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"Those with many cattle were better off": herd size preferences and perceived tradeoffs in the face of extreme events

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African rangelands are changing rapidly due to land use change, the erosion of traditional social institutions, and increasing concern about extreme events. These changes pose a challenge to the resilience of pastoral people, their herds, and the rangelands that they inhabit. Despite these changes, debates in academics and policy continue about the optimal herd size to maintain pastoral livelihoods while avoiding environmental degradation. In this study, we draw from 33 focus group discussions with Maasai men and women in northern Tanzania to explore herd size preferences for coping with extreme events. Study participants expressed a preference for larger herds, with the primary rationale being enhanced ability to cope with drought and other extreme events. Those with large herds are better able to sell a few animals, and this money can directly benefit the family and help feed the rest of the herd through purchasing supplemental feed in the form of pumba, crop residues, or access to farmland for grazing crop residues. These findings highlight new pathways and reasons that large herds can be useful. Chief among these is having enough animals to sell to buy supplemental feed and yet sustain a viable herd. Recognizing the cultural importance of livestock to Maasai along with local perspectives on livestock herd numbers will help in supporting culturally relevant adaptation policy and practice. For example, policies and projects could focus on enhancing resilience through facilitating the saving and storing of crop residues or helping maintain livestock prices during extreme events.

KEYWORDS

adaptation, drought, extreme events, herd size, livestock, Tanzania, Rangelands

Introduction

Rangelands cover more than half of Earth's land surface and support hundreds of millions of pastoralists and ranchers, as well as large populations of wildlife (ILRI, 2021). Most people living in African rangelands have livelihoods based on keeping livestock or a mix of livestock keeping, dry land farming and often some revenues from family members working in urban areas (Homewood, 2009; McCabe et al., 2010). However, African rangelands are changing rapidly due to land fragmentation (Lamprey and Reid, 2004;

Mwangi, 2007; Galvin, 2009), livelihood diversification (Homewood, 2009; McCabe et al., 2010), land privatization (Lesorogol, 2008; Boone and Lesorogol, 2016), restrictions on access to natural resources resulting from creation of parks and protected areas (Igoe, 2003; Goldman, 2003; 2020; Homewood et al., 2009; Sachedina and Nelson, 2010), and erosion of traditional social institutions that facilitate movement of people and animals (McCabe et al., 2020). Along with these human activities, there is increasing concern with the role of extreme climatic events (Western and Manzolillo Nightingale, 2004; McCabe et al., 2020). In East African rangelands the most common extreme event is drought - historically about one every decade with more frequent less extreme droughts.

These changes pose a challenge to the resilience of pastoral people, their herds, and the rangelands that they inhabit. There has been a renewed emphasis on the resilience of pastoral peoples in the recent literature (Leslie and McCabe, 2013; Semplici, 2020; Semplici and Campell, 2023; Scoones, 2023), much of which considers climate change and how pastoral peoples have coped with drought and uncertainly. One key component of pastoral resilience at the household level is the size of individual herds. The debate about the advantages and negative consequences of keeping large herds can be traced back to Herskovits (1926) article on the "cattle complex." Here we revisit this debate and present the results of a recent study of Maasai pastoral and agro-pastoral households in northern Tanzania. We draw from 33 focus group interviews in two districts, Longido and Simanjiro, to explore Maasai herd size preferences for coping with extreme events.

Literature review

Early in the colonial period East African pastoral peoples were viewed as keeping far too many livestock, especially cattle, for their subsistence needs. This view was given academic credence by Melville Herskovits in his 1926 article entitled: "The Cattle Complex in East Africa." Here he argued in favor of the myth that East African pastoral peoples kept cattle primarily for prestige rather than for economic reasons, leading to the notion that they were "irrational" in their management practices. This contributed to the rationale behind many livestock development programs that emphasized destocking livestock as the first step in development projects targeting range management policies and projects. Garrett Hardin (1968) article: "The Tragedy of the Commons" used pastoralists as an example of how individuals would overexploit a commonly managed resource resulting in the degradation of the resource base. This argument recognized larger herds and "overstocking" as economically rational for the individual herdowner in the short term but irrational at larger scales over the long term. The importance of these issues promoted research on pastoral livestock management, the size of herds, and the environmental implications of these practices and became the subject of debate among ecological and social scientists.

Hardin's ideas fit well with the then prevalent understanding of ecosystems as equilibrium-based systems. In a rangeland context, this meant calculating the "carrying capacity" of the rangeland and led to the expectation that once this limit was reached the range would become progressively degraded. This view is illustrated by the writings of Hugh Lamprey, an ecologist who spent his life working in the East Africa rangelands. "In balance, it seems that the symbiosis of pastoral man and his domestic stock have been very successful as a survival strategy in the short term. In the long term, it appears less successful since it tends to destroy its own habitat" (Lamprey, 1983: p. 656). This view of African pastoralists, their management practices and their environmental implications became known as the 'Mainstream view' (McCabe, 2004).

