Ethiop. J. Agric. Sci. 31(3) 41-52 (2021)

Role of Pastoralists' Indigenous Knowledge in Drought Risk Reduction: Implications for Early Warning System and Adaptation Practices in Borana, Southern Ethiopia

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በኢትዮጵያ አርብቶ አደሮች አካባቢ በተደጋጋሚ ድርቅ ሲከሰት ይስተዋላል። ይህ ደግሞ ለአየር ጠባይ ለዉጥ ምክንያታዊ ከሚሆኑት ነገሮች ዉስጥ አንዱ መሆኑ ይታወቃል። ለሁለት አስርት ዓመታት በቦረና አርብቶ አደሮች አካባቢ ከነበሩት ሲጋቶች ከፍተኛዉ የድርቅ ሁኔታ ስለነበር በኢኮኖሚ እና በሰብዓዊ ጉዳዮች ላይ ትልቅ ሲጋት ፈጥሯል። በተለይ በኢትዮጵያ በቅርብ ጊዜያት ከሚስተዋሉት ከባድ የሆነ የድርቅ ሁኔታ በ2010ዓ.ም በቦረና አርብቶ አደሮች ላይ ደርሷል። በዚሁ ምክንያት በርካታ የሆኑ ከብቶቻቸዉ አልቀውባቸዋል፤ አገሪቱንም ለከፍተኛ ወጪ ዳርጓታል። ከዚህ በፊት የአየር ጠባይ ለዉጥ ሁኔታዎችን ለመቋቋም አስመልክቶ ብዙ ጥናቶች ቢደረጉም የአርብቶ አደሮች አገር በቀል የአየር ጠባይ ለዉጥን የመቋቋምያ ዕዉቀታቸዉ፤ በእከ ባቢ ሁኔታ፣ በህብረተሰብ፣ በኢኮኖሚ እና በተቋማዊ ሁኔታ ከብቶችን ከአንድ ቦታ ወደ ሌላኛዉ ቦታ በማንቀሳቀስ መጠበቅ እንዲሁም ብዙ ከብቶችን ከፋፍሎ በመጠበቅ ነው። ይህንኑ ሁኔታ በማገናዘብ ብዙ ጥናቶች ስላልተሰሩ ይሽ ጥናት እንዲሰራ ተደርጓል። የጥናቱ ዓላማ በደቡብ ኢትዮጵያ በቦረና ዞን የአርብቶ አደሮች አገር በቀል ዕዉቀት ፋይዳዉን መዳሰስ ነዉ። በአሁኑ ጊዜ በሚታዩዉ የድርቅ ሁኔታ እና የአየር ጠባይ ለዉጥ ለመቋቋም የሚያስችል የአካባቢዉ ህብረተሰብ ዕዉቀት፤ በማህበራዊ እና ኢኮኖሚያዊ ዙሪያ ጥናት ተካሂዷል። በዚህ ጥናት አካባቢዉን መወከል በሚችል ሁኔታ 352 አባወራዎች ተካተዋል። የቡድን ውይይት እና ከጥናቱ ሁኔታ ጋር ልምድ ያላቸዉ አባወራዎች ተዳርሷል። ጥናቱ ታስቦበት የተሰራ ከመሆኑ የተነሳ የተለያዩ የጥናት ዘዴዎችን በመጠቀም ጥራት እና ብዛት ያላቸዉ መረጃዎችን በመሰባሰብ ሳይንሳዊ በሆነ አኳን የጥናቱ ዉጤት ተተንትኗል። በቦረና አርብቶአደሮች አካባቢ ከፍተኛ የሆነ የአዬር ጠባይ ለዉጥ ከመኖሩ የተነሳ ከብቶችን ከአንድ ቦታ ወደ ሌላኛዉ ቦታ በማንቀሳቀስ እና ከፋፍሎ በመጠበቅ የድርቅና የአዬር ጠባይ ለዉጥ ሁኔታ መቋቋም ይኖርባቸዋል፣ አገር በቀል ዕዉቀታቸዉን ስራ ላይ እንዲያዉሉ ይመከራል።

