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RECEIVED 07 November 2024

ACCEPTED 02 January 2025

PUBLISHED 15 January 2025

CITATION

Weesie RV, Rohse M, Van Loon AF, Koehler J,
Barendrecht MH and Mwangi M (2025) Floods
after drought: storytelling with
agro-pastoralists in a Kenyan dryland.
Front. Water 7:1524554.
doi: 10.3389/frwa.2025.1524554

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Floods after drought: storytelling with agro-pastoralists in a Kenyan dryland

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In East African drylands, agro-pastoralists are continuously dealing with recurrent droughts and floods damaging to their livelihoods. Although droughts and floods have been widely studied as separate phenomena, little attention has been paid to agro-pastoral experiences of the relations between successive droughts and floods over time. Yet when floods follow a drought, they are likely to exacerbate or alleviate the impacts of the preceding drought. To address this, we conducted a study in southeastern Kenya's drylands, organizing storytelling sessions with 213 agro-pastoralist participants. By reconstructing a history of droughts and floods experiences from the 1940s to the early 2020s, we found that droughts and floods are strongly interrelated and ambivalent phenomena. During the latter half of the 20th century, agro-pastoralists narrated droughts as severely disruptive, distinct periods that frequently concluded with flooding, which both alleviated and intensified drought impacts. In the 21st century, however, droughts and floods are no longer experienced as discrete, named events but rather as a new normal. Floods after drought have become more frequent, short-lived, intense, and erosive, their regenerative function diminishing. The participants articulated how they adapt to droughts and floods amidst rapid socio-economic and socio-environmental changes. We found that various drought adaptation measures, largely initiated by (non)governmental organizations operating in drylands, have introduced flood risks. As droughts and floods are expected to become even heavier and frequent in future East African drylands and beyond, the stories underscore a need for adaptation approaches that benefit from the regenerative potential of floods after drought.

KEYWORDS

narrative, storytelling, history, Kenya, dryland, drought, flood, adaptation

1 Introduction

In November 2023, after three years of drought, floods caused widespread damage across East African drylands. Towns and villages were submerged, leaving hundreds of thousands of people homeless (Reuters, 2023). It is not the first time that floods have caused damage after a drought; many lives were lost in floods that ended droughts in 1998 (Little et al., 2001; Ngecu and Mathu, 1999) and 2018 (ReliefWeb, 2018).

These events fit a pattern where anthropogenic alterations to the climate and landscape cause rainfall patterns to shift unpredictably across East Africa (Haile et al., 2019, 2020). With shifts in timing and increased intensity of rainfall, extremely dry and wet periods have become more frequent in recent decades (Segele et al., 2009; Souverijns et al., 2016). As climate

projections indicate increasingly unstable rainfall patterns, destructive floods following droughts are likely to become more common in the future. Facing recurrent droughts and floods, combined with various socio-economic challenges, agro-pastoralists are continually adapting their livelihood strategies (Shikuku et al., 2017; Leal Filho et al., 2020).

With these developments, new research gaps have emerged regarding the relationships between droughts and floods. Firstly, droughts and floods have generally been studied and managed separately (Quesada-Montano et al., 2018). This is also the case in East African drylands, where droughts are known for their severe impacts on agro-pastoralists, leading to losses of human lives, homes, livestock, and crops (Haile et al., 2019). Consequently, drought in the region has been relatively well studied compared to floods, generating information on impacts, coping responses, and adaptation strategies (e.g., by Lott et al., 2013; Agutu et al., 2017). Moreover, drought is monitored and managed through specialized governmental agencies, such as the National Drought Management Authority (NDMA) in Kenya (NDMA, 2024). Given the history of severe drought impacts, a range of infrastructures has been developed to ensure water supplies during droughts, including water pans, irrigation schemes, and boreholes (Wright et al., 2017; Weesie and Kronenburg Garcia, 2018; Lasage et al., 2008; Fisher et al., 2015; Ghimire et al., 2015; Piemontese et al., 2024).

However, drought impacts and responses are likely to affect subsequent flooding (Head, 2014; Barendrecht et al., 2024). But research has not yet adequately addressed these relations for East African drylands, and have only been reported anecdotally. For example, when agro-pastoralists are impacted by drought through malnourishment, they are more susceptible to water-borne diseases when a subsequent flood hits (Miller, 1982). Or when agro-pastoralists respond to drought by planting drought-tolerant crops, these have been shown to be more vulnerable to heavy rain and waterlogging (Tirado and Cotter, 2010). Many other potential relationships remain unexplored.

Secondly, existing studies on drought in drylands of East Africa have predominantly used quantitative assessments (Quandt, 2021), producing data on the impacts, coping responses, and adaptation strategies of agro-pastoralists (e.g., Eriksen and Lind, 2009; Huhu et al., 2010; Fisher et al., 2015; Opiyo et al., 2015; Wens et al., 2020; Lam et al., 2023). While providing valuable information on measurable drought impacts and responses, these studies have overlooked important qualitative aspects, particularly experiences, which are difficult or impossible to measure and quantify (Nielsen and D'haen, 2014; Quandt, 2021). Qualitative data are needed to complement existing analyses, as they allow for greater inclusion of the experiences by those affected, rather than limiting analysis to researcher-defined criteria (Burman, 2017). In this paper, we therefore conceptualize droughts and floods as socially constructed, adopting a constructivist epistemology. This, in short, entails that we see droughts and floods as “a socially made category (a construct), and the characterisation of drought [and floods] is subjective, dependent on experience and positionality...” (Rangecroft et al., 2021, p.222). By doing so, we do not deny that droughts and floods are in part physical phenomena observable in the form of high and low flows of water, but we do assert that these alternating flows become categorised as droughts and floods through the experiences of people (Mauch, 2012; Becker and Sparks, 2020). In general, and in East African drylands specifically, the physical manifestation of droughts and floods has

received much more attention in scientific research than the social one (Quandt, 2021). When studying the social manifestation of floods/droughts, a constructivist approach allows to include voices of the ‘layperson’ or ‘nonscientist’, or in our case, the ‘agro-pastoralist’. This serves to challenge the authority given in most climate-change-related research to more ‘formal science’ using pre-structured approaches (Moezzi et al., 2017). Storytelling, with its open-ended nature, is then a highly suitable method as it allows participant to construct droughts and floods according to their own experiences, without restricting the analysis to our own predefined definitions we would use as outside researchers. Further inclusion of experiences allows for a deeper understanding of how droughts and floods are partly shaped by historical, economic, social, environmental and political processes, while also being actively reshaped by individuals as agents navigating these dynamics (Branch, 2018; Savelli et al., 2022). This, in turn, can inform policies, practices, and research aiming to reduce or prevent drought and flood damages in the future (Branch, 2018).

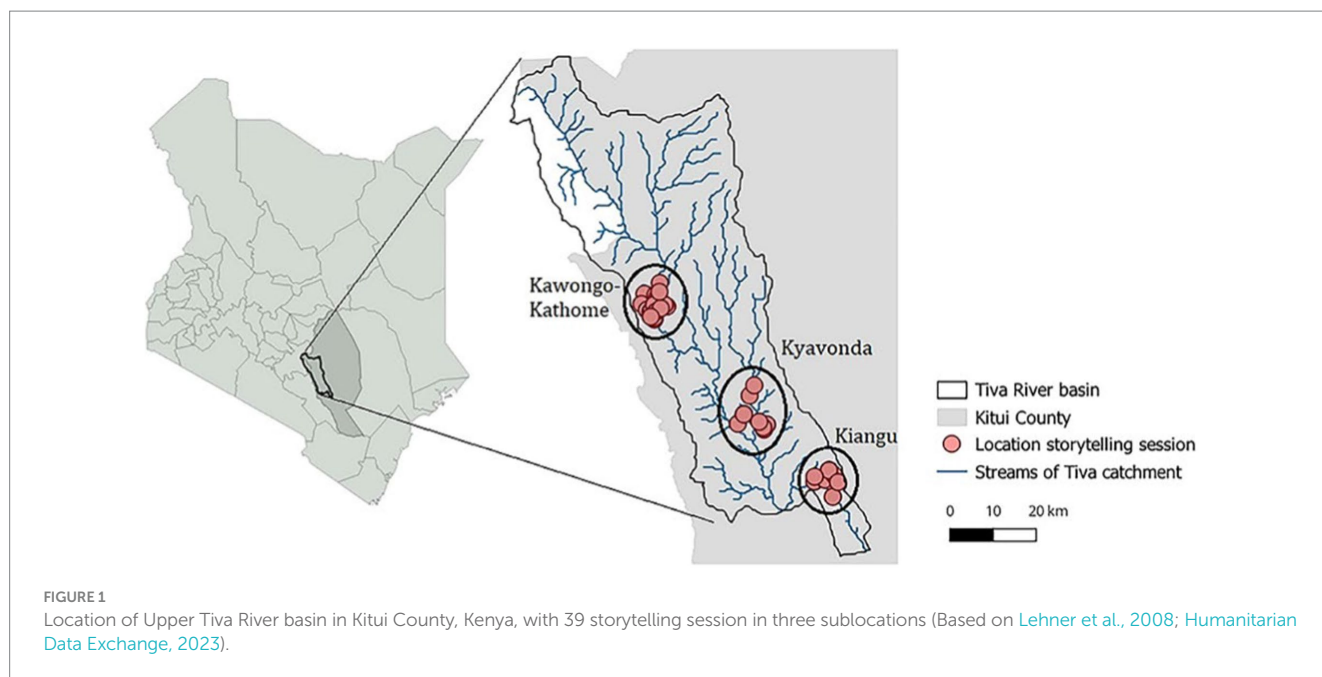
Storytelling is thus a promising avenue to study people’s experiences (Chase, 2003; Cameron, 2012), allowing to reveal the everyday, commonplace, informal, and often overlooked aspects of human-environmental issues (Birchall, 2014; Moezzi et al., 2017). To address the need for a deeper understanding of how droughts and floods experiences are interrelated, we conducted storytelling sessions with agro-pastoralists in a dryland region of Kenya. Through this approach, we reconstructed a history describing how recurrent droughts and floods have been interconnected over time, based on the experiences of agro-pastoralists over the past 70 years. With this work, we aim to contribute to discussions on future adaptation pathways in response to a changing climate with more frequent and intense hydroclimatic extremes and other socio-environmental and socio-economic stressors in East African drylands and beyond.

