

Effects of Climate Change and Variability on Pastoralists and Their Adaptation Strategies in Yabello District, Southern Ethiopia

Gebisa Koroso, Alemnew Muchie, Kedir Erbo

Ethiopian Biodiversity Institute, Hawassa Biodiversity Center, Hawassa, Ethiopia

Email address:

korosogebita@gmail.com (G. Koroso), muchiealex@yahoo.com (A. Muchie)

To cite this article:

Gebisa Koroso, Alemnew Muchie, Kedir Erbo. Effects of Climate Change and Variability on Pastoralists and Their Adaptation Strategies in Yabello District, Southern Ethiopia. *International Journal of Energy and Environmental Science*. Vol. 7, No. 3, 2022, pp. 42-49.
doi: 10.11648/j.ijees.20220703.12

Received: April 3, 2022; **Accepted:** May 10, 2022; **Published:** May 24, 2022

Abstract: In Ethiopia, pastoralist area rain-fed livestock production system was more vulnerable to climate change. Existing climate variability was imposing significant challenges by preventing the struggle to reduce poverty and sustainable efforts. Current climate variability is already imposing significant challenges by preventing the struggle to reduce poverty and sustainable efforts. The study was conducted in Yabello districts southern Ethiopia to understand the effects of climate change on pastoral community and their adaptation strategies. Stratified random sampling method were employed as follows multistage sampling techniques to select the household samples. Both qualitative and quantitative data was uses to gather 142 household information through field surveys. In addition, focus group discussion and key informant interviews were employ to triangulate and substantiate the finding from household survey. Descriptive statistics and chi-square tests were employed to test a degree of significance between the pastoral household to the effects of climate change. The results show that 95.1% of Pastoralists have already perceived the herd mobility adaptation strategies of climate change and variability, and 58.5% made attempts to adapt livestock destocking practices like area enclosure herd mobility, livestock diversification, supplementary feeding, livestock destocking, reducing consumption, religious alms, construction water points for their livestock and off farm activities practice. While their perception of declining annual rainfall are not supported by actual records. Moreover, the result indicated that the significant increment of temperature, high inter annual and seasonal rainfall variability have caused effects on their livestock's wellbeing. The prominent adaptation strategies by the pastoralist are area enclosure herd mobility supplementary feeding livestock destocking. Nevertheless, the adaptation strategy was not practiced in full capacity constrained by different socio economic and institutional factors. Therefore, it is important to provide training and improved livestock's which drought tolerant. Also, intervention is needed to address water shortage and up scaling water harvesting technology to conserve water during drought season in the study area. Also, focus group discussion and key informant interviews were utilized to triangulate and substantiate the finding from household survey. The prominent adaptation strategies by the pastoralist are area enclosure herd mobility supplementary feeding livestock destocking. Nevertheless, the adaptation strategies are not practiced in full capacity constrained by different socio economic and institutional factors. Therefore, it is important to provide training and improved livestock's which drought tolerant. Also, intervention is needed to address water shortage and up scaling water harvesting technology to conserve water during drought season in the study area.

Keywords: Adaptation Strategies, Climate Change & Variability, Pastoral Communities, Yabello District

1. Introduction

Climate change and variability poses a great deal of challenges to all human kind and the environments' (20). Over the years, frequency of climate change and variability

in terms of temperature and rainfall has been changed according to Chibinga et al, [9]. Despite, worldwide coverage of climate change impact, it also expected to have serious environmental, economic and social impacts particularly on rural farmers in Africa, whose livelihood depends on the use

of natural resources [12].

Ethiopia is experiencing the effects of climate change including the direct effects such as an increase in average temperature or a change in rainfall patterns [27]. According to World bank [24] this has already led to decline in agricultural production shortage of foods, a decline in biodiversity, and increase in human and livestock health problems, rural-urban migration and dependency on external support. Pastoralist who reside in 61% of the nation's landmass [2] are highly vulnerable to climate change due to their locations which is isolated, remote and underdeveloped and negatively affected by climate change and variability [9, 2].

According to Cooper [10] pastoralist and agro-pastoralist, communities who reside in the arid and semi-arid environments of Ethiopia are vulnerable to the effect of climate change such as; recurrent drought, floods and conflicts which increased the burden of those who are already poor and weak by affecting their livelihood pattern.

