Prioritization of Forecast-based Impacts for Drought: Challenges and Opportunities

Photo credit: Sarah Posner

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List of Abbreviations

BRC	British Red Cross
CTP	Cash Transfer Program
EWS	Early Warning Systems
EWEA	Early Warning Early Action
FbF	Forecast based Financing
IFRC	International Federation of Red Cross and Red Crescent Societies
RCRCC	Red Cross Red Crescent Climate Center
TWG	Technical Working Group
WFP	World Food Program
KRCS	Kenya Red Cross Society
NDMA	National Drought Management Authority

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Executive Summary

The following report presents the findings of my research from July to September 2019 with support from the International Federation of Red Cross and Red Crescent Societies, Kenya Red Cross Society (KRCS) under the International Centre for Humanitarian Affairs, and the Red Cross Red Crescent Climate Center (Climate Center). The primary focus of this report is to present the major findings and recommendations for which impacts should be prioritized. Major considerations for impact-based forecasts in Kenya will also be discussed which will be used to trigger early action before extreme drought events occur, under the Forecast based Financing (FbF) approach.

This summer 2019 I supported this work by participating in the FbF Technical Working Group (TWG) meetings as well as engaging in focus group discussions with community members living in a drought affected region. The aim of this project was to prioritize the most relevant impacts of drought in the context of Kenya as objectively as possible. I conducted this research through a multi-disciplinary and multi-stakeholder approach using mixed-methods. I incorporated both expert stakeholders coupled with local knowledge using pair-wise ranking and focus group discussions. This allowed me to triangulate information from both quantitative and qualitative data sources to recommend which impacts of drought should be prioritized for FbF in a national-scale approach.

This report outlines the major findings of prioritization of impacts by key stakeholders as well as the findings from focus group discussions with drought-affected community members.

- Drought impacts must be clearly defined which vary depending on the local context.
- Representing multiple perspectives from both rural and urban populations is required for a more objective prioritization to avoid introduced biases.
- A broader definition of drought may help mitigate some of the definitional and scale issues related to drought.
- Disaggregation of primary vs. secondary impacts is a useful conceptualization that considers what indicators are forecastable and which are actionable given available data.
- Primary impacts are direct, biophysical and include: water scarcity, livestock death, and reduced crop yield.
- Secondary impacts are indirect, anthropogenic and include: food insecurity, outbreak of water-borne diseases, malnutrition, increased resource-based conflicts, decreased school attendance, outbreak of livestock diseases, reduced milk production, poor livestock body condition, and livestock migration.
- The main impacts of drought as described by community members includes: water scarcity, livestock death, malnutrition especially of women and young children, decreased school attendance, and in access to critical services including roads and hospitals.
- Local perspectives through qualitative data collection can supplement the introduced biases of expert led prioritization.

Background

Introduction

Droughts occur when there is a deficiency in precipitation over extended periods of time. Since the 1960s, each drought episode in Africa has become more severe than the previous one, spurring humanitarian crises (Huho, 2014). In the Horn of Africa, drought has become increasingly more severe over the past decade with rainfall totals of at least 50-75% below average in the area. Furthermore, this region of Africa is predicted to experience an increase in temperatures of approximately 1.5 times compared to that of the mean global average by the end of the 21st century (Bryan et al, 2013). In Kenya, drought is not a new phenomenon, which varies in spatial extent depending on the event. However, the frequency of droughts has increased from once every 5 years in the 1980s, to once every 2-3 years in 1990s, and every year in 2000 (Howden, 2009).

In recent years, the impacts from recurrent drought events (i.e., 2009, 2011, 2017, and 2019) have led to a decline in crop yields and death of livestock, resulting in an increased reliance on food aid (USAID, 2019). In some arid and semi-arid counties, pastoralists have lost more than half of their livestock while small-holder farmers who depend on rain-fed agriculture have seen a decline in yields attributed to droughts. The impacts of droughts have undermined the livelihoods as well as decreased the resilience of local populations, which can be reduced or even avoided, if weather and climate forecasting were used to prepare for disaster rather than respond.