2 Materials and methods

2.1 Context: the Upper Tiva River basin in Kitui

Our case study focuses on the Upper Tiva River basin, located in Kitui County within the larger Tana River basin in southeastern Kenya (Figure 1).

In precolonial and colonial times, the Kitui region was predominantly covered by forested rangelands and used for extensive grazing (O’Leary, 1980). Semi-nomadic livestock herding, shifting cultivation and trading were the main economic activities of the Akamba, the main ethnic group living in Kitui County. Common historical strategies to cope with drought were rainmaking rituals, such as the Akamba Kilumi dance (Koster, 2011; Nduma Ndanu, 2022); livestock trading with neighbouring crop-producing regions, and migration (O’Leary, 1980; Akong’a, 1988; Borst et al., 2006). In the Upper Tiva basin, a significant proportion of the forested rangelands was lost to the implementation of colonial grazing schemes during the first half of the 20th century (Schmitt et al., 2019). Afterwards, as the population was growing, there was a notable expansion of rain-fed agricultural plots, accompanied by a decline in livestock herds (Akong’a 1988; Schmitt et al., 2019; Borst et al., 2006). In the riparian zones, the natural forest vegetation has been gradually converted into agricultural land since the 1960s, making way for small-scale irrigated farming (Schmitt et al., 2019).



Today, similar to many East African drylands, most residents within the basin engage in mixed farming practices, which involve a combination of subsistence rain-fed agriculture alongside small-scale livestock rearing, commonly referred to as agro-pastoralism ([Morimoto et al., 2010](#)). Agro-pastoralism is practiced in a sedentary way, where most engage in crop-farming while investing a share of surpluses in livestock herds, which in turn serve as a financial buffer during dry seasons and drought. As we describe in the results, there are significant differences in income and capital among the agro-pastoralists, where some can afford to invest in irrigation infrastructures and larger herds of cattle, while most cannot.

The Tiva today is a seasonal river with wide sandy river channels ([Figure 2](#)), and currently flows only during and up to a month after the rainy seasons ([Morimoto et al., 2010](#); [Kitheka, 2016](#)). During dry seasons and droughts, most people rely on the Tiva River and its tributary streams for their domestic water, which they obtain from seasonal shallow wells dug in the sandy riverbeds (visible in [Figure 2](#)). Domestic water is usually transported manually, either by carrying the water on their backs or using bicycles, donkeys, and oxcarts ([Morimoto et al., 2010](#)).

The bimodal rainfall, primarily occurring between March and May (MAM) and October and December (OND), has been described by scientists studying Kitui as unreliable since the 1970s, typically falling in a few intense storms ([O'Leary, 1980](#); [Nissen-Petersen, 1982](#); [Akong'a, 1988](#); [Ndung'u and Muriu-Ng'ang'a, 2021](#)). Scientists have described precipitation patterns as uneven across both space and time, with high rates of evaporation ([Ndung'u and Muriu-Ng'ang'a, 2021](#)). Drought has been reported as a recurrent issue, with both local folklore and meteorological data indicating that drought occurred every 4–5 years until the early 2000s ([Thomas, 1999](#); [MDK, 2005](#); [Lasage et al., 2008](#)). During drought periods, impacts have been severe for a significant proportion of the population, leading to malnutrition, difficulty in accessing potable water, and livestock losses, among other effects ([O'Leary, 1980](#); [Akong'a, 1988](#); [Ndung'u and Muriu-Ng'ang'a, 2021](#)). Consequently, the inhabitants of Kitui are often portrayed as

highly vulnerable to climate extremes ([Khisa et al., 2014](#); [Mwangi et al., 2020](#)). Food aid has been regularly distributed in the area for nearly a century up to the present day, with acute food shortages continuing to be prevalent ([FEWS, 2024](#)). Kenyan scientists anticipate that climate extremes, such as droughts and floods, will become more frequent in the near future ([Mutunga Evelyn et al., 2018](#); [Gladys, 2017](#)).

Similar to most Kenyan drylands, in Kitui, a consortium of actors has implemented various drought adaptation measures in response to severe drought impacts in the late 20th and early 21st centuries. NGOs, local government, and CSOs have been constructing numerous water pans and sand dams to improve access to water during dry seasons and drought ([Thomas, 1999](#); [Borst et al., 2006](#); [Lasage et al., 2008](#); [Manzi and Kuria, 2011](#); [Ryan and Elsner, 2016](#); [Kitheka, 2016](#); [Moïse et al., 2019](#); [Ertsen and Ngugi, 2021](#)). While drought has received substantial attention, notably little response is visible to recurrent floods. Floods causing damage have been mentioned only briefly in case studies and reports, both historically ([O'Leary, 1980, 1983](#); [Akong'a, 1988](#)) and recently ([CCAFS, 2021](#)). The local government and international NGOs, however, have reported that floods in Kitui can occasionally have significant impacts, especially when occurring after a period of drought ([CCAFS, 2021](#)). While no specific analyses have been conducted on floods in Kitui, some studies have demonstrated erosion, sedimentation, and siltation issues in water catchments caused by high surface runoff from limited soil infiltration ([Ngigi et al., 2005](#); [Wambua and Kithiia, 2014](#); [Kambua, 2014](#); [Musyoka, 2021](#)). However, little detail is provided in both academic literature and government reports on other flood impacts and responses, let alone how these relate to preceding drought.

2.2 Methodology

2.2.1 What is storytelling and why use it?

Stories are typically described as narratives that recount a sequence of connected events or experiences ([The Random House Dictionary of the English Language, 1979](#); [Riessman, 2008](#); [Moezzi](#)



FIGURE 2
Upper Tiva River in Kitui, Kawongo-Kathome sublocation. (February 2023; picture taken by research partner Africa Wood Grow Foundation).

et al., 2017). Stories and narratives are often used synonymously and interchangeably in narrative research methodologies (cf. Riessman, 2008). The boundaries between the concepts are blurred and debated, where some argue that narratives tend to denote the more overarching, non-fictional, formal, official, and recorded stories, reflecting a specific discourse, while story tends to be used for the more informal and local (Moezzi et al., 2017). However, like Riessman et al. (2008), Smith et al. (2017) and Moezzi et al. (2017), we chose to use the terms more interchangeably, given the blurred boundaries, where our results are a mixture of accounts of events that reflect both personal stories and collective narratives of past events.

Storytelling in turn, as a method we employ, involves the performing or crafting of stories or narratives (Moezzi et al., 2017; Cameron, 2012; Smith et al., 2017). Storytelling has been used in qualitative research as it enables researchers to delve into meanings, interpretations, and personal experiences (Birchall, 2014). By using storytelling, we aim to provide a qualitative perspective on drought and flood experiences, addressing matters of concern (Latour, 2004). These concerns are assumed to reflect the perspectives of the participants themselves, as we strive to take the situated knowledge seriously (Haraway, 2016; Burman, 2017). Accordingly, there is a small but growing body of research in Kenyan drylands that uses storytelling, stories and narratives relating to water issues as a method (e.g., Bukachi et al., 2021; Zolnikov and Blodgett-Salafia, 2016; Quandt, 2021).