Borana Zone in Oromia Regional State is one of the predominantly areas in Ethiopia the recurrent drought and chronic foods insecurity in the zone are major concern by the federal and regional governmental and humanitarian organization (12).

Perception about climate variability, its cause, impacts and necessary response mechanism to cope with climate calamities are important for any population in given community. In Ethiopia, studies regarding the effect of climate change and variability on pastoral communities and their adaptation strategies have been under taken at national and regional level. However, limited studies have been carried out to investigate the above gap in the study area particularly at district level.

Therefore, this study was done to address the gap and to identify the effect of climate change and variability on pastoral community and their adaptation strategy at Yabello district, southern Ethiopia. This study was to assess effects of climate change and variability on the pastoral communities and response made to overcome the negative effects of climate change and variability and their adaptation strategies and assess perceived effects and pastoral perception on rainfall and temperature with climate change and variability on household.

Also identify the adaptation strategies employed local community in response to climate change and variability. It better understanding of how pastoral community perceived climate change, ongoing adaptation strategies measures, and the factors influencing the decision to adapt pastoral practices is needed to craft policies and programs aimed at promoting successful adaptation. It will also inform decision makers to reduce the negative consequences of predicted effects of climate change, with great benefits to vulnerable rural communities in pastoral areas.

Moreover the finding can be used for better understanding of the kind of training on effects climate change & variability and adaptation strategies, which will be required for pastoral communities. Furthermore, this study determined the current status of the effects of Yabello pastoralists at study area to climate-induced shocks based on cross-sectional data. The study focused on pastoral community in Yabello district and

tried to identify how perceived the effects of climate change and variability on their overall life and the different adaptation strategies employed by pastoralists to minimize climate change and variability induced hazards.

Also the study tried to determine the perception of the communities towards the climate change and variability since perception strongly effects how pastoralists' deal with climate induced risks and opportunities and difference may exit on perception and metrological record.

2. Materials and Methods

2.1. Study Area Description

The study was carried out in Yabello district former Borena Pastoralist southern Ethiopia. Yabello is geographically located between 3° 36'-6° 38' in the North and 36° 43'- 41° 40' in the East (Figure 1). Regarding soil types Reddish soils low hold capacity of water pronounced with flooding and drought area with in country. Although the region has bi-modal annual rainfall ranging from 400 to 700 mm in the south to 600 mm in the north, this was manly characterized by semi-arid climate. Thus, the Borana zone Yabello district climate was mainly influenced due to scarcity of rainfall. Nonetheless, rainfall regime in semi-arid areas of southern Ethiopia including Yabello districts, the study was conducted in Yabello Woreda's, which was one of the learning sites of Climate Change Agriculture and Food Security in East Africa.

2.2. Sampling and Data Collection Method

The study followed a multistage sampling procedure where combination of purposive and stratified random sampling technique was employed for selecting study area and sampled households. In the first stage, the study district Yabello was selected purposively considering the fact that it is one of the most vulnerable areas to the effects of climate change and variability in Borana Zone. In second stage three kebeles (Haro-Beke, Dida-Yabello and Dida Hara) of thirteen (13) kebeles in the woreda purposively selected based on the vulnerability and effects of climate related shocks on local pastoralists and on their livestock's production practices by consulting with districts expert in the study area. In the third stage, accordingly, the number of sample households for the target population at 92% confidence level and 0.08 (8%) level of precision were determined by using a simplified formula provided by [28] Elementary sampling theory and reviewed by [15] sample of 142 households were selected using stratified random sampling techniques based on their wealth status from the three kebeles. Then without looking the researcher selected 142 sample households.