Abstract

There is no doubt that the drought frequency, which is attributed to climate change and variability among other causes, is increasing in both severity and length in all pastoral areas of Ethiopia. It has been threatening pastoral societies of the Borana with increasing substantial economic losses and humanitarian suffering in the last two decades. We have a very recent shocking memory of the 2017 drought in the most pastoral areas of Ethiopia including Borana zone that resulted in deaths of thousands of livestock that turned thousands of people to be dependent on humanitarian aid; and then it forced the country to spend $billions on relief. Though numerous researches have been done on climate change adaptation practices, little study has been conducted concerning the role of indigenous knowledge of pastoral communities in climate change adaptation in specific ecological, social, economic, and institutional context and the current range of mobility, and stock diversification. In this case, our study aimed at investigating the role of Borana pastoralists' indigenous knowledge in drought risk reduction in southern Ethiopia. Multiple data sources, including socioeconomic interviews with 352 household heads, focus group discussions, and key informant interviews with pastoralists were used to capture various aspects of the current drought and drought adaptation and coping practices. The study utilizes multiple research designs and multistage random, purposive sampling methods. The

qualitative and quantitative data were analyzed and the findings indicated that mobility and stock diversity remain the most common method of coping with drought and is recommended that supporting the traditional coping mechanisms and promoting viable programs that support livestock and livelihoods due to the variability of their environment.

Keywords: Coping strategies, Drought risk reduction, Early Warning, Adaptation Practices, Mobility, Pastoral communities

Introduction

World Bank (2004) argued that pastoralism is the main production system in the driest land areas of Africa, where pastoral society dominantly are dwelling and where livestock production is an irreplaceable source of livelihoods. Ethiopia has the African's largest livestock population and over 60% of its land area is arid and semi-arid lowland, contributing more than 46% share of the agricultural sector in national GDP (UN PCI, 2007). However, nowadays, pastoralism has become the most challenged livelihood system and has been failing to support pastoralists sustainably due to different factors (Assefa, 1990) that resulted in the loss of livestock productivity, reduced capacity to sustain pastoralists' livelihoods, and increased risk and vulnerability to natural disasters (Nethononda *et al.*, 2013). Local communities can predict weather conditions using indigenous knowledge, as has been demonstrated in studies on climate change and livestock production (Mudzengi *et al.*, 2013).

Several gaps have been identified how the current early warning system is applied at the districts and zones community levels. The existing early warning system, for instance, mainly focuses on mitigation and relief, and less on adaptation (Gautum D.K. and Phaiju A.G, 2013). This might be a reason for Ethiopian pastoralists, especially Borana people who highly suffered from loss of human life and livestock when drought occurs; a shift towards a risk-based drought management approach offers opportunities to move away from loss of life and animals (ODPPB, 200). In addition, the current system mainly focuses on scientific information to monitor drought despite the presence of an accumulated knowledge among the pastoral communities in dealing with climate variability over the years. The recent 2017 drought resulted in severe damage to assets and exposed hundreds of thousands to famine and costs for relief. Although, numerous researches have been done on climate change adaptation practices, little study has been done on the role of indigenous knowledge of pastoral communities in climate change adaptation in specific ecological, social-economic and institutional contexts. This study was, therefore, conducted to bridge this knowledge gap with the main objective of exploring the indigenous knowledge on early warning systems and adaptation practices as a response to drought risk in Borana, southern Ethiopia.

General Objective

The main objective of the study was to explore the indigenous knowledge of early warning systems and adaptation practices as a response to drought risk.

Specific Objectives

- To identify how the pastoral households survive during drought in the study context
- To explore indigenous knowledge of coping strategies during drought in the study context
- To identify the potential areas where the existing drought risk reduction system can be integrated with pastoralists' indigenous systems.

Materials and Methods

Description of the Study Area

This study targeted the districts of Yabello, Dire, and Teltele of Borana zone, which have been purposively selected. These districts have been focused based on their mitigation of drought risks, and adaptation practices to climate changes, and their livestock ownership in Borana .

Research Design

Study site selection

The study was carried out in 2019/20 in the Borana pastoral area, which was highly characterized by long-term variability in the quantity and distribution of the rainfall and recurrent droughts. Average annual rainfall varies between 350mm and 900mm with a considerable variability of 21 to 68% (ODPPB, 2000).

The study participants

Sample size determination

For this study to select a representative sample, multi-stage sampling technique was implemented. In the first stage, the districts were selected purposively based on their indigenous knowledge potential in drought risk adaptation practices and livestock populations. In the second stage, with the help of pastoral devemopments Kebeles were selected from each using lottery methods. Accordingly the researcher drew nine representative Kebeles from the selected districts. Finally, from the selected Kebeles, sample households were selected randomly. However, the households' sizes were varied across the nine Kebeles; hence, Proportional to the Population Size (PPS) was used. In all the nine Kebeles, the household sample size was determined following the standard formula (Israel, 2012) below.