2.2.2 Design, challenges, and limitations of the storytelling approach

During our fieldwork, conducted from November 2022 to February 2023, we arranged participatory and open-ended storytelling sessions to discuss experiences of droughts and floods throughout participants' lives. Three areas (Figure 2) were selected in collaboration with SASOL (a local NGO involved in improving water supplies in the area). Each of the three areas has a different proximity to the Tiva river

(next to the river, 1–2 km away, and 4–5 km away), to engage with individuals residing in different dryland settings. We conducted 39 storytelling sessions across three communities, using snowball sampling. These sessions involved individuals, couples, and groups (Table 1).

The sessions were held in different group sizes, which allowed for different storytelling dynamics. Some participants we planned to be individual, felt more comfortable to have their spouses, neighbors, or relatives around to support their storytelling effort. Therefore, some individual interviews became couples or small groups, as participants preferred it in a collective setting, which is more similar to historical oral storytelling settings in Akamba cultural traditions. Moreover, some groups became smaller and larger than we anticipated, depending on how many people found time to join.

In all sessions the same open-ended prompts were used, such as “What droughts do you remember? What happened?” The sessions with individuals and smaller groups, it was possible to give all participants ample time to speak. This was however not possible in the larger groups, given time constraints (see discussion section 5.5 for a reflection on this). Instead, in the large group sessions, a self-selected group of participants engaged in the detailed storytelling, while others served to confirm or reject stories, and compare briefly to their own experiences.

The storytelling sessions were held mostly in private spaces, at the homesteads of participants. In some cases with larger groups, we used (semi)public spaces such as collective farms and community centers. The sessions were attended only by those invited, and the stories were told only to the fellow participants and researchers. To participate, individuals had to belong to agro-pastoral households within the designated case study areas. Additionally, we aimed to achieve a balance in gender and age representation among the participants. Most groups were mixed in gender and age, while a few groups were restricted to women only, such as a widowed women's group and a women's savings group. Groups were not intentionally split up along

TABLE 1 Participant composition of storytelling sessions.

Type of storytelling session	Number of sessions	Number of participants	Gender division	Age division
Individual (1 participant)	18	18	10 women, 8 men	Youth (18–35): 4
				Adult (36–65): 10
				Elderly: (66+): 4
Small groups (2–3 participants)	9	17	9 women, 8 men	Youth (18–35): 5
				Adult (36–65): 6
				Elderly: (66+): 6
Large groups (8–20 participants, average of 12)	15	183	106 women, 77 men	Youth (18–35): 67
				Adult (36–65): 80
				Elderly: (66+): 36
Total	39	218	125 women, 93 men	Youth (18–35): 76
				Adult (36–65): 96
				Elderly: (66+): 46

lines of gender and age, as most groups we engaged with consisted out of existing informal or formal local savings groups, which we chose not to separate, to preserve the collective environment already pre-existing in these groups.

Several challenges arose during the sessions. Firstly, women were overrepresented, as they tended to organize group sessions more readily through existing self-help and table-banking groups—common forms of cooperation among women in the region (Morimoto et al., 2010). This may have influenced the types of stories shared. Secondly, we had to be mindful of recall bias in the storytelling (Bietti et al., 2019), where older stories may be remembered with less detail than more recent ones. Conversely, stories from the distant past may receive more attention during storytelling, as elders within a community are usually seen as the legitimate age group to conduct oral storytelling in Akamba cultural traditions (Akong'a, 1988; Nduma Ndanu, 2022). Third, by exclusively choosing agro-pastoral households, we have omitted households that do not engage in agro-pastoralism. Although this constitutes a minority within each community (with most individuals engaged in off-farm employment also participating in agro-pastoral activities), the viewpoints of those with alternative livelihoods, who do not grow crops nor keep livestock, are not represented here.

In an attempt to address matters of concern, we posed open-ended questions to initiate the storytelling sessions (cf. Chase, 2003; Gubrium and Holstein, 2002). The discussions were initiated with open prompts, such as: “What droughts and/or floods have you experienced? Do you remember what happened?” We attempted to leave the terms drought and floods open to interpretation, however at times, more clarification was needed, and our translator used local terminologies as examples for different types of droughts and floods used in Kikamba terminology (see section 3.2.3). Given the oral storytelling traditions in Akamba culture, particularly among the elderly (Akong'a, 1988), these open-ended prompts were generally effective in initiating the sessions. The oral narratives shared were recorded, translated from the participants' native language (Kikamba) into English, transcribed, and analyzed using ATLAS.ti (2024) software. We employed a thematic inductive coding approach (Joffe, 2011). Given the focus of this paper on drought and flood experiences,

only the quotations pertaining to these topics have been analyzed, including 838 coded quotations on drought and 478 on floods. A complete list of pseudo-anonymized quotations and transcripts of the storytelling sessions can be openly accessed online (https://osf.io/sb54g/?view_only=557a458c0d5a4bb5970ebab89081ee9b).

To analyze and present the experiences over time, we opted for a decadal scale to organize the stories chronologically, as most participants were uncertain about specific years but often recalled decades. While each memory of droughts and floods is distinct, there were some notable similarities in how participants recalled past events during the sessions. As storytelling is sometimes criticized for risking to produce anecdotal evidence (Moezzi et al., 2017), we only included stories with significant overlap or frequent mentions (in three or more sessions) in our results, as we assume these to reflect the wider experiences of a broader segment of the population. The small selection of quotes displayed in the results is referred to with their participant (rx) or group number (gx), which are traceable in the datasets.

2.2.3 Positionality during the fieldwork

The way stories are conveyed varies depending on the audience, purpose, location, and other contextual factors, posing challenges to treating stories as consistent data points (Moezzi et al., 2017). In this study, storytelling is likely influenced by the presence of an unfamiliar, white, male researcher working alongside a local translator. This setup could impact both the content and delivery of the stories shared, as well as what remains unspoken. Informal conversations with community members revealed that white individuals participating in social gatherings are often perceived as external agents bringing ‘modern development’ in the form of infrastructure or training. This perception is an understandable consequence of Kitui being recipient to numerous development programs by organizations from the Global North over the past decades.

In response, we dedicated considerable time to engaging participants in discussions about our identity, intentions, and objectives for the storytelling sessions. By collaborating with participants to design the sessions as open dialogues rather than pre-structured interviews, we aimed to avoid an extractivist approach

to data collection (Gorman, 2024), opting instead for informal settings and using the local language. Given that the transcripts were translated into English, nuances have been lost in translation. To minimize such losses, we inquired and adopted locally used mixes of Kikamba and Kiswahili terms for drought and floods. Different terms for drought we distinguished were *yua* (sunny drought affecting people), *muniyao* (prolonged drought affecting people and livestock). An important distinction we had to clarify is that we were not meaning to discuss the regular dry seasons (*thano*). We also made clear that with floods we did not mean solely *mvua mvingi* (heavy rain), but instead *mafuriko* (floods), with actual water flooding the ground—leaving the term open to interpretation from there. By doing so, we aimed to foster collective learning opportunities for mutual exchange, rather than merely extracting data.

Collaborating with a local translator and dedicating 2–4 h to each storytelling session, we aimed to create an environment where participants felt comfortable sharing their concerns openly. We believe this approach was generally successful, as most participants raised a wide range of collective concerns and personal life stories. Many participants were willing to share deeply personal experiences, including those that might be considered painful or stigmatizing, such as detailed accounts of food insecurity or children dropping out of school.

3 Results—a history of drought and flood experiences in the Upper Tiva River basin

3.1 1940s–1960s—floods paralyzing colonial development during drought

During this period, which spanned from British colonial rule into the first decades of independence in Kenya, droughts are recollected as severe episodes with significant repercussions, notably malnutrition and livestock casualties. Droughts were assigned names to signify the impacts experienced by people, the strategies employed to cope, or the type of aid received. Various coping mechanisms included sisal weaving, accessing food assistance, selling livestock or their remains, and hunting-gathering. Additionally, the construction of roads under “Food for Work” programs, initiated by both colonial and postcolonial administrations, featured prominently in the memories of the elderly. Many participants reminisced about prolonged periods of severe drought being alleviated by extensive rainfall, leading to abundant harvests but also triggering disease outbreaks and causing damage to recently dug roads across the region.

