

HUMAN CRUELTY TO THE ENVIRONMENT:

INDIGENOUS KNOWLEDGE FOR CLIMATE CHANGE PREDICTION AND
ADAPTATION AMONG PASTORALISTS IN DHAGAXBUUR DISTRICT OF
THE SOMALI REGION, ETHIOPIA

Tesfamichael Teshale



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EXECUTIVE SUMMARY

This paper explores how indigenous climate change prediction mechanisms help climate change adaptation among Somali pastoralists in Dhagaxbuur district of the Somali Region, Ethiopia. The paper analyses perceptions, indigenous knowledge of prediction and adaptation strategies of Somali pastoral communities in the context of climate change. A qualitative approach and a phenomenological research design were employed to collect data from both primary and secondary sources. The results reveal that pastoral communities recognize the trends of climate variability and its impacts on their livelihoods. Somali pastoralists traditionally predict the weather and climate variation through the observation of various biophysical entities, including livestock, insects, birds, plants and stars. Due to the impact of climate change and climate variability, pastoral communities have been practising various types of indigenous coping and adaptation strategies. This paper argues that there is a need to formulate and implement policies and strategies that incorporate indigenous knowledge related to climate change prediction and adaptation. Understanding pastoralists' perspectives of climate change and their indigenous knowledge of its effects might provide critical input for climate change adaptation policies and pastoral development interventions.

INTRODUCTION

According to the most recent report of the Intergovernmental Panel on Climate Change (IPCC), issued in 2022, climate change increases risks to individuals and societies, potentially affecting poverty. As the IPCC report emphasizes, the growing frequency and intensity of severe weather events increases the risks of larger and more frequent shocks and disasters to people, communities and societies.¹

Ethiopia is among the countries most vulnerable to climate change, due to its dependence on rainfed agriculture and natural resources. It has repeatedly suffered extreme events, such as drought and floods, as well as variability in rainfall and rising temperatures, all of which have a negative impact on livelihoods. Temperatures in Ethiopia have increased by an average of 1°C since the 1960s, at about a rate of 0.25°C per decade. The warming of the sea surface temperature of the Indian Ocean influences the migration of the Inter-Tropical Convergence Zone (ITCZ), which can increase the degree of variability in the time and duration of rainfall seasons, disrupting traditional rainfall patterns and leading to more frequent droughts.² Climate change is already having a severe influence on livelihoods, and this trend is expected to continue, with drought as Ethiopia's single most damaging climate-related natural hazard

Climate change could affect Ethiopia's Gross Domestic Product (GDP) by up to 10 per cent by 2045. This will be mainly the effect of drought on agricultural productivity. Yearly weather variability and weather extremes have a huge effect on economic indicators: Recent droughts have reduced the country's GDP by 1 per cent, and rain-induced soil degradation is projected to decrease GDP by another 1 per cent.³

The Somali regional state in Ethiopia is considered the country's high-potential livestock resource area. Pastoralism is the dominant and essential practice, followed by limited mixed agriculture.⁴ Ethiopia's Somali region is one of the regions worst affected by recurring drought and food security problems. Droughts and the catastrophes they cause have increased

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- 1 Intergovernmental Panel on Climate Change, 'Climate Change 2022: Impacts, Adaptation and Vulnerability', Report, 2022. Accessed 27 November 2023, <https://www.ipcc.ch/report/ar6/wg2/downloads/>.
 - 2 World Bank Group, 'Climate Risk Profile: Ethiopia', Washington DC: World Bank Group, 2021. Accessed 21 October 2023, https://climateknowledgeportal.worldbank.org/sites/default/files/2021-05/15463A-WB_Ethiopia%20Country%20Profile-WEB.pdf.
 - 3 World Bank, 'Climate Risk Profile: Ethiopia'.
 - 4 Malede Birhan, 'Livestock resource potential and constraints in Somali Regional State, Ethiopia', *Global Veterinaria* 10/4 (2013): 432-438.

considerably in the pastoral areas of the Somali region during the last four decades. The following years were designated as drought years: 1999, 2000, 2003, 2004, 2007, 2008 and 2015/2016. Food insecurity affects between 1.2 and 1.7 million people in the region. The rainy season mainly failed in 2016 and 2017, and the zone received less than its long-term average cumulative seasonal precipitation.⁵ Drought returned in 2018 and 2019. Its recurrence has degraded ecology and eroded and jeopardized the livelihood assets of Ethiopian pastoralists in general, particularly in the Somali region's Dhagaxbuur district.

As of the end of 2022, the Horn of Africa was enduring one of its longest and most severe droughts. Drought and the high cost of food had curtailed many people's ability to cultivate crops, produce livestock and purchase food. The worst drought in four decades aggravated the situation, affecting 24.1 million people in Ethiopia, 12.6 million of them children. In the Somali region, this drought affected all the *woredas* (districts) and displacing about 31,894 households (HHs).⁶

Dhagaxbuur is one of the *woredas* affected by droughts; an increase in their frequency and magnitude has either completely or partially eroded the livelihood base of thousands of pastoralists through the loss of livestock assets. It has exposed their families to the risk of food insecurity, resulting in the emergence of a large number of internally displaced persons (IDPs) in the district.⁷

Unlike in the past, we have seen an increase in policy attention to pastoralists. Understanding pastoralists' perspectives of climate change, their indigenous prediction mechanisms—as well as their adaptation and coping mechanisms—might prove itself to be critical input for adaptation policy and pastoral development interventions. Local knowledge and local perceptions of climate change, as well as the types of indigenous techniques deployed in a locally specific situation, have rarely gained scholarly attention, however. In general, studies on climate change variability and coping and adaption techniques in Africa have lacked local specificity.⁸ Understanding indigenous adaptation techniques at the micro-level is thus an important phenomenon.⁹ Furthermore, knowing people's perceptions and knowledge of climate change is critical for informing policy decisions aimed at promoting successful adaptation measures.

5 Disaster Prevention and Preparedness Bureau, 'Somali Region dayr Seasonal need assessment report', 2016.

6 Abduselam Abdulahi Mohamed, Bishar Ahmed and Karthika Palanisamy, 'Perceptual Differences on Drought Occurrence and Resilience Building Mechanisms in Kebri Dehar District, Somali Region of Ethiopia', *International Journal of Professional Business Review* 8/7 (2023): 45.

7 Abdihalim Ahmed, 'Magnitude and Determinants of Pastoral Households Food Insecurity: The Case of Degahbour District of Somali Regional State, Ethiopia,' MSc Thesis, Haramaya University, Haramaya, 2017.

8 Amos Apraku, John Morton and Benjamin Apraku Gyampoh, 'Climate change and small-scale agriculture in Africa: Does indigenous knowledge matter? Insights from Kenya and South Africa', *Scientific African* 12 (2021): 1-13.

9 Anthony Nyong, Francis Adesina and Balgis Osman Elasha, 'The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel', *Mitigation and Adaptation Strategies for Global Change* 12 (2007): 787-797.

As a result, this paper analyses existing local knowledge on climate change predictions among Somali pastoralists in Dhagaxbuur district of the Somali Region, Ethiopia, and how it is used in adaptation to climate change.

Indigenous knowledge is relational or place-based knowledge that informs the day-to-day decision-making of communities. Indigenous knowledge includes the wisdom, techniques, approaches, skills, practices, philosophies and uniqueness of knowledge within a given culture, which is developed by local communities over the years through the accumulation of experiences and informal experiments, and which is based on an intimate understanding of local contexts.¹⁰ Indigenous knowledge is used in climate or weather prediction, helping people to make decisions in their daily activities. The World Intellectual Property Organisation (WIPO) defines indigenous knowledge as 'knowledge, know-how, skills, and practices that are developed, sustained, and passed on from generation to generation within a community, often forming part of its cultural or spiritual identity.'¹¹ They are tailored to a given location with a specific community and are dynamic in nature, despite claims that they are static and inferior.