$$n = \frac{N}{1+N(e)^2} \quad (1)$$

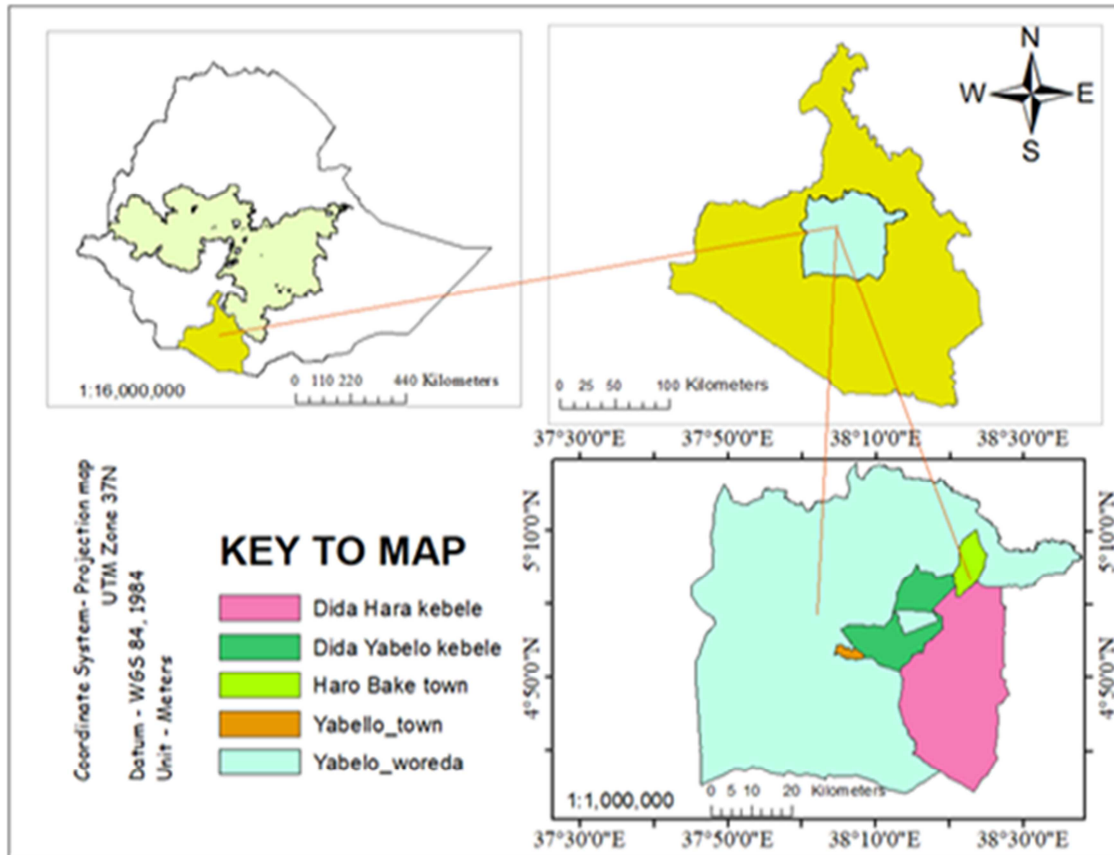
Based on the above formula to get the sample size:

$$n=1572/(1+1572(0.08)^2)$$

$$n=142.$$

Therefore, 142 sample respondents were selected to conduct this particular problem. Moreover, household survey, focus group discussion, key informant interview, and field

observation as well. Finally, simple random sampling (SRS) technique would be used to select sample households from the three kebeles.



Source: CSA developed from QGIS software

Figure 1. Maps of the study area.

2.3. Source and Method of Data Collection

In this study both primary and secondary data collection for this study. The primary data was acquired from primary source including, household survey, key informant interviews, and focus group discussions and field observation. The survey questionnaires were prepared to collect information on Effects of Climate Change and Variability on pastoral Communities and Their Adaptation Strategies. The secondary data were collected from available sources of information such as published materials, these includes related literatures and journals and unpublished data from both regional and the district offices like Agricultural and Rural Development Bureau and Productive Safety Net Program. The questionnaires were translated into the local language (in Afaan Oromoo), would be pretests and have been modified before implementation.

2.3.1. Household Survey

Household was one of method of gathering primary data from horse mouth. By this particular method 142 households (8%) of the total households of the three kebeles were considered.

2.3.2. Focus Group Discussion

In this particular research, focus group discussion were conducted with purposively selected knowledgeable community members consisted of elders, youth and women and from each kebele women in other groups to managed equal chance of gender with in the participations in each FGD issues related to perception of the community on climate change and variability, effects of climate change and variability on their livelihood and local adaptation strategies community that practices in the study area were discussed to get general information.