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

Where, n is the sample size, N is the total population of pastoralist households **(2,973)** and e is the margin of errors (error terms) at 5%. Accordingly, **352** household heads were selected.

Sampling Procedures

Among the thirteen (13) districts of the Borana zone, three of them, namely, Yabello, Dire, and Teltele districts were purposively selected based on their drought adaptation practices and livestock potentials. As such, multistage sampling techniques were employed. The three selected districts had 44 Kebeles, from which 23- were categorized under pure pastoralists with rich indigenously drought risk adaptation practices and large livestock population while the balance 21 Kebeles were agro-pastoralists. Consequently, nine Kebeles (Harowayu, Denbela Saden, Dikale, Medecho, Soda, Higo, Gandhile, Bule Korma, and Mekenisa) were randomly selected among the given pastoralists' Kebele. Sizes of the household heads were varied across the nine Kebeles. Because of its proportionate variation, Proportional to the Population Size (PPS) techniques was employed.

Data Collection Methods

The data collection process involved the operational procedures for both quantitative and qualitative approaches. The indigenous coping strategies were captured using primary data collection method. This was with the help of the household questionnaire, interview guides, key informants interviews, focus group discussions, and observation checklist as study instruments. A total of 54 household heads participated in a focus group discussion. Key informants like local elders, water point caretakers, social workers, community focal persons, community opinion leaders, women, and youth group leaders. Further, secondary data were reviewed from scientific and peer-reviewed journals from the internet and virtual libraries.

Method of Data Analysis

Descriptive statistics were used for all data gathered such as minimum, maximum, mean, mean differences, standard deviations, frequency, percentages, t-test, and chi-square test using Statistical Package for the Social Sciences (SPSS) version 24. The qualitative types of data were analyzed by using explanation, narration, and interpretation.

The operational definition of some variables

Age (AgeHH): It is a continuous variable. Respective to the age of households, the study also analyzed the relationship between old and young age regarding migration.

Education of household head (EDUCHH): It is a categorical variable that refers to when the household head's education increases, the ability to get and use information increases.

Allocation of pastoral rangelands for non-pastoral uses (APRFNPU): It refers to the cultivated land size and is a continuous variable that measured in terms of hectares. The expansion of cultivated farm size on the pastoral rangelands could have negative relationships with collective land management practices.

Availability and access to communal water points (AACWP): This categorical variable is hypothesized to have positive relationships with indigenous drought risk adaptation practices.

Ethical Considerations

The research permit was sought and obtained from the Bule Hora University Research Directorate Director. All study participants were respected, appreciated, and informed of their participation being voluntary with informed consent sought from all participants before this data collected. There was no citation of the participant's identity to ensure involvement and confidentiality.

Results and Discussion

Socio-economic Characteristics of Respondents

Age of the sampled households

The maximum and minimum ages of the respondents were 71 and 26 years for the elderly while the young aged groups were between 26 and 23. The mean age of the total sample respondents was 47.81 years. (Table 1). Regarding migration, the study also analyzed the age of households. Although experience is gained with age, the result showed the older generations were not mobile and rather involved in planning mobility, conflict resolution, and made a relationship among pastoral groups. The results of the t-test indicated that there is a statistically significant difference between the -old and young households with regard to mobility at 1% (t= -5.79, P= 0.000) significant level, and this finding was correspondent with the previous studies (Adugna B. *et al.*, 2013).

Table 1: Age and households involvement in mobility

Particulars	Respondents	n	Max.	Min.	Mean	St.dev	t- value	P-value
Age	Elders	271	71	49	54.72	11.33	-5.79	.000***
	young males	81	26	23	24.53	12.78		
	Total	352	71	23	42.97	13.24		

Note: *** 1% level of significance

Women's vulnerability to recurrent drought

This study acknowledged more men (291, 82.67%) were involved in herd mobility than women (61, 17.33%). This showed that the women had less access to information to early warning systems in times of disasters, and to forecasts of climate variability; and this implied that women would have more difficulties in the face of climate changes. Although mobility is an integral aspect to cope up with drought, early warning systems have been restricted to superstitious customs for women. Women are customarily responsible for domestic tasks. There is a statistically significant difference between the men and women in early warning conditions at 1% (t= 15.91, p= 0.000) significance, a correspondent with the reports of UNDP (2011) on pastoral women.