The growing concerns related to climate change emphasize the need for research that will contribute more effectively to climate action. Modern scientific understanding remains insufficient to modify climate policies and manage the entire range of climate change impacts, particularly for the most vulnerable.¹² As a result, there is a growing need to deploy indigenous knowledge to bridge this climate response gap. Across Africa, indigenous knowledge has been disrupted by colonial education and missionary activity, as well as a general view that indigenous knowledge is antiquated and unfavourably juxtaposed with scientific knowledge. These factors have hampered the transmission of indigenous knowledge across generations. When awareness and attitudes are examined, there is a lack of systematic and effective transfer, dissemination and recording of knowledge and skills throughout Africa.¹³ The influence of monolithic religion and modern education has produced further disturbance and dislocation, labelling indigenous forecast experts as witches and traditional activities as being against God's act. Along with evolving educational standards, there has been a lack of recognition and support for the potential value of indigenous knowledge from policymakers, practitioners and the scientific community.¹⁴

10 Intergovernmental Panel on Climate Change, 'Special Report on Climate Change and Land', Summary for Policymakers, 2019. Accessed 16 September 2023, <https://www.ipcc.ch/srcl/>.

11 'Genetic Resources, Traditional Knowledge and Traditional Cultural Expressions,' World Intellectual Property Organization. Accessed 16 September 2023, <https://www.wipo.int/tk/en/>

12 Paramo. L. Mafongoya and Oluyede Clifford Ajayi, 'Indigenous knowledge systems and climate change management in Africa', Report, The Technical Center for Agriculture and Rural Cooperation, 2017. Accessed 23 September 2023, <https://cgspace.cgiar.org/server/api/core/bitstreams/ebbde06-ca2e-41b6-9492-819e7fc08513/content>

13 Chinwe Ifejika Speranza et.al., 'Indigenous knowledge related to climate variability and change: insights from droughts in semi-arid areas of former Makueni District, Kenya', *Climatic change* 100/2 (2010): 295-315.

14 Munyaradzi Mawere, 'Indigenous knowledge and public education in sub-Saharan Africa', *Africa Spectrum* 50/2 (2015): 57-71.

Nonetheless, many communities, particularly in rural regions, trust indigenous forecasts more than modern scientific forecast systems.¹⁵ Indigenous weather and climate prediction systems have played an astonishing role in resolving the diverse implications of climate change in Africa and are frequently recognised as a vital resource for adaptation and mitigation.¹⁶ Indigenous knowledge, according to Swart et al.,¹⁷ has been identified as a viable option for the prediction and adaptation of climate change. As a result, incorporating indigenous knowledge into climate change policy can lead to the creation of cost-effective, inclusive and long-term mitigation and adaptation solutions. This is achieved most effectively when indigenous knowledge complements rather than competes with scientific knowledge systems.¹⁸ Building on the region's indigenous knowledge systems provides outstanding opportunities for the efficient integration of mitigation and adaptation measures. In light of the relevance of local knowledge and institutions in Ethiopia, it is worthwhile investigating indigenous knowledge to achieve long-term adaptation to the effects of climate change.

In general, the studies focused on pastoral communities' indigenous and local climate change prediction and adaptation techniques are insufficient for the Somali Region as a whole. There has been little research¹⁹ conducted in pastoral and agro-pastoral communities. Authors have emphasized the need for additional research at the local level. Understanding the status of climate variability and pastoralist adaptation techniques at the local level is crucial for introducing practical and acceptable adaptation choices to develop a climate-resilient pastoral community. As a result, the objective of this research was to analyse existing local knowledge on climate change predictions and how that is used in adaptation to climate change by Somali pastoralists in Dhagaxbuur district of the Somali Region, Ethiopia.

After this introduction, the paper turns to a discussion of the research methodology, including the research approach and the fieldwork process. This is followed by a discussion of the main results, including the perception of climate change by pastoralists in the local context, the importance of indigenous knowledge in the prediction of local climate change, indigenous

15 Mawere, 'Indigenous knowledge and public education'.

16 Walter Leal et al., 'The role of indigenous knowledge in climate change adaptation in Africa', *Environmental Science & Policy* 136 (2022): 250-260.

17 Rob Swart, John Robinson and Stewart Cohen, 'Climate change and sustainable development: Expanding the options', *Climate policy* 3/1 (2003): S19-S40.

18 Nyong, Adesina and Elasha, 'The value of indigenous knowledge in climate change mitigation and adaptation.'

19 Tigist Abrham and Muluken Mekuyie, 'Effects of climate change on pastoral households in the Harshin District of the Somali Region, Ethiopia', *Jamba: Journal of Disaster Risk Studies* 14/1 (2022): 1-10; Partha Sarathi, Abdurehman Mektel Weli and Ayanle Igge, 'Changing Climate-Climatic Whimsies and Its Effect on Sedentarisation Process and Livelihood of Pastoral community at Jigjiga Woreda, Somali Region, Ethiopia,' *Natural volatiles and Essential Oils* 8/5 (2021): 10787-10804; Latamo Lameso, Baykedagn Taye Shenkut and Abdurahman Husein Abdilahi, 'Drought characteristics and pastoralists' response strategies in Korahay zone, Somali regional state, Eastern Ethiopia', *Scientific African* 16 (2022): 1-12; Abebaw Shimeles, Mohamed Badel Ali and Keder Kemal, 'Climate variability and agro-pastoral adaptation strategies to climate change in Somali region of Ethiopia. The case of Kebribayah district', *Ethiopian Journal of Environmental Studies & Management* 13/2(2020): 176-188.

knowledge, and the response of local adaptation to climate change. Different types of climate change prediction and adaptation are revealed. The final section, the conclusion, turns to a discussion of the implications of indigenous knowledge in the prediction and adaptation of climate change.

RESEARCH METHODOLOGY

This study was carried out in Dhagaxbuur district in the Somali region of southeast Ethiopia (Fig.1). The Somali Region is geographically located in the south-eastern part of Ethiopia, between 4 ° and 11 ° N latitude and 40 ° and 48 ° E longitude. It is the second largest region in Ethiopia, following Oromia.

The climate is arid and semi-arid, with average annual rainfall ranging from 200–700 mm. Dhagaxbuur district is located in the Jarar zone of the Somali regional state. The district is bound to the north by Ararso district, to the south by Birqod, to the south-east by Gunagodo, to the east by Yoale, to the north-east by Aware, and to the south-west by Dhagahmadow. Dhagaxbuur town, the administrative centre, is located at a distance of 170 km from the regional capital Jijjiga and 790 km from Ethiopia's national capital, Addis Ababa. The district has a total of 17 pastoral administrative *kebeles* (the lowest administrative level in Ethiopia). In discussion with local administration, two *kebeles*, Higolaley and Garawo, were randomly selected from villages in the district.

Due to the minimal amount of rainfall received through biannual rainfall cycles (300–400 mm per year), the district generally has a moisture deficit. The mean maximum and lowest temperatures of the area are 34.40°C and 16.60°C, respectively.²⁰

A qualitative research approach was used to address the desired objectives of the study. The qualitative researcher often provides readers with a realistic, contextual picture of some aspect of life, which can have greater meaning.²¹ Additionally, the study employed a phenomenological research design. Phenomenology provides an important tool of study to understand how locals, as 'insiders', learn to know reality. The purpose of phenomenological research is to understand the meaning that the particular topic of the study has for the study participant. The emphasis is on the insights of the individual participant, which is often referred to as the lived experience. Thinking about the actual subject of our study, that is, individuals' lived experiences, is an important part of phenomenological qualitative research.²² The idea is to delve deep to comprehend the implicit meaning. This research approach allowed the researcher to understand the indigenous knowledge and practices the community learned from their lived experiences regarding climate change forecasting and adaptation.