In the 1940s and 1950s, several older participants recalled a time when women had to embark on lengthy journeys to urban centers in search of food, during which malnutrition was widespread. The name *Ndovoi* (borehole) was frequently mentioned, referring to the construction of the first boreholes in the area. Families predominantly relied on livestock, often bartering it for other food items. Crop cultivation was limited, with families depending on food aid and root tubers. Many elderly participants vividly recalled a drought of the early 1950s, known as *Ngonge*, during which livestock perished. This term derives from the sisal (*Agave sisalana*) leaves, which were scraped for fibers and sold to purchase food. Heavy rains ended *Ngonge*, marking the earliest flood remembered:

“The first heavy rain to bring changes was the one which finished the 1950 drought; 1951 is when this river was full of water until it broke the banks. [...] it was just flash floods [...] resulting in the widening of the river [...] I had to go for my grandmother who had climbed a tree after the farm was flooded” (g6).

In the early 1960s, a prominently remembered drought that ended in flooding is known as *Ndeke* (airplane or bird). Participants recalled this period as occurring in the years preceding independence in 1963, characterized by famine conditions where baobab fruits were cooked and local beer brewed for sustenance. Men engaged in digging public roads in exchange for provisions supplied by the British colonial government as part of the “Food for Work” programs during their waning years in authority.

“62, we were about to gain independence. [...] we were working on this road—digging manually, and the work norms for the day were recorded. (g9) [...] Then after work, we would be given food. [...] by the government” (g4).

This episode illustrates how, in their final year in power, the British colonial administration prioritized road infrastructure development amidst drought conditions, leveraging such periods to mobilize labor. The activities were abruptly halted with the onset of heavy rainfall, rendering most of the basin impassable for food transportation. Consequently, the colonial government initiated aerial food aid deliveries:

“The *Ndeke* drought, there was heavy rain after the drought. [...] Then when the rains came, it was heavy such that the rivers were swollen and no vehicle could cross the rivers. That is the time when aircraft were used to supply food to areas that were surrounded by rivers” (g4).

The rainfall resulted in various other damages:

“Maize was getting ready for harvest, covered by water; they would even turn yellow due to waterlogging. People also died a lot due to disease (*Muimu*). That famine made people even eat wild trees. [...] That was in the year 1963” (r1).

Despite the challenges posed by flooding, some participants recount instances of successful maize harvests by planting seeds sourced from food aid sacks.

3.2 1970s–1980s: crippling droughts producing flood vulnerability

A prominently recollected drought spanning from approximately 1970 to 1977 was referred to as *Longosa* (weak joints), denoting the cattle’s struggle to stand during the drought period, especially after the heavy rains that followed. Participants were highly dependent on their relatively large herds of livestock, most of which succumbed during the drought (as also reported at the time by O’Leary (1980, 1983) and Akong’a (1988)). What has not been reported in existing records is that *Longosa* ended with heavy rainfall and subsequent flooding. The

floodwaters proved disastrous, as, after a while, fatal illnesses began to proliferate among people:

“Children got pneumonia [...] After that rain [...] the mosquitoes that came brought about malaria that was hard to treat, and the hospitals were far, so most children who were below five died during that time. [...] Even during those floods, the elderly were dying a lot” (g7).

Most cattle that (barely) survived the drought succumbed after the rains had fallen due to their weak joints (*Longosa*):

“When it happened to rain, it rained a lot to the point that if there was any remaining cow, it would get stuck in the mud. [...] When the rains came, they also died” (g11).

While these deadly impacts proliferated, there were some positive aspects to the flooding; participants reminisced about bountiful harvests and minimal erosion during this period:

“There was very heavy rain in ‘78. [...] The one that ended the drought, there were a lot of pumpkins even on the roads. [...] Even at some weddings, they would decorate with pumpkins” (g7).

“You would even plant there at the stream after the water was over; you would plant there and harvest. Most people did that [...] it had no major destruction; it just flooded but never swept away the trees along the river, it was just some” (r27-28).

In the 1980s that followed, the most widely recalled drought of the 20th century spanned approximately from 1982 to 1986. During this drought, commonly known as *Nikw’a Ngwete* (I’ll die holding), occasionally appended with *mpesa* (money), participants possessed cash but faced an acute scarcity of food items for purchase, leading to widespread malnutrition. People sought food from faraway urban centers, often to no avail. As no food was found, many participants resorted to consuming baobab fruits, “to the point that the skin had turned white due to peeling off” (r1). Food aid arrived over the new roads developed during earlier droughts but was insufficient. Moreover, participants remembered surviving off a diverse array of animals and fruits sourced from nearby forests, owing to the sparse settlements and dense vegetation cover prevalent at the time.

While these survival strategies were indispensable, new avenues for securing sustenance or income emerged: engaging in casual labor for an emerging formally educated middle class. Predominantly employed in urban centers such as Kitui, comprising professions like teaching and civil service characterized by stable salaries, these individuals were now able to afford to hire laborers to work on their farms. Consequently, casual farm labor became a crucial means of income generation for subsistence farmers. This shift in employment dynamics initiated a trajectory of heightened inequality and differential impacts of drought across families, predicated largely on whether households had members engaged in formal employment. Notably, this marked the first instance where wealthier individuals leveraged drought conditions by employing laborers at minimal wages.

Most participants believed that *Nikw’a Ngwete* concluded with substantial rainfall in the late 1980s. Analogous to the ending of the *Longosa* drought, this event heralded the arrival of new harvests;

however, it was accompanied by deadly disease epidemics exacerbated by the weakened state of the population due to the preceding drought. Some participants contend that the subsequent rainfall was lethal while the drought was not, again signifying the damage of rains after a long drought:

“*Nikw’a Ngwete* [...] did not have people dying, but after the rains, some died because people were sleeping hungry” (r1).

3.3 1990s—drought adaptation efforts affected by El Niño floods

Although widely remembered, the droughts experienced during the 1990s have lacked universally agreed-upon names among the participants. Despite the challenges families faced in accessing food, reports of severe malnutrition or widespread livestock mortality were notably absent, and *Katongelele* (yellow maize) was provided through food aid. Provisions remained available in local stores, as the road network helped the area connect economically to neighboring crop-producing regions. Efforts to mitigate the drought were facilitated through the reinstatement of food- or cash-for-work initiatives, this time not only by the government, but also a range of international nongovernmental organizations (INGOs) such as ActionAid and local civil society organizations (CSOs), usually local and regional churches, gaining prominence in the area. These initiatives started a broad range of adaptation efforts to drought through the recruitment of drought-stricken agro-pastoralists, organizing the excavation of public water pans, terracing, and zai pits. These programs were colloquially labeled as *Katulu* (squirrel), referring to the participants’ digging reminiscent of squirrels.

As not all people were recruited for *Katulu* projects, alternative drought coping mechanisms emerged. In particular, there was an increase in labor migration among young men, with many seeking employment opportunities in other crop-producing regions in “Kikuyu land” (g14). Those who remained in affected areas often resorted to underpaid casual employment as a means of survival. Traditional avenues for generating income for women, in the form of crafting and vending necklaces made of seeds (*ndolongwe*), weaving sisal baskets, marketing acacia fruits as livestock feed, or harvesting tamarind and root tubers (*masembe*), were still undertaken but were partially replaced by the production of charcoal. Initially undertaken on a subsistence scale, charcoal production proliferated as a prevalent source of income, particularly among numerous female participants, who labeled the drought as *Yua ya Makaa* (Drought of Charcoal). Moreover, irrigated agricultural land expanded, with plots increasingly appearing in the riparian zones of the Tiva and its tributaries. Irrigation was initiated by migrants from neighboring Makueni and Machakos districts, where land had become scarce. Their irrigation successes of producing crops during the droughts prompted emulation by locals.

Despite these emerging activities to cope with and adapt to drought, participants recalled it was not sufficient to afford school fees, leading to widespread school dropouts among children. Participants sometimes remembered this as a painful experience that hindered their further opportunities in life. Girls dropped out to be married off “very young” (r14-15) or work as maids in wealthier households. Boys dropped out to do casual jobs on farms or look after livestock (r29-30).

Leading up to the arrival of the October 1997 rains, participants remained preoccupied with managing the ongoing drought conditions. With official sources predicting minimal OND precipitation, individuals were advised by meteorological experts to cultivate drought-resistant crops such as millet and sorghum. Some participants adhered to this advice, driven by the desire to attain their first harvests following years of drought. However, contrary to expectations of scant rainfall, the precipitation arrived early and persisted beyond January, continuing without stopping into the subsequent MAM rainy season in 1998. This extended rainy period is retrospectively recalled as the El Niño, coinciding with the climatic phenomenon. While maize yields flourished, the drought-resistant crops suffered significant losses:

“They were saying people should grow millet because there would be no rain expected. [...] But the rain came early instead [...] I grew maize; I never grew millet. But those that grew sorghum and millet did not harvest anything because it was affected by [...] mold. It gets sticky [...]. Because there was a lot of rain” (g13).