2.3.3. Key Informants Interview (KII)

KII was employed in order to support the data, which those would be collected from household survey. Key informants were knowledgeable people who know about the study area and effects climate change and variability on pastoralists' livelihood from head of livestock production development pastoralists and Agricultural Rural Development Offices were from agricultural experts from three kebeles and were from NGO workers who know about climate situations and local adaptation strategies that have been practices by local community.

2.3.4. Field Observation

Observation was made as supportive or supplementary technique to collect data that can complement or set in perspective the data obtained by other means in this study. Beside the KII and FGDs. During field observation, various environmental and socio-economic activities, the existing and actual Effects of climate change and variability and their adaptation strategies was seen.

2.4. Methods of Data Analysis

Descriptive Analysis

This study employed both qualitative and quantitative data analysis techniques to analyze the data. Collected data were checked, corrected, coded in computer, which were then analyzed to extract meaningful information. Different data analysis techniques were employed since both qualitative and quantitative data were collected. The qualitative data were obtained through key informant interview and group discussion were narrated and summarized. Descriptive statistics was employed to determine and assess the following aspects: respondents' demographic and socio-economic characteristics and assess the effects of climate change and variability on pastoral community through statistical Package for Social Science (SPSS) version 22 software. Independent sample-test was also employed to test the existence of a significant pastoral in their livestock owned, family size, perceived level of effect that poses due to climate change and variability.

3. Results and Discussions

3.1. Demographic and Socio-economic Characteristic of Respondents

Table 1. Perception of effect of climate change & variability by respondents Perceived effect.

| Perceived effect | Pastoral (n=142) | |
|---------------------------|------------------|-------------|
| | Frequency | Percent (%) |
| Livestock Asset Reduction | 135 | 95 |
| Shortage water | 115 | 81 |
| Food shortage | 104 | 73 |
| Loss of income | 126 | 89 |

Source: field Survey, 2020.

Of the total 142 sample households were interviewed the questionnaire survey. On average, 73.24% were male-headed households while the remaining 26.76% were female-headed households. The majority 88.03% were married while divorced were 3.52% widowed were 5.63% and single were 2.82%. Regarding the educational status, on average, 83.8% was illiterate while 10.56% was primary school, 2.11% was high school and 3.52% was collage. The low level of educational suggested that most of the pastoralists in the study area could not find decent employment because of their low level of education this result and discussion were collected from primary data unpublished data from agricultural development offices [19]. It indicates that the

majority of respondents were categorized in illiteracy rate but most of them were low level of education. According to Daniel [9], the head of a household is the key decision maker in the family; the better he or she learns the better he or she will be likely to aware for weather information.

Table 2. Demographic and Socio-economic characteristics of households Characteristics of HHs (n=142).

| Gender of the HH | Frequency | percent (%) |
|-----------------------------------|-----------|-------------|
| Male | 104 | 73.24 |
| Female | 38 | 26.76 |
| Marital Status | | |
| Single | 4 | 2.82 |
| Married | 125 | 88.03 |
| Divorced | 5 | 3.52 |
| Widowed | 8 | 5.63 |
| Educational Status | | |
| Illiterate | 119 | 83.8 |
| Primary school | 15 | 10.56 |
| Secondary school | 3 | 2.11 |
| Collage | 5 | 3.52 |
| Source of income | | |
| On-farm (livestock production) | 127 | 89.44 |
| Off-farm | 12 | 8.45 |
| Both | 3 | 2.11 |
| HHs access to climate information | | |
| Yes | 12 | 8.46 |
| No | 130 | 91.54 |

Source: Field survey, 2020

3.2. Perception on Drought Occurrence

The Yabello district specifically in the zone generally has faced drought-like situation many times throughout history, and it is not a new phenomenon to them. The factors that are new to them are probably that the rain is more irregular than before, and the drought periods probably come more frequently now than before.

Effect of Climate Change & Variability and Adaptation strategies on pastoral communities.

Perception of households on the effects climate change and variability. However, all these effects are complex and are more or less related to each other. Statistically significant differences were observed among some of the perceived effects of climate change and variability among pastoral respondents.