20 Ahmed, 'Magnitude and Determinants of Pastoral Households Food Insecurity', 22.

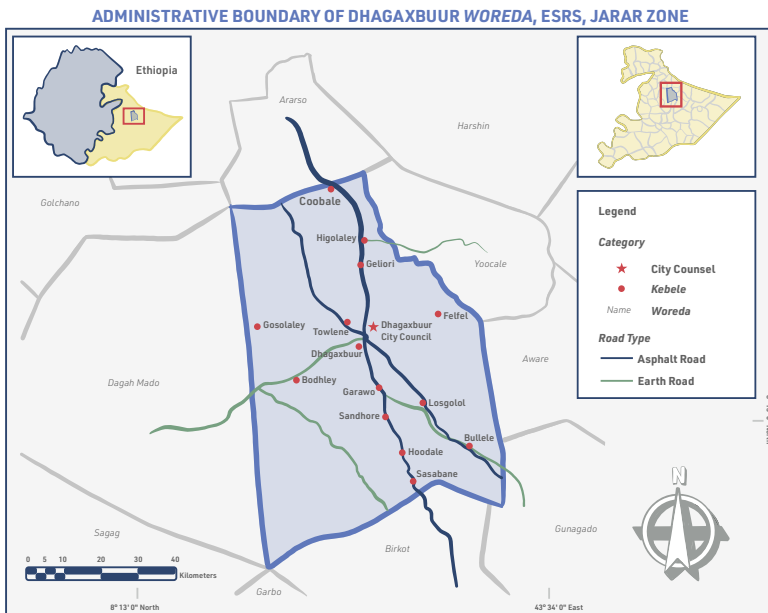
21 Joan Dodgson, 'About research: Qualitative methodologies', *Journal of Human Lactation* 33/2 (2017): 355-358.

22 Ahmed Ali Alzhami and Angelica Kaufmann, 'Phenomenological qualitative methods applied to the analysis of cross-cultural experience in novel educational social contexts', *Frontiers in Psychology* 13 (2022): 1-22.

Field data collection took place from October to November 2023 in Dhagaxbuur district. In-depth insight data were collected through Focus Group Discussions (FGD), oral history interviews and Key Informant Interviews (KIIs) to analyse information on indigenous climate change prediction and adaptation mechanisms. With the help of a local guide, 21 respondents were purposefully chosen for key informant and oral history interviews. Most of them were knowledgeable clan elders, community leaders, elderly women, herders, and local pastoral and agricultural office personnel. Two FGDs were carried out with a group of six to eight pastoralists in two *kebeles*, one with a group of men and the other with a group of women. Participants were chosen based on their experience with traditional/indigenous weather forecasting. The FGDs were planned with consideration of how pastoralists use indigenous knowledge to predict and adapt to climate change. The discussions were carried out in the native Somali language and recorded for later translation into English.

Qualitative data collected from interviews, FGDs and secondary sources, were organised and evaluated in light of the research objectives. The data obtained were analysed, using thematic analysis.²³

FIGURE 1: LOCATION OF THE STUDY AREA



Source: Somali Region Bureau of Finance and Economic Development, 2015.

23 Victoria Clarke and Virginia Braun, *Successful qualitative research: A practical guide for beginners*, Los Angeles, London and New Delhi: Sage Publications, 2013.

PASTORALIST'S PERCEPTION OF CLIMATE CHANGES IN THE LOCAL CONTEXT

As Ethiopia's Somali Region is arid, Somali pastoralists are among the communities most vulnerable to the effects of climate change. This section presents the perceptions of Somali pastoralists about climate change in the local context of Dhagaxbuur district.

AWARENESS OF CLIMATE CHANGE

When asked if they were aware of climate change taking place in their locality, almost all the study participants demonstrated an understanding of the changes taking place in their surroundings. They linked the changes with a variety of phenomena, including prolonged drought, irregular rainfall patterns, changes in vegetation cover and higher temperature fluctuations. According to FGD participants,²⁴ these changes had considerable influence on their traditional way of life, damaging their livestock and livelihoods. As an illustration, one participant responded to the question, 'How do you know the climate in your area is changing?' as follows:

I know the climate is changing because I can see and feel it. The main indicator is rainfall. It has become very erratic and unpredictable. Sometimes it rains too much, sometimes it rains too little, and sometimes it does not rain at all. The rainy seasons have also changed and shortened. This affects the availability and quality of water and pastures for our livestock. The impact is that our livestock become weak, sick, or die. This reduces our income and food security.²⁵

Many interviewees in the study area are believed to have experienced climate change over the last three decades (1992–2022). Study participants reported they saw changes in temperature and rainfall, mostly in the weather patterns; greater temperatures, below normal rainfall and short rainy seasons that resulted in drought and its increased frequency, and they saw greater intensity of extreme weather. Similar statements of perceptions about climate change by

24 FGD participants, Dhagaxbuur, 23 October and 8 November 2023

25 Interview with elder, Dhagaxbuur, 29 October 2023.

pastoralists in Ethiopia have been observed in other studies conducted in the same period.²⁶

Most informants said there had been significant volatility and change in climate variables. Many reported a decrease in precipitation. According to interviewees,²⁷ climate unpredictability—and its terrible consequences—are the product of ‘human cruelty to the environment’. Put another way, they see the phenomena as God’s punishment for irresponsible human action.

Pastoralists’ perception of climate change, in the local context, and trends they perceive in temperature, rainfall, vegetation cover and the occurrence of drought, are discussed below.

PERCEIVED TRENDS OF TEMPERATURE

Most of the study participants stated that temperatures have been rising over the years. They noted that the hot season is becoming longer and hotter, while the cold season is becoming shorter. They have also noticed that there are more hot days than usual, which has a severe impact on their livestock. Other research²⁸ indicates that most Ethiopian pastoralists and agro-pastoralists are aware that temperatures are increasing; the results of other studies have similarly demonstrated temperature changes, such as an increase in maximum, minimum and mean temperatures in the last three decades.²⁹

Participants in FGDs and interviews noted livestock were sensitive to temperature changes and that high temperatures can cause heat stress, which can be lethal to animals. Due to the hot heat, Somali pastoralists have noticed their animals becoming more prone to disease, and that their animals are losing weight from lack of pasture, itself a factor worsened by the hot weather.

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- 26 Abrham and Muluken, ‘Effects of climate change on pastoral households’; Karuturi Venkata Suryabagavan, ‘GIS-based climate variability and drought characterization in Ethiopia over three decades’, *Weather and climate extremes* 15 (2017): 11–23; Nega Debela et al., ‘Perception of climate change and its impact by smallholders in pastoral/agropastoral systems of Borana, South Ethiopia’, *Springer Plus* 4/1 (2015): 1–12; Muluken Mekuyie, Andries Jordaan and Yoseph Melka, ‘Understanding resilience of pastoralists to climate change and variability in the Southern Afar Region, Ethiopia’, *Climate Risk Management* 20 (2018): 64–77; Birhanu Iticha and Abdulaziz Husen, ‘Adaptation to climate change using indigenous weather forecasting systems in Borana pastoralists of southern Ethiopia’, *Climate and Development* 11/7 (2019): 1–10.
- 27 Interview with elder, Dhagaxbuur, 24 October 2023.
- 28 Mulubrhan Balehegn et al., ‘Indigenous weather and climate forecasting knowledge among Afar pastoralists of north eastern Ethiopia: Role in adaptation to weather and climate variability’, *Pastoralism* 9/1 (2019): 1–14; Tesfaye Dejene et al., ‘Temporal climate conditions and spatial drought patterns across rangelands in pastoral areas of West Guji and Borana zones, Southern Ethiopia’, *Pastoralism* 13/1 (2023): 18; Alefu Chinasho, Dalga Yaya and Samuel Tessema, ‘The adaptation and mitigation strategies for climate change in pastoral communities of Ethiopia’, *American Journal of Environmental Protection* 6/3 (2017): 69.
- 29 Suryabagavan, ‘GIS-based climate variability and drought characterization’; Asaminew Teshome and Jie Zhang, ‘Increase of extreme drought over Ethiopia under climate warming’, *Advances in Meteorology* (2019): 1–18.