Numerous participants opted to cultivate maize instead and recalled engaging in multiple replanting cycles to achieve “buffer harvests” (g6, 8, 13). This practice underscored the challenge inherent in selecting crops amidst unreliable weather forecasts, where planting maize was incentivized by abundant rainfall while drought-resistant crops suffered losses. This dilemma in crop choice is highlighted by contrasting sentiments among participants, with some expressing satisfaction at not having planted drought-tolerant crops prior to the El Niño event, while others lamented such decisions.

The prolonged period of excessive rainfall from the OND of 1998 into the MAM of 1999 resulted in significant damage to people, agricultural yields, and infrastructure previously implemented to combat drought. As the nearly 6-month-long deluge persisted, much of the harvest was lost to rot (while people attempted to dry the harvest through lighting fires inside storage buildings), latrines became inundated, mud and thatch dwellings collapsed, locust swarms emerged (Nguuti), and outbreaks of cholera and malaria began to ravage communities. The inundation of roads impeded access to medical facilities in urban centers, which was a primary contributor to reducing access to medical care. The flooding also disrupted children’s schooling, as flooded latrines forced schools to close, exacerbating the already diminished attendance rates resulting from the preceding drought period. Agricultural land, both proximate and distant from main river channels, suffered significant damage and erosion. Those who had initiated irrigation projects along riverbanks experienced the complete destruction of their farms due to floodwaters. The erosion of farmland reached unprecedented levels, manifesting in the formation of numerous gullies across the terrain. Moreover, the protective measures implemented during the preceding drought, such as terraces and zai pits, proved susceptible to the impact of flooding:

“We dug terraces, like now this is a terrace you see, which was here and it got silted. We dug terraces but you will find when the rains fall they do break. We dig zai pits [...] but they got silted” (g14).

Additionally, the recently dug water pans, locally referred to as *silanga* (earth dams), proved vulnerable and even contributed to flooding:

“An earth dam [...] broke; water got into our homes, and you would hear pots crushing each other. On stepping out, the water was knee-level; you would get out and climb on a tree” (g5).

After the El Niño flooding, drought years returned. Participants engaged in efforts to recover from the flood-induced damages and prepare for subsequent dry seasons. Gullies were remediated through the application of cement and soil infill, while grasses were strategically planted within gully areas and along expanded river channels. Individuals financially and/or physically capable of doing so undertook the restoration of terraces, supplemented by the application of manure to rejuvenate soil fertility depleted by sandy and salty deposition. Notwithstanding these remedial measures, the El Niño had led to a collapse in crop productivity. Assistance was communicated by governmental authorities to affected participants, who initiated the registration of flood-related damages for compensation purposes. However, these pledged reparations never materialized. As the drought continued, vital dry-season water reservoirs, including natural springs and wetlands, either desiccated entirely or ceased to supply potable water as effectively as during previous drought episodes. The extensive erosion observed during the El Niño event prompted NGOs and governmental entities to provide compensation to farmers for the expansion of new water catchments and terracing initiatives. Moreover, participants recollect the resurgence of charcoal production, driven by the scarcity of alternative income sources and the burgeoning demand for charcoal in the rapidly growing urban centers.

3.4 2000s—diversification during drought, growing erosive power of floods

The start of the 21st century was characterized by a general recollection of recurring dry conditions, often associated with the La Niña-related drought of 1999/2001 (cf. Ng’ang’a (2006) and Urama and Ozor (2010)). While memories of dry periods became less clear-cut, most remember droughts to have reoccurred until around 2006 (r20-21, g15). Again, most drought events were no longer given common names within the communities.

The scope of the *Katulu* projects initiated, in response to the erosive El Niño floods, emphasized assistance in terracing individual land parcels. Moreover, there was an upsurge in the deployment of government-funded agricultural extension officers and NGO-funded training programs within the region. Participants attribute their adoption of drought-resilient farming practices to these trainings, including increased terracing efforts on their own land, cultivation of drought-tolerant crops such as sorghum and cowpeas, and diversification of agricultural endeavors through the integration of fruit orchards and beehives.

The deposition of sand within and along the expanding riverbanks during the El Niño floods, as well as minor floods afterwards, created an opportunity for a new measure to halt erosion and improve water supply: sand dams. Regional CSOs and NGOs operating in the whole of Kitui engaged participants in the construction of numerous sand dams across various tributaries that feed into the Tiva River.

Moreover, the accumulation of sand deposits, combined with an increased demand for sand in construction projects, presented a new income opportunity. Especially during dry seasons and drought,

young men began engaging in the extraction of sand from the main rivers, transporting it via pick-up trucks or lorries to construction sites in urban areas both within and beyond the region. Often, these trucks were also used for the transportation of charcoal. Participants asserted that as a consequence, some riverbeds became bare, intensifying water runoff peaks, exacerbating erosion, and making sand dams vulnerable to flood damages.

Most participants recall returning to work on the estates of affluent landowners. The proliferation of irrigated agricultural plots alongside the main rivers provided some avenues for earning income. However, wages remained low, job availability was constrained, and hunting-gathering was no longer viable as forest cover had declined, leading to a resurgence of malnutrition.

Although there was no clear-cut end to the drought, substantial rainfall was observed around 2006. Certain newly established infrastructures demonstrated susceptibility to flooding: shallow wells adjacent to recently constructed sand dams sustained damage, rendering them inoperative, while water pans became silted. Not only did rivers overflow their banks, causing flooding, but water pans and sand dams also experienced breaches, contributing to flood damage, as downstream farms were “swept” (r8, g5).

On the growing area of irrigated plots, gullies either formed or deepened, while sand deposition occurred, resulting in the loss of equipment such as pumps and pipes, which were significant investments of the relatively affluent. For the first time, the heavy rainfall coincided with strong winds, resulting in damage to buildings and trees, a phenomenon that persisted during subsequent heavy rainfall events. While erosion worsened, there was no further mention of disease outbreaks as a prevailing concern, as floodwaters no longer waterlogged the area for weeks or months, which they did in 20th century floods. Some participants experienced the loss of their donkeys or oxen, which impeded their ability to efficiently gather water and plow fields in the following drought years.

Drought returned from around 2007 to 2010, prompting the construction of additional sand dams while causing livestock fatalities, crop failures, malnutrition, and instances of school dropouts. Although “livestock died a lot” (r21), not all individuals suffered such losses, particularly among those engaged in irrigation activities near the Tiva River. Others sought income opportunities in urban centers or temporarily migrated again to crop-producing regions of Kenya.

3.5 2010s—drought as the ‘new normal’; floods leading to more erosion

“We got used to droughts, so we no longer give names. [Laughs] [...] A drought occurs, but it does not ring in the mind as a drought” (g4).

Throughout the 2010s, the nature of drought experiences transformed from being exceptional, harsh periods to becoming the ‘new normal’ (g6, 8, 14, r3, 5, 14, 16). Rainy seasons became more unstable, primarily sustaining the cultivation of early-maturing crops such as sorghum, millet, and cowpeas, but not allowing for successful maize harvests—the main staple in the region to this day. The recollection of specific drought and flood years became even less distinct, with the cessation of assigning names and greater disparities observed across case studies regarding which years are remembered as drought years.

As most harvests continued to fail from around 2012 to 2017, participants resumed engaging in various forms of casual labor, including farm work, construction, sand harvesting, brickmaking, and small-scale charcoal production. For some participants, charcoal production became their sole means of income as they saw “no alternative” (r7). While unregulated charcoal burning has been banned in Kenya since 2005, local authorities often turn a blind eye to such activities, recognizing the absence of viable alternatives for livelihood. Moreover, landowners, pressured by income-desperate neighbors, resorted to selling their trees. Concurrently, other participants diversified their income sources during drought periods by venturing into activities such as beekeeping or planting fruit trees, including mangoes. Despite offering some respite, many participants recounted experiencing food shortages once more, resorting to selling all their livestock, consuming crushed baobab fruits, and witnessing a resurgence of school dropouts.