This began to change in the late 1980s as research by ecologists specializing in arid land ecosystems suggested that these ecosystems did not adhere to the dynamics typical of equilibrium-based ecosystems. Instead, these systems were characterized by high degrees of variability, uncertainty, and subject to highly fluctuating animal populations (Ellis and Swift, 1988; Scoones, 1995). In these environments it was argued that it was impossible to calculate a carrying capacity for livestock, destocking was not a necessary first step in development projects, and livestock development projects should be adaptive and flexible (Ellis and Swift ibid). This became known as the 'Alternative view'. Critically, the key dynamics of dryland ecosystems were seen as driven by variables (such as rainfall) that were external to the defined ecosystem and thus not subject to the cybernetic feedback relationships that characterize equilibrium systems. Further, not only has more recent research countered the argument that pastoralism is inherently destructive to the environment, there is evidence that pastoralism can offer sustainable livelihoods and in some cases may even have a positive impact on the environment, forestalling desertification and ecological collapse (Brierley, Manning, and Maslin, 2018). Many ecological and social scientists today accept the 'Alternative view' of African pastoralists and their relationship to the environment, although we still see elements of the 'Mainstream view' in government policies.

One critical component of the "Alternative view" is an emphasis on extreme events, especially drought in the East African context. Climate change has resulted in droughts becoming both more frequent and more severe throughout the region and this trend is projected to continue (Braimoh et al., 2018; Derbyshire et al., 2024). Livestock mortality during droughts can vary between 25% and 75% (McCabe, 1987) depending on the specific location and severity of the drought. Following on the foundational work on the dynamics of livestock herds by Dahl and Hjort (1976), researchers have demonstrated that recovery rates from severe droughts can vary

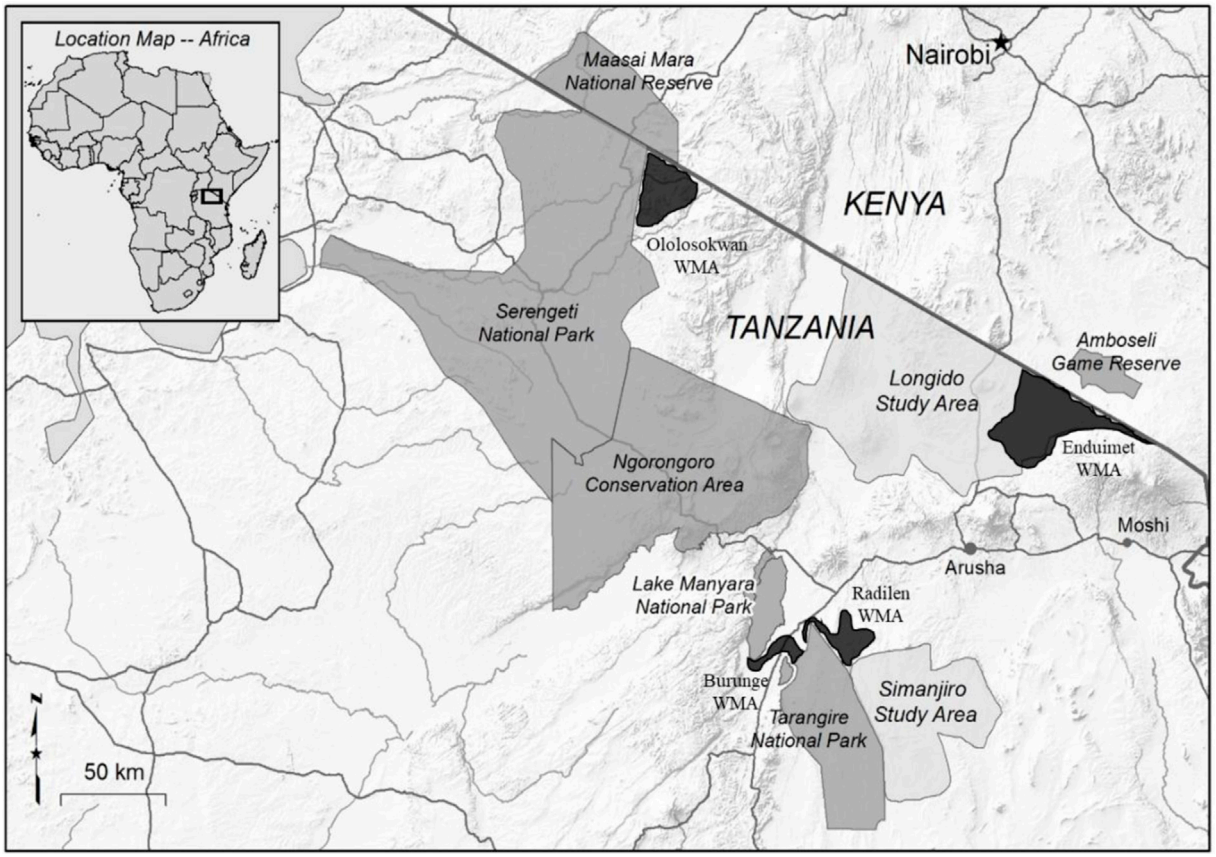

FIGURE 1
Study area map. Longido and Simanjiro study areas are shaded in light gray. The medium gray represents protected areas like national parks, and the dark gray represents wildlife management areas.

from 5 to 7 years among pastoral herds in Ethiopia (Oba, 2001; Desta and Coppock, 2002). However, as Lybbert et al. (2004) demonstrated, once a herd size drops below a critical threshold it is difficult to recover (cited in Aragie and Thurlow, 2022).