PERCEIVED RAINFALL TRENDS

Understanding how pastoralists perceive changes in temperature and rainfall is crucial to identifying locally available climate variability and adaptation strategies. Most of the interviewees and FGD³⁰ participants agreed that the amount, timing and distribution of rainfall in the study area had changed and fluctuated over the past three decades. The duration of the rainy season had also changed: Study participants reported a decrease in the frequency of rainy seasons, with late beginning and early cessation. They have observed that the rainy season is getting shorter and that droughts are becoming more frequent. They have also noticed that when it rains, it is either too much or too little, which negatively impacts their livestock.

There are four seasons in the region and the rainy seasons are locally termed as *Gu* and *Deyr*. *Gu* occurs from April to June in Dhagaxbuur district, and contributes the most to annual rainfall. *Deyr*, which occurs from October to December, is the second rainy season. These rainy seasons are critical to pastoralists' capacity to look after their families because they restore grassland and water sources, allowing animals to survive the dry season, which lasts from December to April. Somali pastoralists rely on grasslands to provide grazing places for their animals throughout the wet season. Due to changes in rainfall patterns, however, grasslands do not develop as well as they once did, resulting in a shortage of pasture. The lack of grazing pasture has resulted in a decrease in animal productivity, which has severely affected pastoralist livelihoods. According to interviewees,³¹ recent delays and the unannounced beginning and ends of rainfall are common in the area. Rainfall was lowest during the *Deyr* season, they said, which begins in October and ends in December.

Additionally, FGD participants³² indicated inconsistent seasonal rainfall distribution. This volatility in rainfall could have major consequences for pastoralist livelihoods. Several studies undertaken in Ethiopia have reported similar results.³³ Participants in the focus groups agreed that the variability of interannual rainfall in recent decades was significant and that the onset and duration of the rainy season had become unpredictable, making pastoral activities more difficult to plan and exacerbating the area's already acute feed and water shortages. Studies³⁴ have documented an extremely erratic distribution of seasonal and annual rainfall in the southern Afar region, supporting the current finding.

30 Interviews with elders, Dhagaxbuur, 23-29 October 2023; Participant in a focus group with women, Dhagaxbuur, 8 November 2023.

31 Interviews with elders, Dhagaxbuur, 23-29 October 2023.

32 Participants in a focus group with male members, Dhagaxbuur, 7 November 2023.

33 Debela Nega et.al, 'Adaptation to climate change in the pastoral and agropastoral systems of Borana, South Ethiopia: Options and barriers', *American Journal of Climate Change* 8/1 (2019): 40-60.

34 Shimeles, Ali and Kemal, 'Climate variability and agro-pastoral adaptation strategies'; Melka Yoseph, Muluken Fenta and Andries Jordaan, 'Vulnerability of Southern Afar pastoralists to climate variability and change, Ethiopia', *Jāmbá: Journal of Disaster Risk Studies* 11/1 (2019): 1-8.

PERCEPTION OF PASTORALISTS ON DROUGHT OCCURRENCE

Droughts have affected the district and the region as a whole at various periods throughout history, and it is not an uncommon occurrence for pastoral populations. Drought is a climatic condition that occurs regularly in the pastoral area.³⁵ But, according to key informants and pastoral and agro-pastoral experts in Dhagaxbuur district,³⁶ the intensity and frequency of droughts have more than increased in recent years. Therefore, drought has had a negative impact on the pastoralist production system, altering income sources, trade and value chains, social structure networks and valued norms, ecosystem and natural resources, and overall cattle production and by-products. Studies³⁷ have shown that drought has a considerable impact on the lowland cattle production system. Their findings demonstrate that animal population and output decreased considerably during drought.

Most interviewees believed that the incidence of drought had increased in the study area during the last three decades. Droughts were reported to occur every three to five years by the majority of interviewees. Nonetheless, a few respondents said drought had recently occurred every one to two years. Drought has an increasingly detrimental influence on the livelihoods of pastoral and agro-pastoral people in eastern Ethiopia, as similar studies note.³⁸ Likewise, most FGD participants and interviewees³⁹ asked about the occurrence of drought over the past three decades in the study area indicated that a high frequency of drought had been experienced in recent years, such as was not previously known, and that it has had a negative impact on the livelihoods of pastoralists in the study area.

PERCEIVED IMPACTS ON LIVELIHOODS

The pastoralists identified adverse impacts of climate change on their livelihoods. Temperature variations, rainfall patterns, vegetation cover and periodic drought have had a negative influence on Somali pastoralists in Dhagaxbuur district. The following are some of their perceived impacts of climate change:

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- 35 Girma Asefa Bogale and Zelalem Bekeko Erena, 'Drought vulnerability and impacts of climate change on livestock production and productivity in different agro-Ecological zones of Ethiopia', *Journal of Applied Animal Research* 50/1 (2022): 471-489.
 - 36 Interview with elders, Dhagaxbuur, 25 October 2023; Interview with district pastoral and agro-pastoral expert, Dhagaxbuur, 31 October 2023.
 - 37 Matiwas Habte et al., 'Effects of climate variability on livestock productivity and pastoralists perception: The case of drought resilience in Southeastern Ethiopia', *Veterinary and Animal Science* 16 (2022): 1-15.
 - 38 Wassie Berhanu and Fekadu Beyene, 'The impact of climate change on pastoral production systems: A study of climate variability and household adaptation strategies in southern Ethiopian rangelands', WIDER Working Paper 2014/028, UNU-WIDER, 2014. Accessed 22 October 2023, <https://doi.org/10.35188/UNU-WIDER/2014/749-3>; Lelamo, Shenkut and Abdilahi, 'Drought characteristics and pastoralists' response strategies.'
 - 39 Interview with elders, Dhagaxbuur, 23-29 October 2023; Participant in a focus group discussion with women, Dhagaxbuur, 8 November 2023.

Livestock Mortality: Interviewees⁴⁰ began by highlighting the loss in the availability and quality of pastureland. Temperature rises and changes in rainfall patterns have resulted in a scarcity of grazing land, which has affected livestock productivity. Due to the lack of grazing pasture, the productivity of livestock has decreased, leading to animal mortality. According to the interviewees, in the last three decades many pastoralists have lost livestock due to the effects of climate change.

Food Insecurity: Food insecurity has resulted from a decrease in cattle productivity among Somali pastoralists in Dhagaxbuur district. The lack of grazing land has reduced milk production, which is an important source of food for pastoralists. The drop in animal productivity has also resulted in a decrease in meat production, resulting in food insecurity.⁴¹

Water scarcity: Water scarcity has resulted from changes in rainfall patterns in Dhagaxbuur district. Rainwater is essential for the livestock and family requirements of Somali pastoralists. However, due to changes in rainfall patterns, there is less precipitation available, resulting in water scarcity.⁴² Additionally, female FGD participants⁴³ discussed how it affected their livelihoods: They are expected to travel a long way, usually on foot, to get water for their household and livestock. The women emphasized the importance of better water management strategies, as water availability is critical for their livestock and livelihoods. They examined the effects of the changing rainfall patterns and the increased frequency of drought, stressing the importance of sustainable strategies for water conservation and use.

Environmental change: According to interviewees, for the last three decades, climate change has brought about various environmental changes in the study area. Water streams have declined and some of them have dried up, and different indigenous plants such as *mido* that were used for food consumption have disappeared. This has affected the quality of honey used as medicine. Because of the disappearance of those indigenous plants, the quality of honey has also decreased.

Decreasing livestock productivity: According to interviewees, climate change has impacted livestock productivity in the area. Study participants asserted that 30 years earlier the size of a camel was very huge, but now the size has grown smaller, both in terms of quality and meat. Besides, the area was rich in its capacity for milk production; now milk production has dropped both in quantity and quality. As interviewees stated the quality of milk used to be determined by the strength it provided the local people, but this is no longer the case. They related the decline in meat and milk productivity with environmental change, and specifically changes in pasture for their livestock.