Table 2: Extent of access to early warning information between men & women

Particulars	Responses	n	percentage	Chi-Square	p-value
Access to early warning information	Men	291	82.67	15.91	.000***
	Women	61	17.33		
	Total	352	100		

Note: *** 1% level of significance
Source: Own survey data August 2019/2020

Marital status of the respondents

The greater (260, 73.86%) proportions of the respondents were married, whereas (56, 15.91%) were single and (8, 2.27%) were divorced. Widows (28; 7.96%) comprised a very vulnerable group and may be more susceptible to drought impacts (Table 3). This finding confirmed widow and resource-poor households were highly influenced by fluctuated conditions (Collins, J. M., 2011).

Table 3: Marital status of the respondents

Particulars	Responses	n	%age
Marital status	Married	260	73.86
	Single	56	15.91
	Divorced	8	2.27
	Widow	28	7.95
	Total	**352**	**100**

Source: Own survey data August 2019/2020

Educational status of the respondents

Among the respondents, (306, 86.93%) did not attend school at all, and more of the respondents were not having any basic education, of which (223, 72.87%) were women and (83, 27.13%) men. (31, 8.81%) of the respondents could read & write while (11, 3.12%) of them attended primary school, and (4, 1.14%) of the respondents had more than high school. (Table 4). Even though education is very important in developing a community that is resilient to drought impacts, the majority of the households were illiterate; particularly women regularly drop out of school, a correspondent with Nori. M. & Davies, J. (2006).

Table 4: Levels of education & the ability to recover from droughts risk

Particulars	Response	n	%	Chi- square	P-value
Levels of education & ability to recover	Illiterate	306	86.93	12.53	.000***
	Read and write	31	8.81		
	Elementary school (1-8)	11	3.12		
	High school & above	4	1.14		
	Total	352	100		

Note: *** 1% level of significance
Source: Own survey data August 2019/2020

Allocation of pastoral rangelands for non-pastoral uses

The minimum and maximum cultivated land in hectares for the sample respondent is 0 and 4 hectares, respectively. The mean cultivated farmland size of the total sample respondents in the study area is 1.83 hectares. The involvement of new patterns of land use including the gradual increments of cultivated farmland size indicated decrements of community lands and increasing competition over resources. The respondents recognize that the allocation of a vast area of rangeland for non-pastoral use and increase in the size of cropland was the major reason for the poor condition of the rangeland, which was correspondent with UN PCI (2007).

Drought resilience and risk reduction

The results indicated that the majority of respondents (227, 64.48%) relied on indigenous knowledge in their pastoralism production and drought risk reduction practices. This finding showed the use of indigenous knowledge is still an integral part of most Borana pastoral communities and pastoralism. Two-third (235, 66.76%) of the respondents also revealed that indigenous knowledge contributed to the flexibility of pastoralists towards drought risks. More respondents indicated this indigenous knowledge 'is wealth and equips them to prepare well for drought' exposure. They also confirmed that indigenous knowledge is very significant for pastoralists with limited formal education. The use of indigenous knowledge was relevant to the Borana pastoral community, especially for households who were illiterate (306, 86.93%) and hence could not access information.

Early warning practices and weather forecasting

The early warning is prevention of the potential harm or loss before the arrival of the hazards. The result revealed that (274, 77.84%) of the respondents acknowledged the existing early warning systems failed due to the lack of community awareness and participation in response to the operations, just (78, 22.16%) of them admitted the existing system. More households' dictated, in Borana people weather forecasting and interpreting was observed based on experiences using contributions of animals, natural resources, and insects than technology indicators. The respondents, especially the elders predict the droughts occurrence based on the climate variability, which helps them in reducing consequent risks. The study also showed meteorological early warning system operations were more directed to agencies than people who were threatened with the hazards. (Table 5). The extent of community participation was unclear and not acknowledged the ownership upon early warning system in reducing their vulnerability to drought risks, consistent with Wilfred L. & Charles M. (2016).

Table 5: Early warning practices of the respondents

Particulars	Responses	n	%age
Early warning access	Meteorological access	78	22.16
	Indigenous practices	274	77.84
	Total	352	100

Source: Own survey data August 2019/2020

Availability and access to water points

The result showed 288 (81.82%) of the households of Borana received water for their livestock and the greater part of the population use water from traditional hand-dug wells, while others also get water from ponds or '*Haro*' (43; 12.21%), donors and government bring (4; 1.13%), underground water (11; 3.12%), motorized deep wells (4; 1.13%), and *Siminto* (harvested water during rainy season (2; 0.59%) (Table 6). The production of forage and availability of water has been directly related to the amount and duration of rainfall. Although livestock production for pastoralists' existences is highly dependent on forage and water availability, water sources are frequently inaccessible to the herds, and pastoralists and households were forced to depend on the traditional well at (288, 81.82%) in the study area. In dryland areas, the availability of forage and water is highly variable in time and spaces, the findings correspond with previous report (Kamara, 2008).