Thus, an understanding of the preferred size of herds kept by pastoral people is an important issue for both social and environmental scientists, as well as development policy. Arguments favoring smaller herd sizes include that they are easier to manage, can seek out smaller patches of forage (thus increasing flexibility in terms of mobility), and are thought to have fewer negative impacts on the environment (Butt et al., 2009). However, some recent research has suggested that larger herds may do better during drought, due to the greater number of options for keeping livestock alive that may be open to wealthier pastoralists, and can thus recover more rapidly (Vetter et al., 2020). Woodhouse and McCabe (2018) demonstrated that views of the preferred size of herds can vary within the same population, with younger Maasai men preferring smaller herds of more productive breeds, while older Maasai men prefer larger herds of Zebu cattle.

Methods

Study area

This study took place in the Longido and Simanjiro Districts of northern Tanzania (Figure 1). The people of these districts are predominantly Maasai, a traditional livestock-keeping group that has also adopted agriculture to varying degrees (McCabe et al., 2010; McCabe et al., 2020). The mobility of livestock has been an important strategy to cope with extreme events, especially drought, and customarily Maasai communities have shared access to grazing and water resources with Maasai from elsewhere. This social institution has long been central to the resilience of both households and communities throughout Maasailand, but there are indications that this tradition is breaking down (McCabe et al., 2020). Since the 1980s, Maasai livelihoods have been changing with the adoption of cultivation, migration to urban areas to seek employment, and alienation from their land by large commercial farms and ranches, as well as establishment or expansion of protected areas (McCabe et al., 2010; McCabe et al., 2020).

In Longido District, most households rely primarily on raising livestock. Households there often engaged in extensive migrations during drought years, with movement across village, district, and regional boundaries, sometimes including migration into Kenya. In Simanjiro, precipitation is higher and cultivation is an important supplement to livelihoods for most households, although crop failures are common due to poor timing or amount of rainfall, and people and livestock also commonly migrate. The main crops are maize and beans, and cultivation is often hindered by wildlife crop raiding. Further, while some households do cultivate their own land, others rent out their land to outsiders. This region includes several Wildlife Management Areas (WMAs), which are village lands set aside for wildlife conservation under Tanzania's 1998 Wildlife Policy, and within which agriculture is not permitted. We included one WMA in the study reported here - the 752-square kilometer Enduimet Wildlife Management Area, established in 2005 below the western foothills of Mt. Kilimanjaro.

The impacts of climate change are already being observed in northern Tanzania. According to a study by Kimaro et al. (2018), pastoralists now perceive more inconsistent and reduced amounts of rainfall, higher temperatures, and prolonged periods of drought. These impacts have negative consequences for Maasai, who have reported reduced cattle productivity due to a shortage of forage and water (Kimaro et al., 2018). Drought can lead to diminished crop production and pasture for livestock, which may have different effects on communities and households depending on the social condition of the household, types of income sources, resource ownership, and other factors (Mdemu, 2021). It has been reported that a recent (2020–2023) drought led to massive livestock death and forced some Maasai in Longido District to migrate 4 months earlier than normal (Mlay, 2022). Drought can lead to food insecurity both for livestock and people (Randell et al., 2022). The COVID-19 pandemic also had severe consequences for these communities as markets for crops and livestock were closed and tourism ceased – an important source of income for some (Shoo et al., 2021).

In each of the two study districts, we selected nine villages within which to conduct our focus group discussions. These sites were selected because 1) they represent a range of livelihood mixes and options; 2) they represent a range of land and resource management regimes; 3) they are all grounded in a common Maasai cultural tradition; 4) the contrasts among them are expected to have a direct bearing on their options in responding to compound extreme events and their resilience.

Data collection

Focus group discussions (FGDs) detailed in Table 1 took place between February and October of 2023. The focus group discussions were centered on 7 open-ended questions. The first three questions asked participants to recall the extreme events they have faced since the 2008/2009 drought, place those events on a timeline, discuss the various impacts of each extreme event and how community members coped and responded to each. The fourth question asked participants to discuss whether some in their community were better able or less able to cope and why that was the case. The last three questions then asked what lessons community members are learning from extreme events that might make them better prepared for the next extreme event, and why or why not they are implementing those lessons.

Focus groups were conducted by three Maasai research assistants who have participated in various social science research projects for over 10 years. FGDs were conducted in the Maa language, in the village or sub-village office or common meeting place, depending on the village. As detailed in Table 1, there were a total of 33 FGDs, 15 with women and 18 with men, with 4–7 participants each. We were able to tape record 17 of the FGDs. Those FGDs were then transcribed verbatim by the research assistants and translated into English. We were unable to record 16 of the FGDs because participants did not consent to this. For those FGDs, copious notes were taken in English by research assistants. While there are likely a variety of reasons that FGD participants did not consent to being recorded, there are ongoing social and political issues that might have made people cautious. In each village, we conducted a minimum of 2 and a maximum of 5 FGDs. In some villages, we visited multiple sub-villages to conduct FGDs, particularly in those villages that are more socially or environmentally heterogeneous. We also revisited some villages in order to try to conduct recorded FGDs where possible.