40 Interview with women, Dhagaxbuur, 2 November 2023.

41 Interview with local elder, Degehabur, 30 October 2023.

42 Interview with women, Dhagaxbuur, 5 November 2023.

43 Participant in a focus group with women, Dhagaxbuur, 8 November 2023.

SIGNIFICANCE OF INDIGENOUS KNOWLEDGE IN LOCAL CLIMATE CHANGE PREDICTION

According to respondents, since time immemorial, Somali pastoralists have used their indigenous climate/weather prediction skills to manage scarce pasture and water resources, adjust to impending weather events and predict the course of the upcoming season. Due to the inadequacy of modern weather prediction in the study area, indigenous climate knowledge and weather predictions are the dominant and known sources of imminent weather events used to sustain livelihoods in an ever more changing climate. Similarly, Mulubrahn Balehegn et al.,⁴⁴ found that indigenous weather prediction is essential to any planning process at the local level, allowing communities to act on time.

INDIGENOUS SEASONS AND MONTHS OF SOMALI PASTORALISTS

According to the FGD participants⁴⁵, the Somali culture has an indigenous nomenclature for seasons and months. The use of indigenous names for materials allows the community to gain indigenous knowledge and experience with objects. The Somali community in the study area counts four seasons in a year (*Jiilaal*, *Gu*, *Xagaa*, and *Deyr*), with three months in each season, for a total of 12 months in a year. *Gu* is the main rainy season between early April and June, and *Deyr* is the short rainy season of the year, usually from October–December. *Jilaal* is the hot dry season between late December and March, and *Xagaa/Hagaa* the dry season between July and September. This knowledge allows the community to analyse seasonal and monthly patterns. Wind directions, dry seasons and rainy seasons are some weather patterns that communities recognize and identify in order to make decisions about their livelihood development.

44 Mulubrahn Balehegn et al, 'Indigenous weather and climate forecasting knowledge among Afar pastoralists of north-eastern Ethiopia: Role in adaptation to weather and climate variability', *Pastoralism* 9/1 (2019): 1-14.

45 Participants in a focus group discussion with men, Dhagaxbuur, 26 October 2023; Participants in a focus group discussion with women, Dhagaxbuur, 8 November 2023.

TABLE : 1 INDIGENOUS NAMES OF SEASONS AND MONTHS

NAMING OF INDIGENOUS SEASONS (SOMALI LANGUAGE)	NAMING OF INDIGENOUS MONTHS (SOMALI LANGUAGE)	ENGLISH NAME
JILAL (WINTER)	Lihkor	January
	Toddob	February
	Habar-Adhi	March
GU (SPRING)	Cambaar	April
	Candho-qoys	May
	Adar/Samuulad	June
XAGAA/HAGAA (SUMMER)	Karan	July
	Nayrus/Habar-ari	August
	Diraacgood	September
DEYR (AUTUMN)	Dalali/Dayrweyn	October
	Ururdha/Ximir	November
	Daradhaf/Xays	December

Source: Fieldwork data, 2023

INDIGENOUS WEATHER PREDICTION INDICATORS USED BY SOMALI PASTORALISTS.

Somali pastoralists predict imminent weather events using indigenous signs, such as star constellations, the behaviour of plants, animals, insects, wind directions, clouds, birds chirping and the intensity of temperature. The next sections provide a brief overview of indigenous techniques and the biophysical indicators used by local pastoralists to predict the beginning of rainfall and drought.

OBSERVATION OF STAR CONSTELLATIONS

Somalis observe changes in the patterns and constellations of many celestial bodies, such as the sky, the sun, the moon and various stars to predict the climate and weather.⁴⁶ Such celestial investigations in search of weather and climatic indications are highly widespread among local people.⁴⁷

Most Somalis, particularly those who still live the traditional nomadic lifestyle, have a deep interest in the weather, stars, group of stars (*Urrur*), and planets and the pervasive effects these have on their lives. This is mirrored in their language, which contains a significant number of sayings, riddles and songs that relate astronomical phenomena to real events in nomadic life. There are numerous Somali traditional songs for girls, camels or livestock that link astronomical phenomena, such as seen omens, to years of prosperity or drought. Citing this song, Muusa Galaal notes that the livestock herder shares his cattle's problems: both will suffer from drought and prosper from rain.⁴⁸

46 Said M-Shidad Hussein, 'The Somali Calendar: An Ancient, Accurate Timekeeping System', Wardheer News. com, 31 December 2011. Accessed 20 October 2023, https://wardheer.startlogic.com/public_html/Articles%202012/Dec/31_Somali_calendar_Said.pdf.

47 Hussein, 'The Somali Calendar', 7.

48 Muusa H.I. Galaal, *Stars, seasons, and weathers in Somali pastoral Traditions*, Bloomington: Indiana University Press, 1970.

SOMALI LANGUAGE	ENGLISH MEANING
Haddaan ururkiyo, Afaggaal ridey Mugga eeddaa, Ilaah bayska leh, Anna orodkay, Waa intii hore.	My lovely cow, now you can see that <i>Urur</i> and <i>Afaggaal</i> have set, and still there is no sign of the Gu rains. I have laboured hard to keep you well. So that you may live through the harsh <i>Jilaal</i> . Be witness, then, it is the will of Allah, And not my neglect of you. ⁴⁹

According to interviewees and FGD participants,⁵⁰ Somali pastoralists are accustomed to predicting imminent weather events based on the orientation and arrangement of stars seen in the nocturnal sky. Somali elders study patterns of the moon with positions of stars in relation to a specific season, month and day to predict the arrival or continuation of a good or bad rainy season. The position of a star or stars in relation to the moon provide crucial information regarding weather patterns for the Somali population. The following are the names of well-known stars that the community uses to predict weather patterns.

Dirrir: If this star occurs, with the moon in close proximity, on 15 April of the *Gu*, it will imply a scarcity of rain during the *Gu*, the main rainy season from April to June. However, if it arrives on 14 April, it will indicate the arrival of a good rainy season.

Godan: If *Godan* appears side by side with the moon, in the west during the *Gu* season, it indicates the arrival of a good rainy season.

TABLE 2: SOMALI INDIGENOUS STARS NAME; AND ITS DESCRIPTION

SOMALI INDIGENOUS STARS NAME	DESCRIPTION	INTERPRETATION	REMARKS
DIRRIR	Appear of 15 April, at sun set or early at night	Scarce rain in the season or drought will occur	The star appears in line with the moon during Gu season
	Appear on or before 14 April, at sun set or early in the night	Arrival of a good rainy season	The star appears in line with the moon

49 Glaal, *Stars, seasons, and weathers*, V.

50 Interview with elders, Dhagaxbuur, 27 October 2023; Participants in focus group discussion with elders, Dhagaxbuur, 8 November 2023.

GODAN	Appear to the west	Coming of rain soon	When this star appears side by side with the moon in the west during the Gu season, it indicates the arrival of a good rainy season.
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Source: Fieldwork data, 2023

OBSERVATION OF ANIMAL BEHAVIOUR

Somali pastoralists also predict imminent weather events based on changes in animal behaviour at specific times of the year. According to interviewees,⁵¹ the camel is not only popular livestock among Somalis but is also seen as a symbol of socioeconomic value. Somalis' main source of income is camel production and productivity. In addition to that, camel behaviour is used as a predictor of weather. Camel behaviour may indicate the arrival of a bad or good rainy season. The elders have an experienced understanding of reading camel behaviour.