The aim of Forecast based Financing is to implement an Early Warning Early Action (EWEA) system in place, supported by Data Preparedness and the Cash Transfer Program (CTP), that provides early action before a disaster occurs, to reduce the risks of populations most vulnerable to the forecasted disaster.

What is Forecast based Financing?

Typically, Early Warning Systems (EWS) monitor the current bio-physical and socioeconomic factors associated with the onset of drought to assess how exposed vulnerable people are to the specific event. However, once impacts are visible, it is already too late and quite costly to mitigate the consequences (Barrett et al., 2019, Kogan et al., 2013). Forecast based Financing (FbF) is an anticipatory mechanism to enable access to funding before a disaster occurs. The aim of FbF is to reduce or avoid human suffering and loss of life by increasing the resilience of livelihoods to disaster events. Drought is often mentioned as an obvious hazard to include in FbF initiatives, however limited focus has yet been given to this hazard (Bengtsson, 2018). The main focus of FbF has been on floods (e.g. in Mozambique and Bangladesh), cold waves (in Peru) and cyclones (in the Philippines). Drought for FbF has not yet been successfully implemented due the issues of the natural phenomenon of drought which will be described further in this report.

Figure 1: Forecast Based Financing Info-Graphic

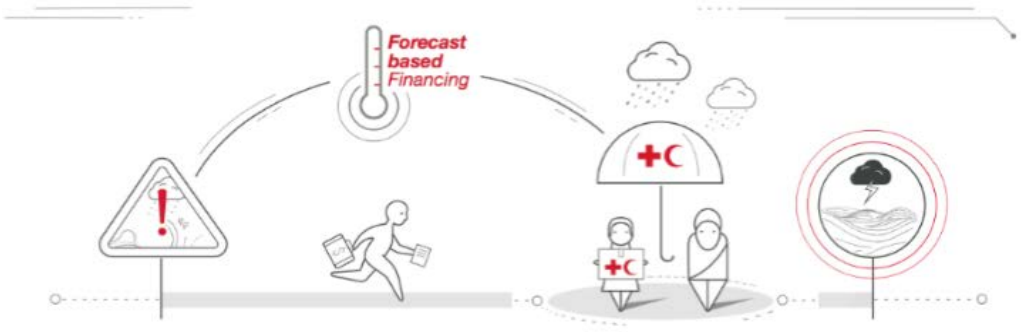


Photo credit: www.forecastbasedfinancing.org

FbF systems represent a marked shift from forecasting hydro-meteorological events toward impact-based forecasting (Barret et al., 2019). More specifically, FbF for drought marks a turning point in humanitarian interventions through an anticipatory, rather than responsive, approach that estimates the expected consequences of hazards before they occur.

Implementing FbF

The Kenya Red Cross Society will implement FbF for both floods and droughts together in partnership with the Red Cross Red Crescent Climate Centre (RCRCC), 510 Data Initiative, the International Federation of Red Cross and Red Crescent Societies (IFRC), and British Red Cross (BRC), and in close collaboration with various stakeholders as part of the Technical Working Group (TWG). To develop the FbF system, one must know the impact of most concern and the set of appropriate actions to address the related impact. To implement FbF effectively, one must know where to act, who will be most affected, and what early actions can be feasibly implemented before a disaster occurs, through impact-based forecasts. Impact based forecasts are defined as a forecast of the potential consequences of a hydro-meteorological event in terms of its effects on people, infrastructure, etc… Stakeholder involvement in implementation is key to the success of FbF and should be involved in every step of the process. In particular, stakeholders need to be involved in the prioritization of impacts that will be used to set triggers (Bengtsson, 2018). It is also key to have the most relevant stakeholders in the room involved in this prioritization who represent various institutions with access to different datasets.

The next step in implementation of FbF is trigger development. A trigger is defined as when forecasts exceed a predetermined probability (hazard) & magnitude (impact), which activates action in a specific place at a specific lead time. By focusing on impacts and communicating them, it is expected that those populations most vulnerable and the professionals in disaster risk management will have a better understanding of the potential risks of an expected hazard, which can be used to develop triggers to identify when and where to take appropriate early action (RCRCCC, 2018). There are a limited number of scientific articles available about FbF, and especially trigger development for drought, which is an almost untouched topic (Bengtsson, 2018). However, it is widely agreed that close cooperation and a contextualization of FbF impacts are important factors if triggers for FbF is to be implemented successfully.