3.3. Effect of Climate Change and Variability on Livestock Asset Reduction

Livestock has been an important asset of the pastoral in the study area upon which their livelihood mainly depends. The majority livestock species reared by the respondents were sheep, goats, camels and donkeys. However, the recurring drought has affected the availability of grazing pasture as most of it has dried up or in infested with weeds, which affected livestock holding per household. About 95% from the pastoral felt the effect of climate variability on their livestock asset reduction.

KII participants also out that animal mortality has been increasing due to shortage of pasture and diseases especially

during drought times, many livestock owners altogether obliged to use the same water sources to drink their animals and concentration of livestock on limited pasture areas which trigger the spread of disease. During field survey it was observed sick animal and also dead bodies and the local people said that animals were dying right now not because lack of forage but disease which they were familiar. Through, further study is suggested to find-out the relationship between climate variability and livestock disease in the study area, pastoralists linked those problems to climate variability.

3.3.1. Shortage of Food to Decline of Grass Quality and Quantity

Rangeland is the main source of feed in pastoral areas, according to the sampled household survey 73% of them believed that they were a change in tree resource and decline quality and quantity of grasses as the roots of grasses species are dried and encroached by different indigenous and invasive bush species and [18] also support that indigenous grasses are gradually being replaced by unknown exotic plant. This study is in agreement with [23] who studied that *prosopis juliflora* represents one of the most vulnerable in environmental problems in East Africa.

3.3.2. Shortage of Water

As water is the most important resource for any kind human activity, water shortage has been main challenges for pastoralists especially in dry seasons of the years in the study area. These was because of the loss of water points like / Haro/pond/ and Ela which were the main source of the water for livestock and human.

3.4. Adaptation Strategies to Climate Variability

Pastoralists were asked which climate change and variability adaptation measure they have been using so far. Thus, the result of response was shows using a table which indicate the pastoralists' adaptation strategies to climate change and variability.

Table 3. Adaptation strategies to climate change and variability used by respondents.

| Adaptation Strategies (%) | Frequency | Percent |
|------------------------------|-----------|---------|
| Livestock diversification | 69 | 48.6 |
| Herd mobility | 135 | 95.1 |
| Livestock destocking | 83 | 58.5 |
| Area closure | 79 | 55.6 |
| Supplementary feeding | 67 | 47.2 |
| Construction of water points | 50 | 35.2 |
| Off farm activities | 26 | 18.2 |
| Reducing consumption | 73 | 51.4 |
| Religious alms | 78 | 54.9 |

Source: field Survey, 2020.

3.4.1. Livestock Diversification

This is traditional management system of keeping different livestock species those are survival such climate condition and a kind of livestock species to another in order to minimize climate change induced problem, Livestock diversification is adaptation strategies in the study area

change in household livestock composition marking a transition from a previously cattle dominated herd structure that was susceptible to drought to mixed livestock composition including drought tolerant animals such as camels and small ruminants. This result was supported by several studies by [7, 20] Climate variability and household adaptation strategies and Sustainability in the Southern Ethiopia.

3.4.2. Herd Mobility

Pastoralists move their animals seasonally in search of better sources of pasture for feed and water and sometimes scarcity of pasture for their livestock. The higher percentage pastoralist herd mobility to remote areas for searching supplementary feeding and water during drought season in the study area. This study is line with [18, 20, 7] who reported that herd mobility to remote areas and supplementary feeding of animals are identified as the most commonly used option by more households in pastoral system than agro pastoral counterparts in Borena. Hence, in past times mobility was the best coping and adapting strategy to drought for the Borana.

3.4.3. Area Enclosure

Area enclosure is one of the major indigenous adaptation mechanisms being practiced by local community to reduce the impacts of climate change and variability. This result is similar with [7] Climate variability and household adaptation strategies and sustainability in Southern Ethiopia. The KI participants also noticed an individual has the right to enclosure a piece of land in the areas controlled by their clan unless the clan has agreed there should be no enclosure.

3.4.4. Livestock Destocking

In the study area when climate extreme begin to hit, they engage in commercial emergency destocking to reduce the risks of death, despite the low prices fetched whatever income obtained through sale of livestock's. In addition, FGD and KI said that the number of cattle at household in the study area was decreased. While they do destocking of livestock through sell, they give less priority to cattle than sheep and goats.