One night, during the 2018 OND, the drought ended with the most abrupt flood thus far:

“We were watching the water from far, and it had broken banks, sweeping away all the people living near the river; their belongings were swept away to the extent that the places where there had been farms became the river. It swept away even the mango trees. [...] When something clears a place, when fire begins burning an area, does not it burn at once? [...] People were drowned along with all pipes and machines. [...] It rained in the night, and in the morning nobody would go closer. It carried away our trees. [...] We think that many earth dams broke their banks due to the rains, the dams that were holding water; it seems they broke and added the water to the Tiva. [...] Because there is one sand dam I heard broke upstream and flooded into the Tiva” (r14-15).

The flood was sudden and short-lived, with heavy rainfall combined with strong winds. It was more erosive than previous floods, causing loss of life and widespread damage, especially near the Tiva River. Those irrigating near the rivers “incurred great losses” (r17, r18) to their investments in pumps and pipes. Sand and salt were deposited on all the farmland near the river, rendering much of it unusable to this day. When the water receded a few days later, participants saw how the Tiva had widened its banks and “eaten” (r17) several tens of meters of the adjacent farms, leaving much farmland “split in two” (r18) by deep gullies (Figure 3).

The causal linkage between the Tiva River floods of 2018 and the potential breach of upstream water pans or sand dams remains uncertain. In the other case study, further away (5–6 km) from the Tiva River, suffered significant damage due to the failure of a water pan:

“There was heavy rainfall [...] This earth dam got filled up and broke its banks. Even livestock died. Donkeys that were tethered along the riverbanks died. [...] The runoff water is what carried [the terraces] away. [...] At that time, no one was left with land that had not been carried away” (g12).

Individuals lacking the resources to invest in brick or concrete housing were particularly affected, as evidenced by a group of widows (g10) whose predominantly mud-and-thatch dwellings sustained substantial damage to living quarters, kitchens, and



FIGURE 3

Participants demonstrating how Tiva River (left) and a tributary Nzeeu River (right) have “eaten” their irrigated riverside plots during the 2018 floods (r17, r25; pictures taken by author RVW).



FIGURE 4

Preventing erosion through grass planting (pictures taken by author RVW).

latrines. Furthermore, their inability to implement terracing measures on their farms resulted in rampant erosion and sand deposition, rendering a considerable portion of their farmland unusable.

The floodwaters rapidly receded the next day, coinciding with the conclusion of the rainy season, leaving many individuals disheartened:

“The following day, people were even passing through Tiva; the water had already gone. [...] There wasn’t any other rain, [...] and we got out with no harvest” (r21).

Relatively dry years followed the 2018 floods, during which participants grappled with the aftermath of the disaster. The floodwaters inflicted extensive damage, undoing much of the infrastructure and investments individuals had made to adapt to the ‘new normal’ of drought, including irrigated farmland, terraces, beehives, zai pits, shallow wells, and fruit/hardwood trees. Numerous participants conveyed their inability to secure the financial resources or labor needed to rehabilitate their drought measures. As an illustration, an elderly participant recounted how he lost over half of the 84 beehives he had constructed during prior droughts. These beehives had been positioned in riparian trees near the Tiva River, which had been swept away by the floodwaters. Lacking the physical

strength or resources to reconstruct the beehives, he now finds himself without an income during drought (r18).

The damaged water pans and sand dams fell into disrepair, failing to fulfill their intended function of providing water during the dry season. The repair efforts undertaken by governmental, NGOs and CSOs were delayed, took several years, and were only partially successful, with some dams no longer retaining significant amounts of water.

Given these challenging circumstances, participants recalled reverting to casual employment and engaging in charcoal production once again. Moreover, when accessing water during the dry years around 2020, participants noticed an increase in salinity levels in the water obtained from seasonal shallow wells located in and around the rivers, asserting that this increase was caused by the floods.

Nonetheless, participants endeavored to recover. Irrigators who ceased irrigation activities allowed their eroded, sandy plots to lie fallow or planted grasses to mitigate further erosion and provide fodder for livestock. Those with access to oxen or tractors attempted to restore their farmland through plowing and the addition of manure. Those able to repair their terraces did so. Many participants initiated efforts to prevent further erosion by planting *Napier* (*Cenchrus purpureus*) or *Vetiver* (*Chrysopogon zizanioides*) grass along riverbanks, streams, and within gullies (Figure 4).

3.6 2020s—the struggle for flood recovery during drought

In the MAM season of 2021, brief yet intense rainfall events resulted in the flooding of certain rivers and water pans once more. These rains exacerbated erosion to a greater extent than previously observed:

“Today it rains only little rains, and you see gullies being formed [...] In the past, it was not like that. There were a lot of rains, and they were not causing erosion, but today I see soils being eroded” (g13).

Afterwards, drought returned:

“There are four seasons that have failed. [...] The foodstuffs are too expensive. [...] Along the river, those people who grow vegetables pay us 300 [shillings] per day. [...] On other days, you go without food. On other days, we do not eat; we sleep—Kuveta! (putting aside)” (g5).

The drought has coincided with an unprecedented surge in food prices, a consequence of the global economic repercussions stemming from heightened prices on imported staple foods following the Russian invasion of Ukraine in February 2022 (Arndt et al., 2023). This situation underscores the substantial reliance of many individuals on purchasing food during periods of drought rather than depending on their own produce.

Throughout our fieldwork (late 2022–early 2023), sporadic rainfall has facilitated the cultivation of certain drought-tolerant crops, such as sorghum, millet, and green grams; however, maize harvests have predominantly been unsuccessful. Although drought no longer results in widespread malnutrition, it remains a significant concern. Numerous individuals struggle to afford their children’s school fees and procure an adequate food supply.

Moreover, the aftermath of the floods has left participants vulnerable to the ongoing drought, impeding their recovery efforts from flood damage. Participants emphasized that their engagement in casual labor leaves them with insufficient time to prepare their own terraces in anticipation of the next rains. Many individuals have not only been unable to restore their terraces, but also struggle to rebuild lost beehives, rehabilitate eroded farmland, or repair demolished houses. For instance, a mother who had been producing bricks to repair her flooded house had to sell those bricks to cover her son’s school fees during the drought.

Meanwhile, competition for the limited employment opportunities intensifies. Women’s groups (g10, 11) noted a shift towards a more individualistic approach in securing casual employment; individuals now independently seek job opportunities without informing others who may be vying for similar positions. The flood damages disproportionately affect the most vulnerable, as they are least able to recover their losses. Those who can recover from flood damages, and even benefit from low-cost labor availability during drought, are individuals with steady income streams from employment, enabling them to enlist the assistance of others for tasks such as terrace construction or irrigation. For instance, a retired teacher and his spouse (r17–18) have been able to hire laborers to cultivate their land and construct food and fodder storage facilities amid the ongoing

drought. Similarly, another participant, whose spouse is employed as a teacher, has managed to irrigate grasses for livestock feed despite experiencing pipe damage following the 2018 floods. She reports having avoided livestock losses by being able to employ others to undertake the necessary tasks.

4 Discussion

Through storytelling, agro-pastoralists of the Upper Tiva River basin in Kitui have articulated their lived experiences of historical and recent droughts and floods, sharing firsthand accounts of how these events have changed over time. This approach provides new and relevant insights into the evolution of drought and flood experiences and highlights the complex interconnections between them. Figure 5 presents an indicative timeline of the main events experienced over time, along with the relative severity of their impacts. This overview is not quantitatively precise; rather, it conveys an impression of how the severity of impacts and the frequency of droughts and floods have evolved based on the shared stories. We discuss this further below.