What is different about FbF for Drought?

Drought can have a severe impact on the lives and livelihoods of populations. It is a natural hazard that is highly complex to forecast and address in a timely manner (WFP, 2019). Compared to floods and cyclones which occur in a short time period, droughts are slow-onset events, manifesting themselves over longer periods of time to varying spatial extents. The effects of droughts are indirect, depending on the magnitude of the event. Such impacts, including failed harvest, livestock mortality, and insufficient access to water, can degrade the lives and livelihoods of local populations. As past events continue to repeat themselves, recurrent droughts continue to undermine livelihoods and exacerbate local conditions of poverty, health, and food security (Muller, 2014). In East Africa, drought occurrence is frequent, but has been difficult to forecast due to various natural and anthropogenic factors along with inefficient forecasting capacities (Gebremeskel et al., 2019). Thus, building an FbF system for drought in Kenya is

imperative, yet different from that for other extreme such as floods or cyclones (WFP, 2019). However, there are many challenges as well as opportunities when it comes to implementing FbF for drought which I will discuss further below.

Challenges: Defining Drought

One major challenge of implementing FbF for drought is it is difficult to define, which stems from the slow-onset nature of drought. There are four recognized types of drought: meteorological, agricultural, hydrological, and socioeconomic, each with its own set of related impacts on society and environment (Glantz, 2009).

- Meteorological drought is defined as when an area experiencing a deficiency in precipitation within a particular area over a given time period, which will vary depending on what is considered 'normal' conditions.
- Agricultural drought is associated with soil moisture and occurs when there are deficiencies that inhibit plant growth for crop cultivation.
- Hydrological drought refers to water supplies, both surface (e.g. reservoirs, streams, snow pack) and sub-surface (groundwater, aquifers), and occurs when these supplies are deficient (Glantz, 2009).
- Socioeconomic drought is the most enigmatic type, which considers the supply and demand of water for various commodities or economic goods. This type of drought occurs when supply is lower than demand and takes a broader societal perspective (Bengtsson, 2018).

Due to the multiple definitions of drought, it is difficult for various sectors to agree on a single definition as the definitions tend to overlap and converge. In fact, Lloyd-Hughes (2014) argues that achieving a universal drought definition would be impossible, let alone impractical. These definitional issues complicate the process of reaching a consensus on thresholds and triggers among different sectors at varying spatial scales. To overcome these definitional issues, the key stakeholders who form the TWG agreed that all four definitions of drought are equally important for implementation of FbF using a national scale approach in the context of Kenya. Thus, when I conducted an impact assessment, all four definitions of drought were considered which are discussed later in this report.

Opportunities: Innovative Partnerships

Implementation of FbF for drought requires significant capacity to produce long range forecasts that are accurate, reliable, timely and actionable. A major challenge of implementing FbF for drought lies in data availability and forecasting capacity at the local level which often become a hindrance along with communication and coordination among the multiple stakeholders. This requires significant cooperation and coordination across multiple sectors and necessitates support from regional forecasting centers (WFP, 2019). Thus, FbF for drought offers new opportunities for innovative partnerships that enhance capacity building as well as knowledge creation around forecasting and anticipatory actions for drought. The Technical Working Group (TWG) meeting is one such example of this, which is comprised of technical experts who represent different disaster intervention institutions. Some of these representatives include, but are not limited to; the Kenya Meteorological Department (KMD), the National Disaster Management Unit (NDMU), and National Disaster Operations Center (NDOC). The group meets monthly to

discuss the process of implementing Early Warning Early Action (EWEA) systems among stakeholders of these institutions.

Impact Prioritization of Drought

Before implementing FbF for drought, it is necessary to objectively select the top three impacts that are most applicable. Since the impacts of drought on natural and human resources are distinct for different regions, it is not possible to define a uniform measure of drought vulnerability suitable for everywhere. Therefore, the first step in the prioritization process is to identify the relevant factors that address different dimensions of drought impacts including environment, health, society, and economy (Smit et al., 1999). Selecting relevant factors requires both expert knowledge as well as local knowledge from the ground. The next section describes the results of impacts prioritized by both key stakeholders as well as the findings from focus group discussions with drought-affected community members.