According to the perceptions of the respondents, good *Gu* rains are predicted if camels exhibit the following behaviour. When camels develop an unexpected habit of looking for bones and chewing on them like vegetation, it is considered that good rains will fall in the upcoming *Gu* rainy season, in less than one or two weeks. Heavy rain is projected to fall in less than a week if camels refuse to drink water at a water point and expose themselves to the intense mid-afternoon sun. Normally, camels urinate by spreading their rear legs; however, if camels entangle their rear legs while urinating, it is thought to presage an imminent rainy season. Instead of sitting/standing comfortably in their small compound, if the camel walks all night/move in different directions within the compound, it is also perceived as an indication of the imminent good rainy season.

If camels refuse to enter their hut and congregate in front of it a few days before the start of the *Gu* or *Deyr* rainy seasons, it is interpreted as the coming of good rain. Refusing to enter their hut or tent is regarded as a sign of good, favourable, imminent rains. This behaviour is interpreted to mean that, if camels notice the rains falling quickly, they expect a hut to be swamped with water, muddy, and unsuitable for them to enter. They have instinctively detected rain and are trying to avoid being swept away in any flooding.

In contrast, when camels howl for a long time while in their hut, and if breastfeeding camels refuse to feed their calves from the breast, it is regarded as a sign of imminent drought. When they refuse to go and browse in neighbouring pasture, preferring to stay near a water point after drinking, this is considered another sign of imminent drought. When camels do not give birth sufficiently, or give birth in an unusual period (in which they might be physically weak), it predicts drought.

51 Interview with elder, Dhagaxbuur, 30 October 2023.

Additionally, the community sometimes listens to a camel to determine its irregular messages. Camel sounds indicate a good, fair and bad future in the area or for households, according to interviewees and FGD participants. Thus, the camel sound and its connotations are: If the camel emits a plausible ‘Baaaaaaaaaaaaaaaa’ sound, it signifies the approach of good hope; if the camel sounds most like ‘Immmmmmmmmmmmm’, it signals fair hope of good rain; and if the camel sounds like ‘Baaaaaaaaaabaa’, it predicts the approach of a bad time. Interviewees in the local area also observed tortoise behaviour to predict the rainy season. When a tortoise has hidden for three months in the ground and comes out to upper land, it indicates rain is coming.

TABLE 3: CAMEL BEHAVIOUR, DESCRIPTION AND INTERPRETATION

CAMEL BEHAVIOUR	DESCRIPTIONS	INTERPRETATION	REMARKS
SOUNDS	If camel sounds plausible 'Baaaaaaaaaaaaaaaa'	Will signify the approach of good hope	For rainy season or other matters
	If camel sound most likely 'Immmmmmmmmmmmm'	Will signal fair hope	
	If the camel sounds likely 'Baaaaaaaaaabaa'	Will predict the approach of bad time.	
URINE TIME	Give urine by crossing its front feet	Rains in near future or continuing of rains	
MILK PRODUCTION	Give less milk	Scarcity of rain	
	Give much milk	Good period of rainy season	
BIRTH	Less pregnancy or productivity Give birth out of period	Coming of drought or scarce rains	
WATERING	If camels refuse to drink water at a water point and expose themselves to the intense mid-afternoon sun	Heavy rain is projected to fall in less than a week	
	Much drinking	Heavy rain	

Source: Fieldwork data, 2023

OBSERVATION OF BIRDS' BEHAVIOUR

Somali elders use their knowledge of understanding the movement and sounds of birds to predict weather trends in their area. Bird movement and sounds have the potential to indicate bad or good seasons. FGD participants agreed on the following:

If flocks of birds have moved away from their normal habitat, it indicates a bad or scarce rainy season. However, if flocks of birds had moved into their area in an abnormally large

number, it would indicate a favourable rainy season.⁵²

The singing and twittering of specific birds are held to be a good predictor of the start of rains and the quality of the season among Somali pastoralists. According to interviewees,⁵³ Somali pastoralists often use eight different bird species in Dhagaxbuur district to anticipate the start and extent of the rainy season. These birds are locally named; *irsankeyar*, *gumeys*, *fin/glow*, *gugule*, *hedka*, *digren/lugubey*, *timbul* and *kooragu*. When *gumeys* (described as the eldest female, unmarried and ugly) makes a voice day and night, three times consecutively for 15 days, this signals a rainy season is approaching. When *irsankeyar* (which locally means ‘a good sky’) sings *wiy, wiy, wiy* three times and, on the fourth time, *Babobo*, it indicates the onset of the rainy season.

When *fin/glow* makes a voice *wedi*, it indicates a dry season. When the *gugule* bird sings *kuukuuku* in the morning or afternoon, it indicates the coming of rain in a short period or within few days. When the *fin* bird sings in the morning, it indicates the coming of rain within seven days. When the *kooragu* bird sings at night (*Duu—duuu* sound) it indicates the coming of rain within three days. They will stay and make the sound for five to seven hours for almost three days.

When the *digren/lugubey* bird appears, and flocks of birds move together and sing during a high-temperature period, it indicates the coming of rain soon. *Timbul* and *hedka* birds are also used to predict a good rainy season, though difficult to hear. When these birds sing, but with irregular sounds outside of the normal time, this is thought to be an indication of impending drought.

TABLE: 4 INDIGENOUS KNOWLEDGE OF IDENTIFYING BIRD'S SOUNDS FOR WEATHER PREDICTION

BIRDS LOCAL NAMES	SOUNDS	DESCRIPTIONS/PERCEPTIONS
GUGULE	<i>kuukuuku</i>	In the morning or afternoon indicates the coming of rain within short period (days)
FIN/GLOW	<i>wedi</i>	An indicator of drought
KOORAGU/TIMBUL	At night: <i>Duu—duuu</i>	Indicates the coming of rain within three days. The bird will stay and make the same sound for five to seven hours for almost for three days
IRSANKEYAR	<i>wiy wiy wiy</i> three times and on the fourth, <i>Babobo</i>	The rainy season is coming

Source: Fieldwork data, 2023

52 Participants in focus group discussion with elders, Dhagaxbuur, 8 November 2023.

53 Interview with elder, Dhagaxbuur, 30 October 2023.

OBSERVATION OF FLORAS

According to the study participants, Somali pastoralists in the Dhagaxbuur district customarily examine the maturation and blossoming of species of flora to predict the fate of impending weather events. The native flora used by Somali pastoralists to predict imminent weather events begins to blossom and its leaves grow brilliantly green as the *Gu* rainy season approaches.

Some study participants have first-hand knowledge of recognizing and understanding plant behaviour signalling either favourable or unfavourable local weather patterns. They described it as follows:

If trees such as *garas* (*dobera glabra*), *meyag* (*boscia minimifolia*) and *hegilo* (*cadaba heterotricha*) have grown fresh flowers or leaves in the area, it indicates the coming of a long dry season. Other trees with green flowers, such as *hagar*, *hode*, *hankokib*, *lebihi*, and *yohob* indicate the continuation of the rainy seasons.⁵⁴

The unexpected tumbling, or shedding, and drying of these flora before their abundantly mature and flowering seasons is a sign of imminent drought.

The appropriate use of the indigenous indicators mentioned above is critical to the promotion and sustainable conservation of natural habitats. Thus, the use of these strong indicators implies the importance of preserving and protecting plants that exhibit these signs.⁵⁵

OBSERVATION OF INSECTS

According to elders,⁵⁶ in local Somali knowledge, insect behaviour has the power to predict weather patterns. Somali elders have knowledge and expertise in detecting insect behaviour as indicators for weather prediction mechanisms regarding the arrival or the scarcity of rain. Interviewees described insect behaviour that indicates whether the rainy season will be good or bad. The behaviour of these insect, *abor* and *bolol*, are used in weather prediction. If they gather grass or other things in their holes for sustenance, this suggests drought is approaching. But if they place the grass outside their holes or form a dam, it signals that the rainy season is approaching.

