoral community. Particularly women and children, who are disproportionately affected by drought, deserve special policy attention.
- Pastoralists are increasingly switching to farming due to pushing factors such as limited pasture and water scarcity. Thus, the government should design attractive and remunerative projects, which pastoralists pursue without living their major livelihood strategy.

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Authors' contributions

¹DT designed the study, reviewed literature, defined the research problem, analyzed data and prepared the manuscript.

² BM conducted fieldwork, analyzed data and edited the manuscript. Both authors read, edited and approved the manuscript.

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