Results of Pair-Wise Ranking

To prioritize the top impacts of drought for FbF, I engaged and consulted with stakeholders on a monthly basis at the TWG meetings alongside the data preparedness team. The aim of these meetings was to narrow down thirteen drought impacts to the top three most relevant, which can be targeted in the FbF system. To prioritize these impacts as objectively as possible, the team used pair-wise ranking. This involved each representative of eight disaster risk organizations of the TWG ‘ranking’ the thirteen impacts based upon which they deemed most relevant based upon expert knowledge. The rankings were scored and are presented in Table 1. Results indicated that the three highest scored impacts include; food insecurity, outbreak of water-borne

disease, and water scarcity. However, using pair-wise ranking has its benefits and drawbacks in terms of prioritization.

Table 1: Results of Impact Prioritization by Key Stakeholders of TWG using Pair-wise ranking

Prioritized Drought Impacts	**Score 1**	**Score 2**	**Score 3**	**Score 4**	**Score 5**	**Score 6**	**Score 7**	**Mean score**
Food insecurity - access, availability	11	8	11	10	8	9	11	9.7
Outbreak of water-borne diseases - e.g. cholera, diarrhea	12	0	8	10	16	15	5	9.4
Water scarcity	6	12	11	9	6	7	12	9.0
Malnutrition	7	10	4	12	10	6	10	8.4
Increased resource-based conflicts - e.g. human/wildlife, farmers/pastoralists	8	5	12	6	8	11	5	7.9
Livestock deaths	7	2	7	7	10	7	8	6.9
Reduced crop yield	6	5	4	5	6	3	9	5.4
Decreased school attendance	5	4	10	8	4	5	0	5.1
Outbreak of livestock diseases	6	2	6	5	2	8	3	4.6
Reduced milk production	7	5	2	3	4	1	1	3.3
Lack of pasture	1	10	1	1	1	2	5	3.0
Poor livestock body condition	2	6	1	2	2	4	2	2.7
Livestock migration	0	9	0	0	0	0	7	2.3

Note: Primary impacts are highlighted in red, secondary in black

Discussion

While one of the main objectives of my research was to prioritize drought impacts objectively, it was evident that the pair-wise ranking process reflected the knowledge base and personal experiences of those doing the ranking. In this instance, key stakeholders did the pair-wise

ranking, who reside mostly in urban areas and are exposed to different impacts than those who reside in rural areas. Thus, based upon further discussion in the TWG meetings, I surmised that these rankings are not representative of rural populations who are dependent on natural resource-based livelihoods, but rather knowledge from technical experts in disaster risk management. For example, livestock death and crop failure were ranked lower than food security and outbreak of disease which illustrates the rural-urban divide in prioritization. Hence, it would be of interest to repeat the exercise to include other participants who are dependent on rural livelihoods to see how the rankings would change. Additionally, in small group discussions with various stakeholders, it was drawn to my attention that such a process can lead to one item being ranked higher than others, depending upon its position on the list. The first options usually are selected for prioritization.