Data analysis

FGD transcripts were analyzed by Quandt using thematic coding. We used NVivo software for the coding and analysis. Thematic coding used both *a priori* codes, themes that we expected to emerge as a result of the research topics and questions, and *a posteriori* codes, or themes that emerged from the FGDs that were not foreseen (Cope, 2005). There was a total of 564 codes produced in the analysis and they were organized into major topics including impacts of extreme events, the role of institutions, resilience and coping with extreme events, and a timeline of extreme events. These codes were organized hierarchically and there was some coding redundancy between major topics. Importantly, in May 2024 the PI's spent 2 days with the research assistants to go over the FGD analysis in detail and ensure that the organization and coding was in accordance with their knowledge and perceptions of the study area. After this, Quandt re-read all the codes and reorganized them based on feedback from the research assistants. In this paper we focus on the sub-set of topics and codes related to herd size and rationale for herd size preference. Subsequent papers will treat other aspects of these FGDs, including more general coping strategies, migration, and non-livestock related coping strategies.

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TABLE 1 Focus Groups Discussions. This table includes the FGD sites and site descriptions, as well as the number of FGDs conducted with women and men in each site. The number in the superscript is the number of FGDs in which the participants did not consent to being recorded.

Study area	Village	# Focus groups		Site location and characteristics
		Women	Men	
Longido	Gelai Lumbwa	1	1	Mixed livestock-agriculture, located at the base of Gelai Mountain, much of the agriculture takes places at higher elevations
	Engikaret	2^1	2^1	Mostly livestock, poorer, along Nairobi-Arusha road
	Mairowa	1	2^1	Mixed livestock-agriculture, agriculture fails often
	Sinya	2^1	2^1	Livestock-only, inside Enduimet Wildlife Management Area, human-wildlife conflict
	Elerai	1	1	Mixed livestock-agriculture, borders Enduimet Wildlife Management Area, near big commercial farms and Mt. Kilimanjaro forests
Simanjiro	Loiborsoit	2	3^1	Mixed livestock-agriculture, renting farms to other ethnic groups, human-wildlife conflict
	Sukuro	1^1	2^2	Mostly livestock, part of the Simanjiro Conservation Easement
	Terrat	3^2	2^1	Mixed livestock-agriculture, more developed for the area
	Emboreet	2^1	3^1	Mixed livestock-agriculture
	TOTAL	33^{16}		

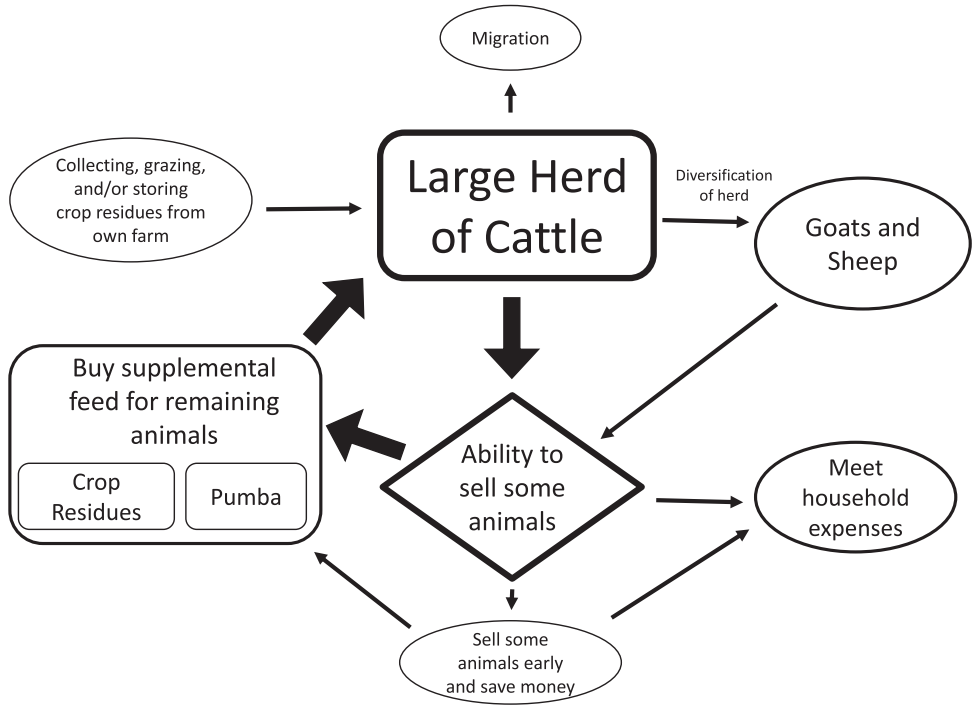

FIGURE 2
Conceptual diagram of the role large herds play in coping with drought. Thicker arrows highlight the main rationale for larger herds; thinner arrows indicate supporting rationale for larger herds.