3.4.5. Construction Water Points

Watering points are moderately practiced by some headers probably because of the increased drought. When pasture and water resources were insufficient due to drought to dig water holes/pits for livestock watering were completely dry, they used to travel to other nearby of even far away areas with their livestock.

3.4.6. Supplementary Feeding

The use of purchased hay and other feeds are become the recent coping practice to increase livestock productivity and resilience during peak feed shortage as a result of drought in the study area.

The result is supported by [10] states that, climate-induced distress and local hardships has induced Borana pastoralists to change their range management practices and stocking up of hay for use during dry periods.

3.4.7. Reducing Consumption for Meal and Ceremony

The other coping strategies considered by households were reducing consumption which included reducing the frequency and amount of meals, eating less-preferred food items, reducing spending on weddings and funerals by reducing socialization. This adaptation was also supported by [6, 25, 26, 4] the adaptation strategies climate changes and variability in the Ethiopia.

3.4.8. Religious Alms

The micro finance and “Bussa Gonofa’s” are non-governmental organization the doing on community development. They are doing those within pastoral communities by giving money as cope to effects of climate change and variability and their adaptation strategies by that taken money from “Bussa Gonofa’s” and micro finances to response the negative effects of climate change and variability their livestock and chronic food insecurity their livelihoods.

3.5. Barriers of Adaptation

Respondents were asked to identify barriers impeding them fully employed of adaptation strategies to counteract the effect of climate change and variability. The shortage of labour, limited government support, clan-based land tenure systems barriers are combined with other socioeconomic and political constraining factors, there is limited adaptive capacity. Survey result obtained from household respondents, FGDs, expert and key informants on barriers to taking up adaptation options indicate that shortage of labour, limited government support, clan-based land tenure system, and limited access to market, lack of climate information and financial were the various perceived limitations.

3.5.1. Shortage of Labor

According to the respondent’s herd mobility is a labor intensive and shortage of labor can hinder herd mobility. To move livestock when there is shortage of feed require labor and if the family don’t have enough labor it become a challenge. Thus, those households who have high family members can have better chance to move their livestock easily during shortage of pasture and escape the problems induced by climate change and variability.

3.5.2. Limited Government Support

Inadequate government assistance to farm households and communities was recognized as a barrier to overcoming the negative effects of climate change. The support could be in the form of technical, financial or policy backing to facilitate successful adaptation. Participants emphasized that government support rarely understand local needs and priorities in terms of adaptation and overall development goals. Due to climate variability, livestock exposed to different animals disease.

3.5.3. Clan Based Land Tenure System

Another important constrain of adaptation to effect climate variability noted by the respondents was clan based land

tenure system. This may due to the fact that most pastoral households in the study area have no private enclosure and utilize communal resources with the spatial and temporal variability of rangelands with diversified livestock. Pastoralists are confronted with competition of their communal rangeland they were overgrazing and decline of biodiversity and land degradation becomes inevitable.

3.5.4. Limited Access to Market

Limited and poor to access fair markets to sell farm produce including livestock and livestock products and grains as well as limited access to input markets to buy inputs necessary to improve production and support successful adaptation were identified as barriers to adaptation.

3.5.5. Lack of Meteorological Information

Lack of information is one of the most important barriers to adapt in the study area. The respondents and agricultural experts found in the area declared that lack of access to timely meteorological reports (information) is one most pressing constraints for making adjustment to erratic or reduced rainfall to adjust soil and water harvesting technologies.

3.5.6. Financial Barrier

Similar to the labor shortage, to move livestock from elsewhere and escape climate change induced problems, buying improved livestock’s varieties and other technologies, construction of water ponds to overcome water shortage problem require finance and the poor families can’t afford it. Almost all of the barriers were in line with [6, 25] and [4] finding in different part of Ethiopia.