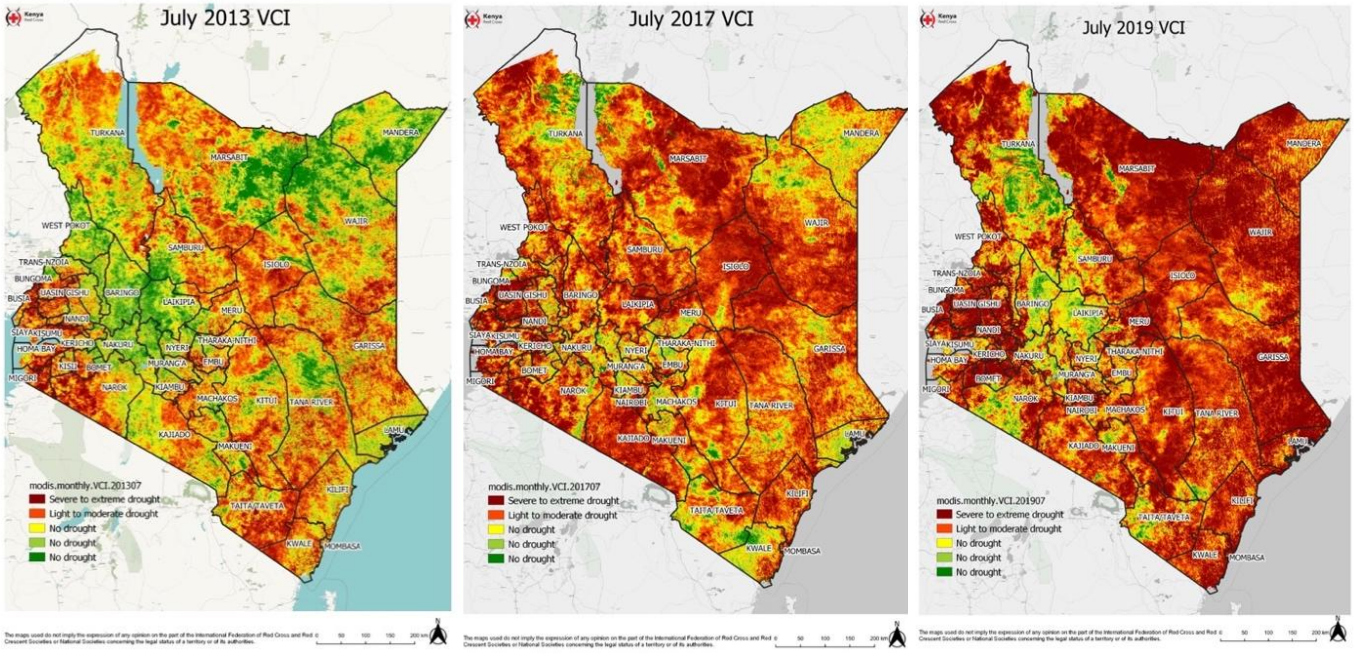
I would also note that defining what we mean by drought and related impacts is an important first step in prioritization. This is because drought is a phenomenon that is complex with different meanings depending on who you ask depending on their own, personal experience. What one means by ‘water scarcity’ in one region can have a completely divergent definition in another, depending on the local context. Also, the importance of scale came up recurrently, and was a major concern because due to the slow onset nature of drought, impacts may be felt differently at a particular place for a period of time. Thus, reconciling issues of scale was considered to be the top priority within FbF for drought. Thus, the prioritization process needs fine-tuning as well as context-specificities while outlining clear definitions for each respective impact.

Primary vs. Secondary Impacts

The major breakthrough in the prioritization process was the disaggregation of *primary* and *secondary* impacts. Primary impacts are *forecastable* while secondary impacts are *actionable.*

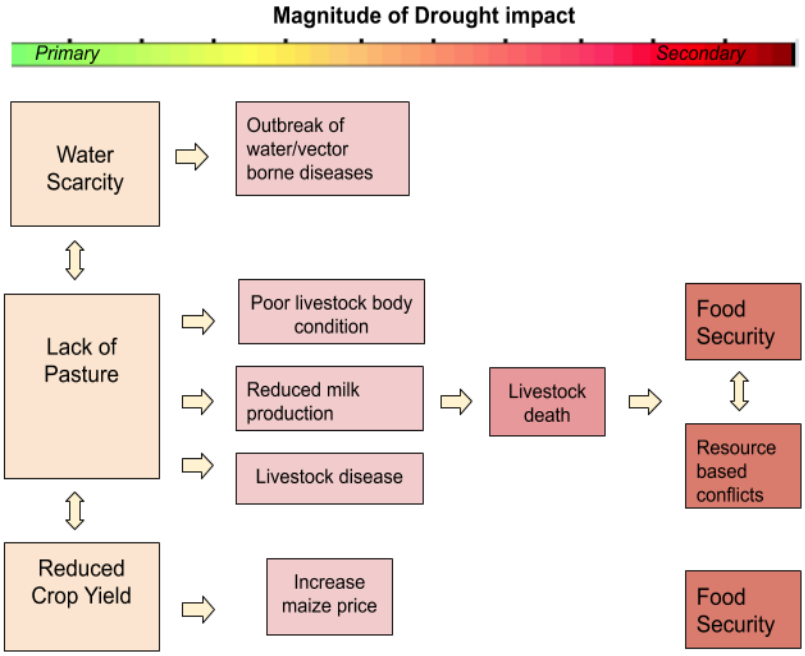
- Primary impacts are defined as the direct biophysical impacts that are the first, visible signs of drought on the landscape. These impacts are considered 1) water scarcity, 2) lack of pasture, and 3) reduced crop yield. Considering they are biophysical in nature; these impacts are forecastable with the use of satellite data and can be to set triggers for early warning based upon thresholds of drought years that have occurred historically. For instance, water scarcity can be forecasted using the Standard Precipitation Evaporative Index (SPEI), while lack of pasture and reduced crop yield can be forecasted using the Vegetation Condition Index (VCI) as illustrated in Figure 2. More severe drought is indicated in red and less severe in green. 2013 was not considered a drought year compared to drought years of 2017 and 2019.