Results

To explore the issue of preferred herd size, we asked focus group participants to reflect on which types of people in their communities do better during extreme events. While we did not specifically ask about herd size, this topic came up frequently during the discussions. Among participants, the general sentiment was that Maasai with larger herds are better able

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FIGURE 3
Pumba.

to cope with drought. Figure 2 outlines the reasoning highlighted in the FGDs and displays different pathways for how and why larger herds help during drought. We expand on portions of Figure 2 in the following sub-sections. In the diagram and text, the term *pumba* refers to supplemental feed, commonly made from maize husks, maize cobs, and sometimes the husks of wheat and rice grains. These ingredients are then normally ground and mixed together to make *pumba* (see Figure 3). The actual ingredients vary, but *pumba* that uses rice residues is much less common.

Larger herd sizes are better for coping with drought

During FGDs, participants noted that households with larger herds (13 FGDs) and wealthier households (14 FGDs) are better able to cope with extreme events. Often, wealth was equated with larger herds in the discussions. For example, as described in a men's focus group in Longido, "*The people who were able to resist are economically stronger people only. When you find someone with 200 or 100 cows, he is able to struggle with the hardships because when a hardship occurs, he is able to sell a certain number of cattle to fight with the hardship.*" Similarly, women in Simanjiro stated that "*the successful pastoralists are the economically strong people, because they have a lot to sell."*

FGD participants highlighted how Maasai with smaller herds struggle during extreme events because they only have a few animals to sell, and those few animals may perish during an extreme event. As stated by a woman in Simanjiro, "*The poor obviously lose terribly in a drought.*" Elaborating on this, a woman in Longido talked about how "*for a poor person, they use physical labor to carry grass to their one cow, which may still die. A person with low income will face hardships in two ways: they have no means to bring grass besides physical labor and their children are starving. You feel stranded as a result.*"

However, there were a handful of FGD participants who disagreed and pointed out advantages of smaller herds. For example, during a women's discussion in Longido, participants discussed how "*Some people also protect their farmlands in order to graze their livestock during the drought. That's for someone with a few cattle. It doesn't work for people with many cattle.*" In other discussions, participants described how they might reserve some grazing land near their homes, and that strategy works with a few cattle. Others did state that people with many cattle might struggle because they need a huge area for grazing.

Selling animals to support the remaining herd during drought

As outlined in Figure 2 above, the major benefit of having a large herd is the ability to sell animals in order to cope with an extreme event. During a women's focus group discussion in Simanjiro, a woman stated that "*a poor person is the one who can't overcome events such as the drought because he has nothing to sell to buy food. The one who has cattle, however thin they are, at least few from the herd are sellable. So, they can tackle an extreme event.*" Those with large herds are more able to sell a few animals, and this money can both benefit the family and help feed the rest of the herd through purchasing supplemental feed (in the form of pumba, crop residues, or access to farmland for grazing crop residues). For example, a men's focus group in Longido discussed how "*nowadays, cattle are like children in terms of feeding. You purchase pumba at the same time with maize flour for the family.*"

Table 2 below provides a breakdown of how often some of these themes came up in the FGDs based on location and gender of the FGD participants. However, while some trends may exist between locations and genders, that is not the focus of our paper. Our qualitative data are not meant for such comparisons, as the sample sizes are small. Instead, the intent is to provide nuanced perspectives and experiences concerning herd size and coping with extreme events.

Selling animals to buy *pumba* came up frequently as an important strategy to cope with drought. Selling cattle to buy *pumba* was directly discussed in 8 focus groups, while 5 focus groups talked about selling goats and sheep to buy *pumba*. For example, as mentioned in a men's focus group in Simanjiro, "*you find someone with 100 cattle and he sells 80 of them and leaves*

TABLE 2 Rationale and topics supporting the large herd narrative. This table shows focus group discussions themes by district and gender of focus group. The numbers indicate the number of FGDs in which the theme was mentioned; the percentages refer to the proportion of all quotes coded to that theme. All percentages are rounded to the nearest tenth.

Focus group theme or code	# Total FGDs	Longido FGDs		Simanjiro FGDs	
		Men	Women	Men	Women
Number of FGDs	33	8	7	10	8
Wealthy households do better	14	4 30.9%	5 31.1%	3 23.1%	2 15.0%
Larger herds do better	13	4 29.2%	5 39.8%	1 11.45%	3 19.6%
Smaller herds do better	8	1 13.6%	1 14.0%	4 48.3%	2 24.1%
Collecting crop residues from own farm	7	1 16.3%	0 0%	3 68%	3 58.5%
Grazing crop residues from own farm	7	1 10.9%	2 45.4%	4 43.8%	0 0%
Private grazing reserves near household	9	1 14.8%	0 0%	6 66.7%	2 18.5%
Buying crop residues to carry to livestock	10	3 50.4%	2 22.6%	2 30.1%	3 41.8%
Buying crop residues for on-farm grazing	11	4 43.6%	2 15.4%	3 23.1%	2 17.9%
Pumba	24	8 47.9%	6 19.7%	6 25.9%	4 6.6%
Selling cattle early to save	10	6 63.6%	0 0%	3 27.3%	1 9.1%
Selling cattle early to meet household expenses	8	5 72.7%	2 18.2%	0 0%	1 9.1%