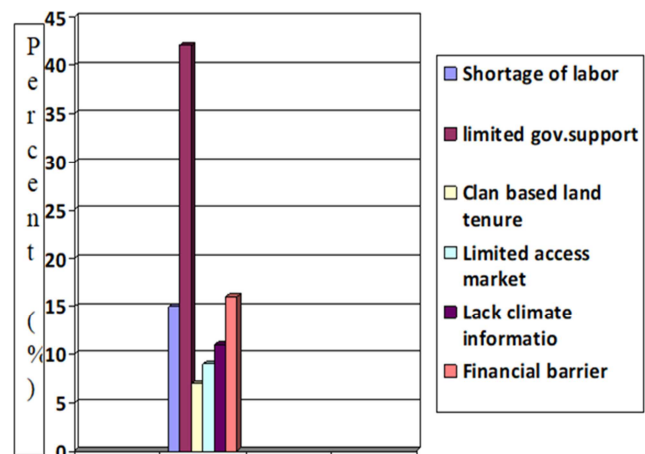


Figure 2. Barriers for adaptation strategies.

4. Conclusion and Recommendations

This study investigated perceptions of local communities on climate change and its effect on their livelihood and adaptation strategies. The livestock disease and death of livestock, shortage of water for livestock and human, reduction in prices of livestock, and migration of households’ members were the major effects of climate change in the study area. In Yabello district, pastoralist practiced various types of adaptation

strategies. Among them mobility, change compositions of herds, income diversification, splitting of herds and making enclosure for calves and cows around village, supplementary feeding, construction of water points, off-farm activities and reducing consumption were the common ones. Herd mobility access to forage and water drought encounter were found to be the most important factors that affect local communities' choice of adaptation strategies in the study area.

To reduce the effect of climate variability and change and recurrent drought, different water harvesting and irrigation technologies should be incorporated by governmental and non-governmental organizations with their local adaptation strategies. Thus, attention should be given to management of grazing lands and controlling of invasive species including *Prosopis juliflora*. Therefore, the pastoralist and agricultural development office should work on an awareness rising of the local communities about the importance of destocking to manage and able to feed their livestock during drought seasons and local communities' choice of adaptation practice and the importance of "Kaaloo" traditional range land management systems to adapt impacts of climate change.

Acknowledgements

Above all, I would like to thank the Almighty God who made this paper possible. It's my honor to express my sincere gratitude to my main advisor Muluken Mekuriye (Ph.D.) for his invaluable comments and excellent supervision. I am also very much grateful to Hawassa biodiversity center staff that helped me in providing genuine and relevant information.

Finally, I would like to take this opportunity to thank my all friends for sharing ideas and encouraging me to work hard from the starting to ending of this paper work.