Figure 2: Vegetation Condition Index (VCI) for July 2013, 2017, and 2019



- Secondary impacts are defined as the indirect anthropogenic impacts that are visible over longer time frames. These secondary impacts affect multiple sectors of society, including social, economic, political and cultural aspects. Secondary impacts include those related to food security, malnutrition, and resource-based conflict, which are the more extreme long-term impacts of drought. These impacts are not easy to forecast due to data limitations but are more actionable. What actions are implemented depends on the aims and scope of the project, what actions have historically been taken, and the funding mechanisms available from various donors. Whether an impact is considered primary or secondary depends on the magnitude of the drought, which are visualized in Figure 3.

Figure 3: Causal pathway of primary and secondary impacts across increasingly severe magnitudes of drought



Note: More severe drought is indicated in red and less severe in green. 2013

Recommendations

FbF requires extended cooperation between multiple stakeholders and so it must be considered how best to include them in the project and how to reach a consensus (Bengtsson, 2018). Based upon my experiences in the prioritization process, I will make several key recommendations for working with key stakeholders as part of the TWG.

- Ensure equal representation of technical experts from a variety of disaster risk management institutions. This will offer not only a range of different perspectives when prioritizing impacts, but also access to wide range of datasets across various economic, political, and health sectors that are normally difficult and expensive to access. It also allows new channels of communication and cooperation between different authorities,

which can help clear confusion about the roles and responsibilities of various actors. This will help to achieve a more efficient FbF system for drought.

- Disaggregation of primary and secondary impacts is an innovative approach that can help to overcome definitional issues, data limitations, and issues of scale. By prioritizing primary impacts in forecasting and secondary impacts within actions, it becomes much clearer what the scope and aims of a particular project need be for a certain drought event. More observational satellite data is available for primary impacts including VCI for lack of pasture and reduced crop yield and SPEI can be used for water scarcity. This data is reliable, consistent, and has large spatial and temporal resolution. Additionally, when thinking about actions, secondary impacts, like malnutrition and livestock death, can help to define what we mean by reduced crop yield and lack of pasture within various geographic contexts.

Results of Focus Group Discussions

While the TWG provided much needed insights into prioritization, it was addressed that there is a need to contextualize drought impacts on the ground from the perspective of those most affected. To supplement these findings, I went on a three-day field mission to Turkana County, one of the most drought-prone in Kenya, to elicit information from communities about the unfolding drought situation in 2019. Through focus group discussions, I collected qualitative data on first-hand experience with drought on the ground in coordination with the Turkana Red Cross branch. Participants were recruited from a small, rural community of Turkana people near the capital city of Lodwar. Initially, there were 10 community members recruited, both male and

female. However, when the team arrived, over thirty community members of all different ages were there, eager to discuss the impacts of the most recent drought event (Figure 4).