OBSERVATION OF TEMPERATURES INTENSITY

The respondents assured the researcher that the area was generally hot, but that if it is hotter than usual, rain will fall within a day. Also, if the temperature is excessively high and there is no trace of air movement, elders predict that rain will fall shortly. They have air movement parameters, using an indicator called *dunta* (thread). They would put a thread on their hands to

54 Interview with elder, Dhagaxbuur, 30 October 2023.

55 Iticha and Husen, 'Adaptation to climate change using indigenous weather forecasting systems.'

56 Interview with elder, Degehabur, 3 November 2023.

check and see if the air is moving. If the *dunta* moved in one direction, it suggests the possibility of rain, but if not, it predicts a bad rainy season.

OBSERVATION OF WIND DIRECTION

Customarily, traditional communities have used wind variation as a signal of weather change since time immemorial.⁵⁷ Somali pastoralists use the direction and magnitude of the wind to forecast the beginning of rain and drought. According to interviewees,⁵⁸ a dusty, rapid wind called *Eemis*—which blows from west to east during the dry July to September *Xagaa/Hagaa* season and east to west during the *Deyr* or secondary wet season from October to December—is considered a good indicator that rain will most certainly occur within days.

On the other hand, when a powerful wind blows consistently from east to west close to the arrival of the April to June *Gu* rainy season and from west to east during the January to March *Jilaal* dry season, it is seen as an indication of drought or a delay in the approaching rainy season. Among the Afar and Borena pastoralists in Ethiopia, observations of wind direction are also used to predict the weather.⁵⁹ According to the knowledge and experience of Somali elders, the direction of the rain indicates whether the rainy season will be constant or scarce. If the rain comes from the east, it indicates a good rainy season, but rain falling from the south indicates no rain or a scant rainy season.

Despite the growing number of governmental and non-governmental organizations converging in climate change adaptation and indigenous weather forecasting, the incorporation of local community knowledge is not being taken into consideration. One interviewee stated that many generations of top-down development interventions in the Dhagaxbuur area had ignored indigenous knowledge on the grounds that modern models were being used. According to Dejene Alemayehu and Zerihun Doda,⁶⁰ development interventions, such as adaptation to climate change, the conservation of natural resources and others have varying degrees of effect on local knowledge. As a result, any strategy to improve the quality of life of local people will continue to be futile unless it takes the knowledge of the local community on board.

This paper argues that interventions should consider the local context and support the use of a hybrid blend of indigenous and conventional weather prediction systems to provide timely and relevant services to pastoralist communities.

57 Iticha and Husen, 'Adaptation to climate change using indigenous', 569.

58 Interview with elder, Dhagaxbuur, 5 November 2023; Interview with woman, Dhagaxbuur, 7 November 2023.

59 Mulubrhan Balehegn et.al, 'Indigenous weather and climate forecasting knowledge; Nega Debela et.al, 'Adaptation to climate change in the pastoral and agropastoral systems of Borana, South Ethiopia: Options and barriers', *American Journal of Climate Change* 8/1 (2019): 40-60.

60 Dejene Alemayehu and Zerihun Doda, 'Indigenous environmental knowledge of Borana pastoralists', *Grassroots Journal of Natural Resources* 3/4 (2020): 110-131.

INDIGENOUS KNOWLEDGE AND LOCAL ADAPTATION RESPONSE TO CLIMATE CHANGE

Pastoral communities have been managing to adjust to changing climatic conditions for hundreds of years. As a result, their adaptive and coping mechanisms have long-lasting knowledge, skill and experience. Indigenous knowledge serves as the foundation for local-level decision making in many rural communities. It is valuable not only to the culture in which it develops but also for planners and scientists working to improve circumstances in those rural areas.⁶¹ Almost all study participants agreed that pastoral communities had a long history of indigenous knowledge, as well as skills that could be used to put into practice various adaptation measures to mitigate the negative effects of climate variability. Local adaptation and coping responses to climate change are highlighted below.

MOBILITY (HAYAN OR KEYNAAN)

One of the primary forms of adaption methods indicated by respondents was pastoralist mobility with their livestock in search of pasture and water to mitigate drought. Pastoral mobility is a form of indigenous and lifelong pastoralist experience to adapt to changing climates, improve output and use scarce resources (pasture and water) effectively.

The mobility of pastoralists and their herds is organized properly, with ample consultation with local elders. Before mobility begins, a few respected and knowledgeable men are dispatched to assess places that are likely to have greater forage, be free from insects and biting flies and be ideal for habitation. Subsequently, they are periodically on the move in search of better pasture and water for their livestock.

Sahan (scouts) are a vital source of information on the weather and climate change. The *sahan* system is also important in the decision-making process for mobility patterns. Typically, the assessment includes the distance and condition of pasture and water, an estimate of how long the fodder and water would sustain a certain quantity of livestock, the type of fodder and other factors. If a survey team discovers a better location, *sahan* marks the area and instantly advises

61 E. N Ajani, R. N. Mgbenka and M. N. Okeke, 'Use of indigenous knowledge as a strategy for climate change adaptation among farmers in sub-Saharan Africa: implications for policy', *Asian Journal of Agricultural Extension, Economics & Sociology* 2/1 (2013): 23-40.

the elders to move in the direction of the new location. According to an interviewee,⁶² during movement, the entire household family and all the livestock owned may not be mobilized. Most of the livestock migrate seasonally, while some, such as milking cows, frail livestock and calves, remain home to serve women and children, while adult male herders migrate with the remaining herd.

LIVESTOCK DIVERSIFICATION

Diversification of livestock species is an essential alternative adaptation technique to the effects of climate change. It helps mitigate the effects of climate change and variability in the study area. Keeping mixed herds of different animal species that can endure different climatic and ecological circumstances allows for adaptation and risk reduction.⁶³ In Dhagaxbuur district, pastoral communities were traditionally dominated by a camel pastoral system. However, as a result of the constraints posed by climate change and variability, most pastoralists in the district are now trying to diversify their livestock species to include sheep, goats and cattle as an alternative adaptation strategy. The diversity of livestock species has both ecological and economic significances.

The raising of multiple livestock species can help pastoralists make use of the diversified nature of ecosystems. The rearing of all these types of livestock by a single household is one of the most powerful indicators of a climate change and variability adaptation approach. In this regard, Yosef Tadesse et al.,⁶⁴ found that pastoralists raise several livestock species, particularly goats and camels, to increase their resilience to drought, heat stress and disease.⁶⁵ Dejene Alemayehu and Zerihun Doda also discovered that pastoralists diversify their herds in order to more efficiently exploit limited resources (grazing land and water), and that livestock diversification as an adaptation strategy is possible by sustaining diverse livestock that can overcome various climate and environmental impacts.⁶⁶

SELLING OF LIVESTOCK AND LIVESTOCK PRODUCTS

The herd is a vital resource for pastoralists serving various roles in economic, social and risk management. Study participants reported that livestock and livestock product sales are very important adaptation strategies and cash sources for the majority of pastoral households in

62 Interview with elders, Dhagaxbuur, 29 October 2023.

63 Chinasho, Yaya and Tessema, 'The adaptation and mitigation strategies for climate change,' 69.

64 Yosef Tadesse et al., 'Camel and cattle population dynamics and livelihood diversification as a response to climate change in pastoral areas of Ethiopia', *Livestock research for Rural Development* 25/9 (2013): 1-10.

65 Tadesse et al., 'Camel and cattle population dynamics,' 8.

66 Dejene Alemayehu and Zerihun Doda, 'Indigenous environmental knowledge of Borana pastoralists', *Grassroots Journal of Natural Resources* 3/4 (2020): 110-131.

Dhagaxbuur district.⁶⁷ Because animals were unable to withstand long dry periods, due to lack of food and water, pastoralists were forced to sell their cattle during drought. According to interviewees, in times of drought and food scarcity, livestock selling is a strategy to reduce animal losses while meeting family expenses. Pastoralists prefer to sell sheep and goats on a regular basis for small expenses, whereas they keep camels and cows for milk and calf production and occasionally for large expenses, such as selling them to pay for marriage and weddings. According to the women respondents in FGDs,⁶⁸ selling various livestock products, such as milk, butter and cheese, became a critical source of revenue during periods of drought. This finding is consistent with the findings of Dejene and Doda,⁶⁹ who show that the sale of cattle is an important adaptive mechanism in the face of climate shocks.