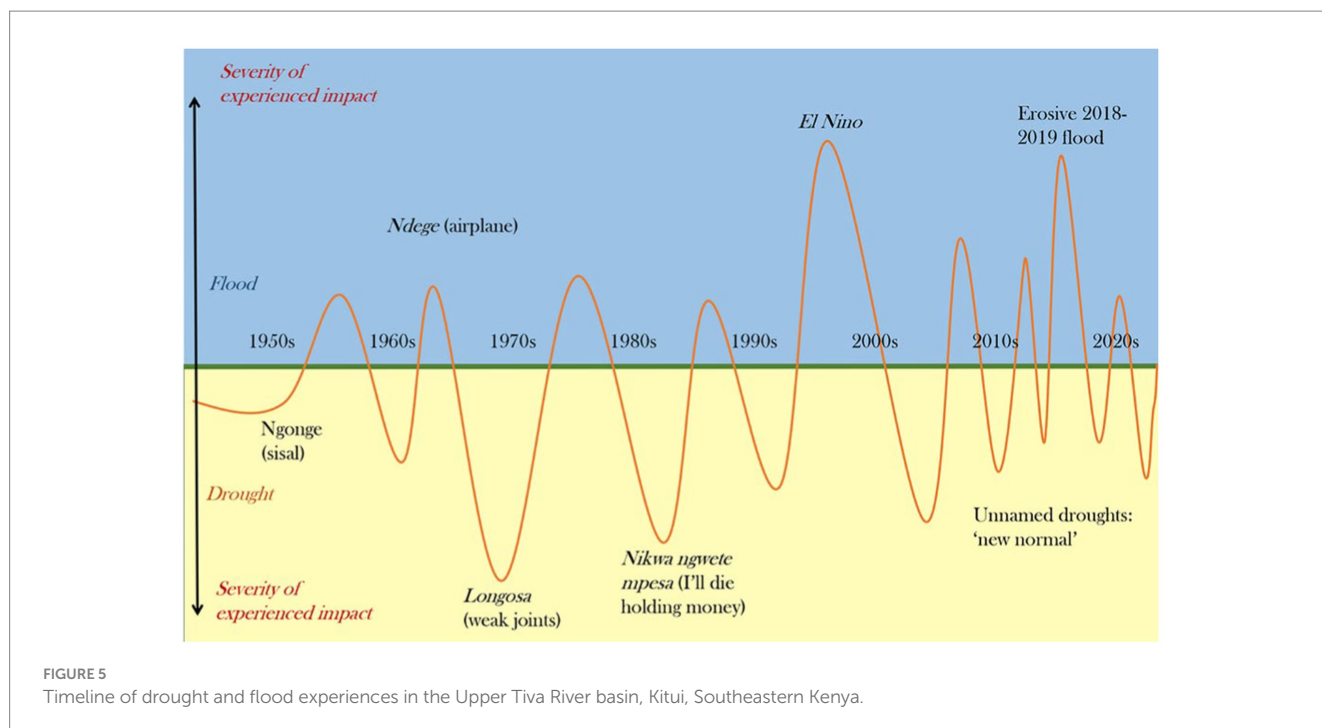
4.1 20th century floods after drought: a double-edged sword

As agro-pastoralists vividly recalled and named droughts after coping mechanisms, such as *Ngonge* (sisal weaving), or their severe impacts, such as *Longosa* (weak joints), until the late 20th century (Figure 5), their experiences align with existing historical records of drought impacts and coping strategies in Kitui (Akong’a, 1988; O’Leary, 1980, 1983). Similar experiences of drought have been recorded in other Kenyan drylands (Little et al., 2001; Ifejika Speranza et al., 2010; Quandt, 2021).

However, what has received far less attention in existing records and studies is the participant’s accounts of how 20th-century droughts often concluded with periods of abundant rainfall, including floods. These post-drought floods acted as a double-edged sword.

On one hand, the abundant water often led to successful harvests and replenished water sources, providing a buffer for the next dry period. In this sense, Kitui resembled other East African drylands, where the first rains after drought were usually welcomed (Little et al., 2001). In the wider region, the regenerative function of post-drought rains, including floods, has historically been essential for livelihoods and the health of ecosystems: vegetation can regenerate, groundwater levels can rise, and rainwater can be harvested (Little et al., 2001; Rettberg, 2010; Ward et al., 2020).

On the other hand, our study reveals that floods in the latter half of the 20th century also resulted in damage to infrastructure and lethal disease outbreaks among people and livestock weakened by preceding droughts. Floods severely hampered access to healthcare facilities for families affected by outbreaks of cholera and malaria. Additionally, livestock that were malnourished due to drought succumbed to various waterborne diseases when floods arrived. As such, the participants demonstrated how the impacts of drought extend beyond the drought period and can paradoxically be exacerbated by subsequent floods. This illustrates how drought can have lasting memory effects beyond its occurrence (Van Loon et al., 2024).



4.2 The 21st century: normalization of drought and more erosive floods

Once perceived as infrequent yet severe events, the participants expressed how drought has become ‘the new normal’ in Kenyan drylands in the early 21st century, which aligns with existing reports on other Kenyan drylands (Little et al., 2001; Urama and Ozor, 2010; Quandt, 2021). Storytelling has clarified that droughts are no longer standalone events but rather a recurrent state of affairs to live with (Greene, 2021). This is evident in participants no longer giving distinctive names to droughts and recalling drought periods that are less sharply defined. This mirrors experiences in other Kenyan drylands, where drought now occurs roughly every other year (Quandt, 2021), compared to once or twice per decade in the past (see heightened frequency of experienced droughts in Figure 5). Moreover, this may stem from participants stating that direct impacts have become less severe, with fewer people suffering from malnutrition as agro-pastoralists diversified their income sources over the last two decades (cf. section 5.3). Plotting deviations in precipitation from the long-term mean (Figure 6) reveals an increase in drought frequency in the 21st century, aligning with experiences of drought normalization. As drought is experienced as a new normal in East African drylands, one can debate—while beyond the scope of this paper—to what extent research ought to still conceptualize dry conditions as drought, as drought is usually defined as a lack of water compared to normal conditions (Van Loon et al., 2016).

While floods were considered relatively abnormal events in the late 20th century compared to drought in Kenyan drylands (Little et al., 2001), participants now describe floods as a more recurrent phenomenon in the 21st century. In addition to being more frequent, floods have become shorter and more erosive, with water receding within hours after causing damage. Erosion from heavy rainfall has been reported in various East African drylands, where flash floods

now erode cropland, homes, and roads (Blake et al., 2018; Watene et al., 2021; Githae and Mutiga, 2021). The flashy nature of these floods has transformed their impacts: damages from extended rainfall, such as waterlogging, waterborne disease outbreaks, and post-harvest losses, have diminished from 2000 to 2023. Consequently, participants described how floods have lost their regenerative function of replenishing water resources and supporting the recovery of vegetation. With shorter rainfall periods and less water retention within the landscape, floodwater often no longer leads to maturing crops, instead receding within hours or days. When visually interpreting monthly rainfall anomalies (Figure 5), extended periods of high rainfall that once ended drought, such as during the late 1970s, seem to have occurred less frequently in the 21st century.

4.3 Adapting to droughts and floods amidst rapid socio-economic and environmental change

Through storytelling, we now better understand how experiences of droughts and floods are shaped by historical, political, socio-economic, and environmental processes, while also being actively reshaped by agro-pastoralists as agents navigating these dynamics. We proceed to discuss a selection of findings that could inspire further inquiry.

The participants have shown how, in the 20th century, colonial and postcolonial government administrations leveraged drought conditions by recruiting income-seeking agro-pastoralists to implement a range of infrastructural developments—first the road network and later various hydraulic infrastructures. While drought itself is considered a product of (post)colonial histories (Savelli et al., 2022), the stories illustrate how drought conditions have been used by those in power to implement infrastructural development across the

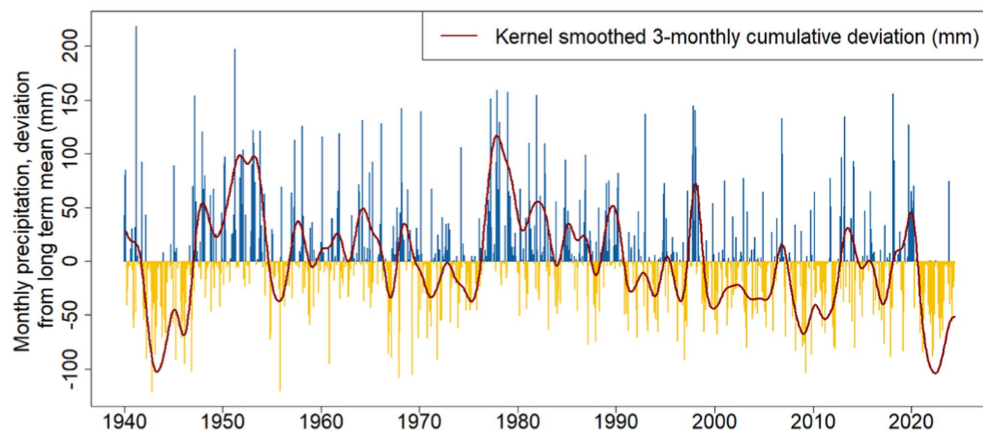


FIGURE 6

Monthly precipitation deviation from long term mean in Kitui 1940–2023 [Contains modified Copernicus Climate Change Service information (Hersbach et al., 2023)].

region. From the 1990s onward, this role was increasingly taken up by INGOs, shaping drought adaptation as a process of constructing widespread small-scale hydraulic infrastructures. Many of these infrastructures meant to improve water supplies during drought, proved susceptible to flooding, in turn producing more vulnerability to subsequent drought (which is discussed in section 5.4 below).