20 to feed with pumba." Another Simanjiro focus group with men discussed how,

> "What is rescuing cattle now is pumba. That is why cattle still exist in the area. Hadn't people used it now, cattle would have been dying enormously or could have been finished . . . So, goats and sheep are sold to rescue cattle with pumba . . . you find that goats and sheep got finished up due to a sale to buy pumba for cattle, in an attempt of rescuing cattle at the expense of goats and sheep . . . You find a person with 100 goats and sheep and 30 cows prior to drought. When the rain comes after the drought, you will find him with 70 or 50 goats and sheep. The rest of the goats and sheep had been consumed by cattle. And the same cattle would have reduced in number as well."

Thus, large herds were perceived as important in order to sell enough to buy *pumba* and feed that to the remaining livestock during times of drought. In the discussions, this was emphasized repeatedly as a major advantage of large herds. In addition, it was mentioned that there was a preference for selling stronger animals as they would bring a higher price, then buying *pumba* for the weaker animals.

However, the use of *pumba* is relatively new in some places as more and more Maasai are beginning to rely on supplemental feed. In Longido, "*we began feeding them with pumba during the Manyara drought* [2008/2009]", as stated during a men's focus group there, while in Simanjiro adoption of *pumba* was a bit later. This is likely because in Longido, there is less farming than Simanjiro and thus households are less able to rely on grazing crop residues. In Simanjiro, agriculture is more widely practiced, and thus they are more able to rely on their own crop residues, as opposed to *pumba*. However, the use of *pumba* as supplemental feed appears to be expanding in both locations. As explained in a men's focus group in Simanjiro, "*consumption of pumba then was less compared to the 2022/2023 drought. The recent drought was much more excessive*." Thus, since the 2008/2009 drought, the use of *pumba* has become a fairly common strategy for feeding cattle during drought in both study sites.

Although *pumba* can be very important in providing supplemental feed during drought, it can also be susceptible to manipulation by those selling it. We have heard of sellers

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adding saw dust or other contaminants to the *pumba*, especially sellers who do not live in the buyer's area, so the quality, not just the quantity, of the *pumba* is important.

Larger herd sizes allow for the sale of animals not just to purchase *pumba*, but also other types of supplemental feed including crop residues, which are mostly the corn stalks, bean husks, or other parts of crops that are left over after harvest. Focus group participants discussed feeding livestock with crop residues bought from others (10 focus group discussions) or paying to access the fields for grazing the crop residues directly (11 focus group discussions). In Longido, participants discussed both purchasing maize stalks and migrating their cattle for grazing on maize stalks to the area of Sikirari, which lies between Arusha and Moshi and near the Kilimanjro International Airport. This process was described by men in Longido as they discussed how in 2016,

> "*some parts got rain, like Sikirari, by the end of the normal rain season. So, their maize ripened by July and harvest began in August and ended in September and October. So by the end of those months we went there with cattle to buy maize remains after harvest, cobs and other residue, to take cattle to feed on them. By then, prices haven't been too much because you could pay for one acre of maize residue at Tsh 20,000.*"

As with *pumba*, this strategy has been expanding, as explained in the same focus group they discussed how "*When it is August, we have maize residue. That's something we are taught by droughts of this kind. And we didn't know in the past.*" However, during some discussions, participants discussed being misled and purchasing farm residues from someone that is not the farm owner, only to discover that they were cheated later when they tried to graze their cattle on those farms.

Alternatively, those households who also farm may feed their livestock with their own crop residues as a drought-coping strategy. This came up more commonly in the Simanjiro focus group discussions (see Table 2), as some households there do own farmland. For example, during a women's focus group in Simanjiro they discussed how,

> "*We have learned to keep residue of our crops when we get a harvest, to feed cattle in the drought. That's why we bought the residue you can see from somewhere else. We bought them because we didn't get a harvest this year. If we could have harvested crops, we wouldn't have bought the residue from elsewhere. We could have kept residue from our harvest.*"

Even at times when the crops fail during a drought, they might grow enough for grazing cattle. As described during a men's focus group in Simanjiro, "*. . .when grass isn't in large quantities in the wild and harvest has failed, the stalks of failed maize sustain cattle for several months.*"

FIGURE 4
Example of bean crop residue storage in Longido.

Some households are actively storing their crop residues for the dry season or drought (Figure 4). As described by a man in Simanjiro, "*at the moment, we keep bean residue on a rack like that one located outside this home, the purpose of which is to feed cattle during a drought. When feeding stuff is available in farms, we deprive cattle of the bean residue until October in order to survive with it until rain pours. They eat maize stalk first and keep bean residue for later.*" This proactive strategy helps households prepare for drought, while not necessarily having to sell any animals to buy supplementary feed.