References

- [1] Abebe Tadege, 2008 Climate change and development adaptation measures. *Economic Focus*, 11 (1): 15-24. Addis Ababa, Ethiopia: Ethiopian Economics Association.
- [2] Aklilu Amsalu and Alebachew Adem., 2009. Assessment of climate change-induced hazards, impacts and responses in the southern lowlands of Ethiopia. *Forum for Social Studies (FSS)*.
- [3] Aklilu Amsalu, Desalegn Wana, Mesfin k and Negash T, (2013) 2008. Climate change impacts on pastoral women in Ethiopia. Some evidence from the southern lowlands. *PPE Ethiopia Consortium* p 1-6.
- [4] Arragaw Alemayehu and Wildemalk Bewket (2017) Smallholder Farmers' coping and adaptation strategies to Climate change and Variability in the central highlands of Ethiopia. *Local Environment* 22 (7); 85-839.
- [5] Assefa Admassie and Berhanu Adenew., 2007. Stakeholder Perception Climate change adaptation strategies in the central highlands of Ethiopia. *EEA Res. Report, Annual Report 26* Addis Ababa, Ethiopia Technical Report.
- [6] Belay Kassa, Beyene Fikedu and Manig, W., 2005. Coping with drought among pastoral and agro-pastoral communities in eastern Ethiopia. *Journal of Rural Developments* 28 (1885-210).
- [7] Berhanu Wassie and Beyene Fikedu, 2014. Impacts of climate change on pastoral production system; A study of climate variability and household adaptation strategies in southern Ethiopia rangelands (2014/028) WIDER Working Paper.
- [8] Beyene Fikedu, 2006. Informal institutions and access to grazing resources: Practices and Borana of Northern Kenya. Climate change and natural resources conflicts Borana zone of southern Ethiopia. *Journal of the Environmental Management*.
- [9] Chinbinga, O, C, Musimba, N. R. K., Nyangito. M. M., Simbaya, Jand Daura, M. T. (2012). Climate variability; Enhancing Adapting Utilization of Browse Trees for Improved Livestock production among agro-pastoralist communities in the southern Zambia *African Journal Environmental Sciences and Technology*, 6 (7): 267-274.
- [10] Coppock, D. L., Gebru, G., Desta, S., Mesele, S. and Tezerra, S., 2008. Are cattle Critical analysis and evaluation. Third National Conference on Pastoralism and demographic surveillance system. *PLoS One*, 9 (9), pp. 106781.
- [11] Desalegn Yayeh Ayal, Radeny, M., Solomon Desta, and Getachew Gebru., 2018. Climate change and variability, perception of pastoralists and their adaptation strategies. *International Journal Climate change strategies and management*.
- [12] Devereux, S., 2006 *Vulnerable livelihood in Somali region, Ethiopia*. Brighton: Institute Development studies.
- [13] Doti, T., 2010. Climate variability, pastoralists' vulnerability and options. The case of the Borana of Northern Kenya climate change and natural resource conflicts in Africa *Monograph*, 170: 189-204.
- [14] Galgalo Dika, 2018. Impact of climate variability and household's adaptation strategies in lare district of Gambella region, south western Ethiopia. *Journal of Earth science and climatic change*, 9 (2): 7.
- [15] Gbetibouo, G. A., 2009. Understanding farmers' perceptions and adaptations to climate change and variability, Washington, DC: Intentional Food Policy Research Institute.
- [16] Getachew, K. N. 2001. Among the pastoral Afar in Ethiopia: Tradition, continuity and Highland and Lowland of Ethiopia: Implications to Adaptation Strategies.
- [17] IPCC (Inter-governmental Panel on Climate Change). 2n014b. Africa. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*.
- [18] Little, P. D. 2013. Reflections on the future of pastoralism in the Horn of Africa. *Livestock system and diseases in Borana zone. International Journal of M.*, 2015. Climate variability, adaptation strategies and food security.
- [19] Muluken Mekuyie Fenta, 2017. Understanding Resilience of Pastoralists to climate change variability in changing Rangeland Environment in Afar region, Ethiopia. (Doctoral of dissertation, University of the Free State, South Africa).
- [20] Nega Debela, McNeil, D., Bridle, K. and Mohammed, C., 2019. Perception of climate change and its impacts by smallholders in pastoral/agro-pastoral systems of Borana, Southern Ethiopia. *Springer plus*, 4 (1): 236.

- [21] Nega Debela, Mohammed, C., Bridle, K and McNeil, D., 2015. Adaptation to climate change and variability of pastoral and agro-pastoral systems of Borana, South Ethiopia. Option and barriers. American Journal of climate change, 8 (1): 40-60.
- [22] Okoti, M., Kung'u, J. and Obando, J., 2014. Impact of Climate Variability on Pastoral Households and Adaptation Strategies in Garissa County, Northern Kenya. Journal of human ecology, 45 (3): 243-249.
- [23] Smit, B., Burton, I., Klein, R. J. and Wandel, J. 2004. An anatomy of adaptation to climate Change and variability. Climatic Change, 45 (1): 223-251. Socioeconomic change. Utrecht, Netherlands: International Books.
- [24] The World Bank (2010). Costing Adaptation through Local Institution Village survey results a report-Ethiopia.
- [25] Temesgen Tadesse Deressa, Ringler, C Rashid M. Hassan., 2010. Detriments of Farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. Global Environmental Change 19: 248-255.
- [26] Temesgen Tadesse Deressa, Ringler, C Rashid M. Hassan., 2010. Factor affecting the choices of coping strategies for climate extremes. The case of farmers in the Nile Basin of Ethiopia IFPRI Discussion Paper, 1032.
- [27] UNFCCC (2012). United Nation Framework on Convection Climate Change; Retrieved November 13th, 2012 from www.unfccc.int/adaptation/items/2973.php
- [28] Yamane, T., 1967. Elementary sampling theory.
- [29] Zampaligre, N., Dossa, L., H. and Schlecht, E., 2014. Climate change and variability perception and adaptation strategies of pastoralists and agro- pastoralists across different zones of Burkina Faso. Regional Environmental Change, 14 (2): 769-783.