Meanwhile, agro-pastoralists have coped with and adapted to recurrent droughts and floods on their own initiative, amidst rapidly changing economic and environmental conditions. Over the last 70 years, Kitui has experienced climate change, declines in vegetation cover, rapid population and economic growth, urban encroachment, land subdivision, and agricultural intensification (Schmitt et al., 2019; Musyoka, 2021)—trends that have occurred in many East African drylands (Kioko, 2010; Greiner and Mwaka, 2018; Guzha et al., 2018; Greiner et al., 2021; Ruttoh et al., 2022). Adapting to droughts and floods amidst those rapid changes, agro-pastoralists have described how they actively diversified their previously pastoral livelihoods by engaging in labor migration, irrigated crop farming, charcoal and clay brick production, basket and necklace weaving, fruit tree orchard planting, beekeeping, and various other practices. While such diversification is reported to occur in various East African drylands (Kebede et al., 2019; Greiner et al., 2021), participants have narrated how many adaptive strategies are not accessible to all: From the 1990s onward until today, drought has become an opportunity for those with stable incomes to employ village members at minimal wages to support their diverse adaptive practices—such as irrigating crops and terracing farms. While engaged in such casual labor, participants expressed that they are no longer able to adapt to droughts and floods themselves. For example, they cannot afford to maintain their terraces, leaving them exposed to flood erosion, nor afford bricks to replace their mud-and-thatch houses, which are more susceptible to flood damage. As such, our study has demonstrated how drought and flood impacts are unequally distributed (Savelli et al., 2022) whereby opportunities to adapt to droughts and floods for some, produce vulnerability to the same events for others. In this sense, the constructivist approach to researching drought and flood experiences through storytelling, has shown how the same events are experienced very differently among people (Branch, 2018; Quandt, 2021;

Rangecroft et al., 2021; Greene, 2021; Savelli et al., 2022). Notably, for many agro-pastoralists drought is a time of severe shortage of income and lack of subsistence, while for others an opportunity to access low-cost labor and sell their produce at higher prices. Equally huge differences were observed in the experiences of floods, where some lost harvests, livestock, homes and even family members, while others recall joyful periods with abundant harvests in the same event. This shows how droughts and floods are experienced as highly ambivalent and socially produced (Mauch, 2012).

4.4 Drought adaptation producing flood risks

Finally, the participants have allowed us to better understand how some drought adaptation measures are related to floods and vice-versa. We found that adaptation measures for drought have been consistently undermined by increasingly erosive floods, exacerbating subsequent drought impacts. Below, we discuss the most severely affected measures, which could inspire further research into how adaptation approaches can be more resilient against both droughts and floods.

Firstly, significant investments in mechanized irrigation systems along rivers (cf. Farah et al., 2003; Karimba et al., 2022) have proven to be highly vulnerable to flooding. Many participants reported losing substantial investments in irrigation equipment, which has severely impacted their ability to produce crops, grasses, and sustain livestock during subsequent droughts. Secondly, terraced farms in dryland Kenya have been famously lauded for their ability to mitigate erosion during floods and retain moisture during droughts (Tiffen et al., 1994). However, our study revealed the challenges agro-pastoralists face in maintaining these terraces under erosive flood conditions. Terrace maintenance requires access to structural labor, which many agro-pastoralists lack, while gullies tend to reappear once heavy rains return. Thirdly, agro-pastoralists noted that water pans, a popular drought adaptation measure implemented by governments and NGOs across East African drylands (Piemontese et al., 2024), are not only vulnerable to flooding but also introduce new flood risks. While water

pans aim to stabilize access to water by harvesting rainwater, participants highlighted that these structures are prone to overtopping or failure after heavy rainfall. This vulnerability is in part a result from siltation and erosion over time, as reported in previous studies conducted in Kitui (Manzi and Kuria, 2011; Kithaka, 2016; Moïse et al., 2019). Similar to terraces, agro-pastoralists do often not have access to the needed maintenance to prevent damaging floods. Drought adaptation measures in the downstream areas of these pans, such as irrigated crops and fruit trees, become highly susceptible to flooding when the pans fail. As soon as drought returns after the flood, the losses of drought adaptation infrastructures have shown how this introduces more vulnerability.

With the continued popularity of measures focusing on rainwater retention for use during dry periods among governmental and NGO actors operating in various African drylands (Weesie, 2019; The Star, 2022; Piemontese et al., 2024), the flood risks introduced by these forms of drought adaptation necessitate careful consideration by those involved in their design and management. The participants have shown how they are already actively engaged in adaptive measures against both droughts and floods, such as grass planting, gully remediation, tree conservation, and fallowing of land. It is these practices that deserve further support and studying, as they have the potential to prevent both drought and flood damages.

4.5 Limitations and challenges of the storytelling approach

Finally, we reflect on some limitations and challenges we encountered by using storytelling as a method.

Firstly, at times, as we left droughts and floods rather open to interpretation, it remained unclear how the droughts and floods narrated would be conceptualized according to a Western hydrological perspective. For example, it remained largely unclear whether the experienced droughts were meteorological or hydrological, or whether a flood could be classified as a flash flood, pluvial, or riverine. A particular challenge was that heavy rains seemed at times to have been classified as floods by participants. If future storytelling exercises would value such classifications, these should anticipate this challenge and take it into account in their design. In our case, we had no aim to classify the different droughts and floods experienced. In fact, our more unstructured approach allowed us to open up our understanding of what droughts and floods meant to participants, thereby challenging our assumptions of what droughts and floods mean for us as researchers.

Secondly, during the larger group sessions, there was no time to engage with all the participants equally, and in some groups, the agency to narrate stories was left to a few participants. These participants seemed better able or more comfortable engaging in the act of storytelling than others. Future storytelling methods could therefore consider how to achieve more equity in the representation of stories, including those who are less vocal in group settings.

Thirdly, the work of undertaking the 39 storytelling sessions and analyzing the transcripts was highly time-consuming, with a vast amount of data to process, taking several months. Future endeavors should think of ways in which this can be done more efficiently.

Fourth and finally, this type of storytelling research would benefit from being complemented with other types of data which can be retrieved or collected from the case study area—such as longitudinal meteorological, hydrological or remote sensing data—which would make it a more interdisciplinary effort, providing insights across disciplines on how drought-flood dynamics occur over space and time.

5 Conclusion

Storytelling has provided a deeper understanding of the complex and interlinked relationships between droughts and floods over time. In East African drylands, these events have become experienced as a new normal, with recurrent droughts and floods causing significant damage to agro-pastoral livelihoods across the region. Agro-pastoralists have shared how they actively navigate and adapt to these recurring challenges amid rapid socio-economic and environmental changes. While doing so, their stories of droughts and floods have shown how these are ambivalent phenomena, intricately related as they occur over time. Several drought adaptation measures require intensive maintenance for them not to produce flood risks. Drought adaptation measures damaged by floods, have shown to in turn produce vulnerability to subsequent drought.

These concerns are pressing, as many communities in East African drylands today continue to face persistent food and water insecurity during droughts, with reliance on food aid remaining widespread (FEWS, 2024).

Looking ahead, future adaptation strategies must address both drought and flood risks, especially as rainfall patterns grow more unpredictable. Encouragingly, our findings highlight that, historically, post-drought floods have held regenerative potential for livelihoods and ecosystems. Building on this insight, further research should explore how post-drought floods can be harnessed to support recovery, allowing agro-pastoral livelihoods to thrive rather than erode under increasing climate pressures.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: Open Science framework: https://osf.io/sb54g/?view_only=2f4628c6c63c4194a3706fbedcb70807.

Ethics statement

The studies involving humans were approved by VU Amsterdam BETHCIE ethics committee. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

RW: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing. MR: Conceptualization, Methodology, Supervision, Writing – review & editing. AV: Conceptualization, Funding acquisition, Project administration, Supervision, Writing – review & editing. JK: Conceptualization, Methodology, Supervision, Writing – review & editing. MB: Conceptualization, Data curation, Methodology, Supervision, Writing – review & editing. MM: Conceptualization, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This research was funded by the European Union (ERC, PerfectSTORM, ERC-2020-StG 948601). Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union or the European Research Council Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

Acknowledgments

We would like to express our gratitude to all participants who have engaged in the storytelling sessions, from whom we have learned

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a great deal. We would like to thank Sahelian Solutions Foundation (SASOL), Africa Wood Grow Foundation (AWG), South East Kenya University (SEKU), and last but not least, the research assistants for their invaluable support during the fieldwork.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The author(s) declare that Gen AI was used in the creation of this manuscript. During the preparation of this work the author(s) used generative AI in order to correct grammar and spelling in the manuscript. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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