Figure SEQ Figure * ARABIC 4: Community discussion on impacts of recent drought

Photo credit: Sarah Posner

Community members were asked to describe the impacts of the recent drought event unfolding in 2019 which are outlined in Table 2. The major findings from the focus group discussion members center around issues related to water scarcity, livestock death, malnutrition, and lack of critical infrastructure including roads and hospitals. Turkana people are pastoralist by nature, and livestock are a major source of wealth and income to these communities. When a major drought hits, this leads to a decline in livestock, and perpetuates a cycle of poverty and malnutrition that is difficult to break with more recurrent droughts. Water scarcity is a major issue addressed by community members, and the nearest water source is the Turkwell river, located several miles away in Lodwar (Figure 5). Increased trekking distances was an impact described in relation to drought which makes watering livestock and accessing water for household use increasingly difficult. In addition, lack of access to critical services is limited within this remote village,

leaving communities unable to treat illnesses that may be perpetuated by drought, including cholera and other water-borne diseases.

Table 2: Impacts of drought described by members of a community in Turkana during focus group discussions

Impacts	**Description**
Water scarcity	"The young people fetch water from there, but the old people will not drink there. The trekking distance is far, and one injured his leg in the rocky river bed when he went to fetch water just the other day."
Livestock death	"The drought took them all, even one community member does not have any goats. Before, my father was killing animals like goats, cattle, and sheep when visitors come when there was lots of livestock, but we can't even compare to the situation now."
Malnutrition	"This place is dry and a place of hunger. Some of the mothers are inside dying from hunger, they are merely surviving. Children are going hungry. The old fathers have children whose mothers have died, and old mothers won't reach out to get food."
Decreased school attendance	"We have no money for school books and the primary schools are far from here. Even our children are not going to school because when you take them to school, they don't have anything to feed them."
In access to critical services (hospitals)	"We have sickness because there is no hospital here. When you get sick here the way to get treatment is only found in Lodwar town. Now we are bankrupt from animals lost in drought and the district hospital will not assist you without payment."

The final impact of increasing importance to consider in the context of Turkana was school dropout rates, which are linked to incidence of drought in several key ways. As families are deprived of their main source of livelihood, this leads to a decline in income and an increase in malnutrition. If schools do not have feeding programs, children will not attend, and will increasingly engage in domestic labor at home or graze livestock in pastoralist households. These are some of the key considerations when prioritizing impacts for drought from those feeling the effects most. Recommendations for early actions to deal with secondary impacts in the context of Turkana County include strengthening school feeding programs to reduce school dropout rates,

mobilizing local community members to advocate for water holes, and integration of traditional resource management institutions through communal land tenure.

Figure 5: Turkwell River flowing through Lodwar Turkana (Left) A herd of goats off to the market to be sold (Right)

Photo credit: Sarah Posner

Recommendations

For successful implementation of FbF, I have emphasized the importance of cooperation and partnership between multiple actors. This involves not only technical experts, but also the involvement of people at risk who bear the brunt of drought at the local scale. These populations need to be involved in the process because of not only their local knowledge of the area, but also their participation in early actions is necessary for them to be implemented effectively (Lumbroso, 2018, Bengtsson, 2019). The nature of droughts varies from one location to another and this case study is just one example of how drought manifests in a small pastoralist community in Turkana County. Key recommendations for how to incorporate this information are outlined below.

- In the context of Turkana, strengthening pastoralist livelihoods is especially important to increase resiliency of households. Access to viable water sources is a key aspect of this. Engaging local community leaders to reach out to county coordinators is one area of opportunity to mobilize early action by petitioning for a pipeline to supply locals with a long-term, consistent water supply rather than trucking water which increases short-term dependency on aid.
- Considering the ecological context is key within quantitative data analysis. By conducting fieldwork, I was able to observe the discrepancies between local ecological dynamics and observational satellite data. The importance of this is highlighted in the example of the invasive shrub *mathenge*, which skewed the results of the VCI. This has major political impacts at the national scale as VCI data triggers the release of funds for humanitarian interventions by the National Drought Management Authority (NDMA). These findings illustrate the importance of a mixed-methods approach to triangulate findings of what impacts are most importance across multiple scales of analysis.

What were the key lessons learned?

Drought is a phenomenon that is complex with different meanings depending on who you ask. This is a major challenge in the prioritization process especially in the context of Kenya, where various livelihoods are differentially vulnerable. Reaching a consensus as to which impacts are most significant poses challenges due to the complex nature of drought, which operates across multiple scales with a wide variety of impacts depending on their magnitude (Kossida et al., 2012).