Importantly, participants emphasized the value of large herds in meeting household needs during extreme events. This was most commonly discussed in the context of selling cattle to buy food and other supplies for the family. Even when men may be away with the cattle, they are still able to sell a few and send money back home using mobile money services like M-pesa. In a women's focus group in Simanjiro, participants discussed how "*they sell cattle to buy maize for their children . . . they sell 1-2 cows to save them from the drought and buy food for the children so they don't starve. When you sell you buy food for the children or you buy medicine for the rest of the flock.*" Further, during a men's focus group in Longido, men mentioned how "*I am thinking of buying food and keeping it in the house for the children to eat in the future . . . we now keep livestock knowing they will help us, not just keeping them for prestige.*"

Some groups discussed selling animals early, while they are still healthy and the prices are good, in order to save money to prepare for upcoming extreme events. There were also

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discussions of keeping cattle with goals and objectives in mind in order to profit from them, instead of just keeping cattle for the sake of it. For example, a man in Longido discussed how "*I should keep livestock with a certain goal ahead. Keeping a thousand cattle without a purpose will bring a loss*." Further, some participants did discuss saving money in bank accounts. While describing someone they think is successful at coping with drought, the men in a Longido discussion talked about how "*when he realizes that the month of May has approached and goats and sheep are fat, or juvenile male cows are fat, he sells. He saves his money in the bank account and wait for the drought*." However, in other discussions, participants discussed how this can be challenging. For example, in a men's discussion in Longido, a participant brought up how "*not everyone is courageous enough to be able to sell cattle and buy others later. This is because Maasai do not have a bank, and so they don't know how to save money. Their bank is to buy livestock and look after*." So while some people may be selling livestock for household needs or financial savings, it is certainly not as common as other drought coping strategies, especially as the use of electronic (M-pesa) accounts becomes more widespread.

Importance of goats and sheep during drought

The importance of goats and sheep in helping to cope with drought came up throughout the focus group discussions and were seen as a key reason for having large herds. Most commonly, having larger herds of goats and sheep means that those can be sold to help buy supplemental feed for cattle. As described by women in Longido, those that did best in drought where "*People with a lot of livestock. Those with goats and sheep who were sold to feed cattle. Goats and sheep rescued cattle. A person with 100 or 200 goats and sheep was able to sell them and buy pumba for cattle. Those with cattle only, sold stronger cattle to feed the weak herd*." Being able to sell goats and sheep, instead of cattle, helps Maasai maintain their cattle herds during drought. This was described by men in Longido who stated that "*goats and sheep are sold to rescue cattle with pumba. At homesteads that is what is helping people*."

Thus, being able to rely on goats and sheep for household necessities and supplemental feed means that cattle can be spared from sales. Also, keeping goats and sheep can support the family, and the herd at the same time. As put by a man in Longido, "*cattle consume goats and sheep for pumba*." Goats and sheep are smaller, so they are also easier to just sell one of them as opposed to cattle. Further, some participants did discuss that Maasai may have more trouble selling cattle, since that is their traditional culture and they often feel an emotional attachment to their cattle, while selling goats and sheep is easier.

Discussion

In his book, Livestock Development and Policy (Raikes, 1981), Philip Raikes traces the history and current policy of livestock development in Kenya and Tanzania. He cites the accepted wisdom during the colonial period that herd management strategies of pastoral peoples will inevitably lead to overgrazing and rangeland degradation, and that this could be traced back to Herskovits (1926) article. According to Ellis and Swift, "The idea that pastoralists do not achieve a balance with their environment but routinely overstock and overgraze, is an old one (Stebbings, 1935), but was stated most forcefully and coherently by Brown (1971), the Chief Agriculturalist of colonial Kenya, and more recently by Lamprey (1983)" (Ellis and Swift, 1988:451). They go on to say that: "If this assumption is accepted, it is logical to reason that internal alterations in system structure can correct the imbalances and restore the system to equilibrial conditions. The most obvious adjustments to make are those involving the number of livestock per unit area. Hence two types of development procedures follow: reduction of stocking rates and alteration of land-tenure systems. Destocking is a very direct means of altering system structure, but it is hard to sell to pastoralists" (ibid. p.452).

During the colonial period the governments did not have to "sell" this idea to pastoral peoples as government policy emphasized forcibly destocking the herds kept by pastoral peoples as a way of increasing the availability of cattle to local markets while also expecting this to reduce overgrazing and environmental degradation. However, as Ellis and Swift argue, if the ecosystem is in fact not based on equilibrium dynamics then the result of reducing livestock numbers on the rangelands would have no impact on range degradation but would result "in immediate deprivation for pastoralists even during mild stress periods" (ibid. p.458). Such deprivation would be even more consequential following the extended, severe droughts and other extreme events that are the focus of our study.

The attitudes and preferences expressed in the FGDs reflect the local pastoralists' livelihood strategies born of long experience in an environment characterized by non-equilibrial dynamics.

Some results are similar to those mentioned in the literature review above, but the local people's explanations for the importance of large herds provide new insights into the resilience of pastoral people as they cope with drought and climate change. The selling of small stock in order to purchase grain for human consumption during droughts is well documented, as is the importance of goats in the recovery process following livestock losses (McCabe, 2004). Less well understood is the selling of small stock to buy supplementary food for cattle.