Table 6: Access of the respondents to the water points

Particulars	Responses	n	%
Access to water points	Traditional wells(*'tuulaa'*)	288	81.82
	Ponds(*haroo*)	43	12.21
	Donors approaching	4	1.13
	Underground water	11	3.12
	Motorized deep wells	4	1.13
	Harvested water	2	0.59
	Total	352	100

Source: Own survey data August 2019/2020

Pastoralists' drought coping mechanisms

In the study area, (256, 77.72%) of the population identified mobility as their main coping strategy followed by increasing the stock densities by rearing herds that are dominated by females (47, 13.35%); splitting animals at (32, 9.1%); accessing livestock extension services for knowledge of livestock farming during droughts at (6, 1.71%) and finally using the saving kept to buy grass from the government reduced prices (4, 1.14%) and sending family members away to relatives (7, 1.98%). Although the indigenous drought coping strategies and a disaster risk reduction was critical in determining the resiliency of a community to hazards, currently the strategies has become incapable to reduce hazards, which is consistent with Ndikumana *et al.* (2000) (Table 7).

Table 7: Drought coping mechanism of the households

Particulars	Responses	n	%
Drought coping mechanisms	Mobility	256	72.72
	Increasing female sock density	47	13.35
	Splitting animals	32	9.1
	Livestock extension services	6	1.71
	Buying grasses with discount	4	1.14
	Sending family members to relatives and mutual assistance system	7	1.98
	Total	352	100

Source: Own survey data August 2019/2020

Weakness and Strength of the study

Given the time and the objectives of the research, fragility of the study location, and unpredictability of the environment, it was not possible to handle more case studies because Borana pastoralists were very mobile from one place to another to adapt to temporal and spatial resource dynamics during the research. As long as the study was aimed to investigate the role of Borana pastoralists' indigenous knowledge of early warning and adaptation practices as a response to drought risk and climate change; the research mainly focused on the socio-economic aspects of the households, their indigenous knowledge of coping mechanisms and how the pastoralists survive within repeated drought risks.

Conclusions and Recommendations

Conclusions

In traditional society, the increased knowledge of indigenous drought risk adaptation practices and the more the households' aged long, the more they were dependent on indigenous knowledge of weather forecasting and suggesting livestock mobility to reduce the impact of disasters and difficulty in accessing the scattered rangeland resources that hindered their livestock production. Women are more vulnerable to climate disasters; especially the widows (28, 7.95%) comprised a very vulnerable group and more susceptible to drought impacts.
In the study area, more of the respondents (306, 86.93%) have no education at all, more of them were illiterate. The more the households' illiteracy level increases, the more it is associated with marginalization and poverty, or the more the households' education level increases, the more their ability to recover from risk increases. The more the overall problems of land use changes over communal rangelands the more the degrees of the harshness of feed shortages.

The study findings revealed that the existing early warning system includes less indigenous early warning systems of the pastoral community. Despite the households cope with drought risks by utilizing the indigenous drought coping strategies, the existing early warning system was not relying on the participation of those most likely to be at risk.

Recommendations

- In the study context, there was a high illiteracy level of (306, 86.93%); so, the government should give due attention to access to education and training by advocating and improving infrastructures and their socio-economic related problems.
- In the launching of new land-use patterns, it should necessitate and keep especial supports for the customary institutions, which contribute to ecosystem management, which has the potential to reverse aspects of climate and environmental change, and benefits of the new land use should be shared among the pastoral groups to protect them from the drought risks.
- Ensuring and promoting community ownership in managing of own drought-related problems. The livestock extension services provision, conservation sites, buying and preserving hay, dry land ecosystem restoration, and water conservation structures in arid and semi-arid lands of the zone were suggested.
- As an effort of responding to these problems, a well-structured and organized early warning system (EWS) to the indigenous knowledge of the community is crucial to build the adaptive capacity of pastoralists through the provision of timely and effective information to reduce risks and prepare them for effective responses.

Acknowledgments

Above all and forever, my blessing goes to the almighty God, who gave me all the endurance and everything I ever asked to keep me on track. Special thank goes to Bule Hora University for funding this research. Last but not least, my expressed gratitude to all the stakeholders who contributed extra efforts to this research.

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