MIGRATION AND REMITTANCE

The ability of pastoral communities to adapt to the impact of drought has been threatened, as access to resources and the stability of a livelihood based solely on livestock has been reduced. When livestock numbers per household continued to decrease due to prolonged drought, heat stress and diseases, household members sought other livelihood alternatives and supported family members through migration and remittances.

As a result, migrant remittance is becoming a major source of income and adaptation strategy in the study area. As the focus group discussants revealed, remittance usually comes from family members, mostly in urban areas in and outside the district, and in some cases outside the country. It was recognized that remittances have been increasing as many young people migrate to towns in the region, such as Jigjiga and Dire Dawa, and outside the region, as well as outside the country. They are expected to support their families. Migration and remittances are becoming increasingly appealing adaptation strategies, particularly for young people from low-income families.⁷⁰

SPLITTING OF LIVESTOCK AND FAMILIES.

According to elders, during severe drought seasons, the application of livestock and family splitting is becoming more common among pastoral communities as a coping and adaptation method in the study area. During prolonged drought, livestock are divided into smaller groups. Sheep, lactating and physically weak herds remain with family members, such as mothers,

67 Interview with elders, Dhagaxbuur, 26 October 2023; Participants in focus group discussion with elders, 4 November 2023.

68 Participants in focus group discussion with women, Dhagaxbuur, 8 November 2023.

69 Dejene and Doda, 'Indigenous environmental knowledge', 110-131.

70 International Organization for Migration, 'Regional Study on Remittances and their Potential Use in Migrant Remittances Receiving Households,' Regional Overview, International Organization for Migration (IOM), Regional Office for East and Horn of Africa, 2023. Accessed 15 November 2023, <https://eastandhornofafrica.iom.int/sites/g/files/tmzbd1701/files/documents/2023-09/regional-study-on-remittances-and-their-potential-use-in-migrant-remittances-receiving-households.pdf>.

children and older men located near villages, while young men migrate with large numbers of stronger livestock, such as camels, cattle and goats to more remote places in search of better water and sources of pasture. During the FGDs, participants stated that during drought seasons, households frequently split, with the stronger herds being taken further away to locate suitable water and pasture, usually near rivers and boreholes. In line with this, a study conducted by Teferi Tolera and Feyera Senbeta⁷¹ showed that, during drought seasons, pastoralists split their livestock and family members into other locations. The division of livestock and families is determined by the type and physical condition of the animals, as well as the availability and demand of labour for those specific animals in specific regions.

SOCIAL NETWORK AND RELATIONSHIP

Somali society is well known for its extensive social network and interpersonal relationships. The social network greatly helps develop social capacity, reduce vulnerability, maintain recovery and preserve social existence. According to respondents, the main pillars of the social structure of the Somali pastoral community can be divided into three categories, which are further discussed below.

Zakat is a type of Islamic social financing system in which all well-off people are obliged to provide a portion of their wealth or assets (money, livestock) to those in need, based on Sharia rules, and is compulsory. This type of social support is quite effective in terms of helping households, with a method of governance and of recovery to risks or to climate change shocks to their livelihood.

A socially mandated social network is a second section: The concept is based on social or social obligations between members of a community in a certain area. This can be a clan-based form, a locality-based form or another type of *xeer*⁷² agreement reached by a specific group.⁷³ Essentially, this approach is one-time disposal support rather than a long-term social support system designed to minimise vulnerability and improve resilience in impoverished households. The following are the most well-known types of this system: *Xoolo-geyn* (unconditional free gift) is a social support network. Whenever a member of the community suffers an unexpected shock or loss of livestock or an asset, elders or leaders gather livestock from the community and distribute it to the destitute person who has lost all animals or assets. *Dhowrto* (stored surplus milk) is a form of social assistance that is more proactive and prepared. The scheme aims to collect and store additional milk during the dry season to provide it to poor families that do not have milking animals.

71 Teferi Tolera and Feyera Senbeta, 'Pastoral system in the face of climate variability: Household adaptation strategies in Borana Rangelands, Southern Ethiopia', *Environment, Development and Sustainability* 22 (2020): 3133-3157.

72 *Xeer* is the traditional legal system of Somali society. Interview with elders, Degehabur, October 24 2023.

73 Interview with elders, Dhagaxbuur, October 24 2023.

The third section is individual and voluntary based. In general, this segment of the social support network is based on personal willingness rather than social authority. This category is simply based on clan kinship and relative connection and includes: *irmansi* or *maalsin* (temporary loan). This is to loan a member of your family lactating animals (cattle or goats) for a certain amount of time. Typically, an agreement is reached between two people. When the borrower's illness improves or the livestock gives birth, the animals will return. *Qowsaar* or *raci* (animal care) is the other form of voluntary based support. During difficult times, poor households organize their younger children or young men to seek to herd better-off households' cattle in order to receive food and other benefits as recompense.

Unfortunately, as a result of recurring drought, calamities, shocks and other associated factors that have increased the vulnerability of the pastoral community, the social reciprocal system is declining, particularly social and individual-based, as certain groups may become more disadvantaged than others.

CONCLUSION

The study was carried out to examine the perception, prediction, and adaptation methods of pastoral communities in the context of climate change and variability in Ethiopia, with a focus on the district of Dhagaxbuur in the Somali Regional State. Considering all factors investigated in the study, the following conclusion can be drawn.

The perception of climate variations was explored from the perspectives of both pastoralists and experts from the district. The majority of respondents identified climate change and variability as real phenomenon in the study area. However, most of them were unaware of the scientific causes of climate variability. They strongly associated the reasons for climate variability with Allah's punishment for people's refusal to comply with Allah's rule. This means that, while pastoralists accept that the climate is changing, they believe that Allah is in control of the weather and has rendered them impotent. This scenario is expected to have an impact on pastoralist efforts to adapt to climate change at the individual, household and communal levels. As a result, the findings point to the necessity for public awareness campaigns about the causes of climate change and the steps that should be taken at the household and community levels.

According to the study findings, the pastoralist groups in Dhagaxbuur district in the Somali Region of Ethiopia are aware of many indicators of climate change and variability. The occurrence of drought, the variation in rainfall amount and distribution, the delayed onset and early cessation of rainfall, the rise of temperature, frequent drought, the failure of the short rainy season critical for the development of grazing, and the decline of water sources are therefore perceived by most pastoralists as indicators of climate change. Drought has become a continuous concern for climate variability that has severely impacted the lives of pastoral communities over the last few decades, making it one of the key markers of climate change. Loss of cattle, due to repeated drought, is a difficult challenge that erodes the adaptive capacity of pastoralist communities. As a result, a context-based scientific intervention is required to support and address the lack of pasture and water for pastoralists' livestock during the dry season.

Pastoral communities have developed indigenous knowledge and abilities to forecast and convey relevant information about climate change over time. Pastoral groups are already implementing various coping mechanisms and adaptation methods to mitigate the negative effects of climate change in the area. They possess indigenous knowledge and capabilities to deal with climate change. Mobility, livestock diversification, sales of livestock and livestock products, migration and remittance, the splitting of livestock and families, and social networks and relationships are the most important indigenous adaptation and coping strategies. Various

forms of restrictions influence pastoralists' adaptation tactics to climatic variability, including rangeland degradation, a shortage of assets, education, household size and a lack of training and awareness. Both indigenous and modern institutions can help pastoralists cope with and adapt to the effects of climate change and variability. Understanding pastoralists' perspectives of climate change and their indigenous knowledge might prove to be critical input for adaptation policy and pastoral development interventions.

By working together with local communities and incorporating their indigenous knowledge and practices we can develop more effective solutions to the challenge of climate change.

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