The Technical Working Group (TWG) meetings revealed that cooperation and coordination are very difficult given the constraints and opportunities of incorporating multiple perspectives. There was general agreement in the meeting, as well as in the literature, that contextualization of FbF are important factors if it is to be implemented successfully. Reconciling issues of scale was considered to be the top priority within FbF for drought. Disaggregation of primary and secondary impacts was a major methodological breakthrough that reconciles some of the issues related to scale as well as data availability. Continued involvement of stakeholders throughout implementation of FbF is recommended.

Insights from focus group discussions found that these primary impacts, specifically primary impacts of water scarcity and livestock death, are realities for the Turkana people which perpetuates cycles of poverty, further decreasing the resiliency of local livelihoods with more recurrent drought events. With the onset of climate change, it is imperative to build the resilience of these vulnerable communities' livelihoods who are on the forefront of related impacts that affect all sectors of society including food security, water, health, and education. The findings of these focus group discussions highlight the importance of contextualizing impacts.

References

Barrett A., Duivenvoordena S., Salakpia E., Muthokad J., Oliver S., and Rowhani P. June 2019, Forecasting vegetation condition for drought early warning systems in pastoral communities in Kenya.

Bengtsson T. J., (2018). Forecast-based Financing: Developing triggers for drought. Dissertation.

Gebremeskel Haile, G., Tang, Q., Sun, S., Huang, Z., Zhang, X., & Liu, X. (2019). Droughts in East Africa: Causes, impacts and resilience. *Earth-Science Reviews*, *193*, 146–161. https://doi.org/10.1016/j.earscirev.2019.04.015

Glantz, M. H. (2009). Heads Up! : Early Warning Systems for Climate, Water and Weather-Related Hazards, United Nations University Press, 2009. ProQuest Ebook Central, http://ebookcentral.proquest.com/lib/ucb/detail.action?docID=728606

Howden, D. (2009) The great drought in East Africa; No rainfall for three years. Available at: http://www.infiniteunknown.net/2009/10/03/the-great-drought-in-east-africa-no-rainfall-for-three-years/ gov/fews/africa/index.php

Huho, J, and Kosonei R. (2014). Understanding extreme climatic events for economic development in Kenya. *Journal Of Environmental Science, Toxicology And Food Technology.* 8(2), 14-25.

Kogan F, Adamenko T, Guo W. Global and regional drought dynamics in the climate warming era. Remote Sensing Letters 2013;4(4):364–72. URL: https: 610 //doi.org/10.1080/2150704X.2012.736033. doi:10.1080/2150704X. 611 2012.736033. arXiv:https://doi.org/10.1080/2150704X.2012.736033

Lloyd-Hughes, B. (2013). *The impracticality of a universal drought definition.*

Lumbroso, D. (2018). How can policy makers in sub-Saharan Africa make early warning systems more effective? The case of Uganda. International Journal of Disaster Risk Reduction

Muller, J. C.-Y. (2014). Adapting to climate change and addressing drought – learning from the Red Cross Red Crescent experiences in the Horn of Africa. *Weather and Climate Extremes*, *3*, 31–36. https://doi.org/10.1016/j.wace.2014.03.009

Ongwenyi, G.S., Kitheka, J.U., Denga, F., (2000). The Impact of Climatic Changes on Land and Water Resources Management in Kenya. Proceedings of the Fourth National Workshop on Land and Water Management in Kenya: Towards Sustainable Land use, Kikuyu, Kenya, 15-19 February, 1993, pp. 219–222.

Red Cross Red Crescent Climate Centre (RCRCCC), the German Red Cross and the 510 team of the Netherlands Red Cross, (2018). A guide to trigger methodology for forecast-based financing. Republic of Kenya (2012). Kenya Post-Disaster Needs Assessment (PDNA) 2008-2011 Drought.

USAID April 2019., Climate Risks in FFP Geographies: Kenya.

World Food Programme (WFP). April 2019. Forecast-based Financing (FbF) Anticipatory actions for food security.