Overall, the results point to a strong and widespread preference for having large herds. That preference certainly is in accord with traditional Maasai cultural values, but the reasons elicited during the discussions clearly reflect their views of economic rationality in an unpredictable, fluctuating environment. The results highlight an emergent rationale for

larger herd size based on a growing dependence on supplemental livestock feed, in the form of *pumba* and crop residues, and the importance of a larger herd for obtaining these resources. Selling some animals has been a common strategy for surviving extreme events, although selling livestock during droughts results in lower prices for livestock and higher prices for maize or other grains. However, such sales have served primarily to buy food for people, not to buy feed for the remaining livestock. The latter use has not been evident in the literature, nor acknowledged in the narratives of government and development project destocking efforts.

Although livestock development projects today do not depend on forceable destocking there is still an emphasis on reducing herd size and incorporating improved breeds into pastoral management systems. While our results generally point towards support for larger herds, some local people do not agree with this. Advantages of smaller herds can be seen and are articulated, especially when coupled with keeping improved livestock breeds that can be more productive in certain environments. But these advantages are bought at the expense of some of the benefits of large herds, creating a need to find substitutes for those benefits such as alternative means of "banking" wealth. In a study of wellbeing among Maasai pastoralists in Tanzania, many young men felt that fewer livestock and improved breeds would lead to an increased sense of wellbeing, while older men demonstrated a strong preference for large herds (Woodhouse and McCabe, 2018). In the focus group study reported on here, however, the majority of men and women showed a preference for large herds. A key basis for this preference was access to supplemental livestock feed, which increasingly is considered essential to the long-term survival and resilience of pastoral herds. Evidence suggests that households with larger herds are better able to cope with drought and to recover more quickly from drought. Many pastoralists in our study would agree with Raikes when he stated as early as 1981, "Large holdings of cattle and other livestock represent security, political influence, economic power, and respect in a number of ways" (p.95).

Conclusions

The objective of our study was to explore the rationale shaping herd size preferences among pastoral and agro-pastoral Maasai in two regions of northern Tanzania, particularly given the ongoing impacts of climate change. Drawing from 33 focus group discussions with men and women, our findings illustrate the perspective of our participants that larger herd sizes may be important for how they cope with extreme events such as drought. Figure 2 highlights new pathways and reasons that large herds can be useful. Chief among these is the importance of having enough animals to sell to buy supplemental feed to sustain a viable herd.

Another objective of the paper is to present Maasai perspectives that reflect an emphasis on the importance of herd size to the resilience of pastoral livelihoods. These views show how herd size is not just a matter of cultural preference, nor that larger herds simply allow faster recovery from livestock loss because more animals are likely to remain after a disaster. Rather, having a large herd provides a herd-owner with options to both cope with and recover from droughts and other extreme events.

It is also important to remember that the challenges facing Maasai today are not related to climate alone. Lands and resources traditionally used by the Maasai have been constrained by the implementation and expansion of protected areas and the expansion of cultivation in some area, along with the changing aspirations of many young men. Fragmentation of the landscape can hinder livestock movement and imperils traditional reciprocity among Maasai communities in times of stress, and may stimulate changes in traditional and formal institutions relevant to sustainable livelihoods (McCabe, Leslie, and Davis, 2020). Ongoing climate change is likely to intensify the interactions among these social, political, economic, and environmental influences. According to the 2024 World Bank Report (World Bank, 2024), the livestock sector in Tanzania contributes 13.8% of rural household incomes, and employs 33% of the total population considering production, processing and marketing. The livestock sector also makes significant contributions to Tanzania national objectives, especially those relating to food and national security. Thus, policy solutions that address these challenges are critical.

Beyond the findings reported here, our study does have certain limitations, especially our reliance on focus group discussions. While these provide significant insight and nuance, they are insufficient for answering research questions based on demographic categories such as age or other possible influences such as wealth or experience with labor migration. Further studies utilizing quantitative survey data may help to support and refine our findings.

We have focused here on drought, the most persistently salient type of extreme event faced by Maasai and many other pastoralists. These populations face other extreme events as well, including flooding, livestock disease epidemics, and alienation of resources due to establishment of protected areas or other changes in land use policy. Preferences and practices regarding herd size and management may be important to household and community resilience in the face of these other challenges as well, although the pathways through which the advantages and disadvantages of management strategies affect response to those challenges will vary. Consideration of the interactions among different types of extreme events must await results of further, ongoing research.

The results reported here may help livestock and pastoral development projects today to improve support and resources provided to pastoralists during extreme events. Recognizing the cultural importance of livestock to Maasai along with local perspectives on livestock herd numbers will help in

supporting culturally relevant adaptation policy and practice. For example, policies and projects could focus on enhancing resilience through facilitating the saving and storing of crop residues or helping maintain livestock prices during extreme events. While the pastoral systems in northern Tanzania are unique in some ways, the experiences highlighted in this study may resonate in other rangeland regions of the world. Many of these places are similarly experiencing increases in droughts and other extreme events and lessons learned in Tanzania may well be applicable elsewhere.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by University of Colorado Boulder Institutional Review Board, Protocol number 22-0330. The studies were conducted in accordance with the local legislation and institutional requirements. The ethics committee/institutional review board waived the requirement of written informed consent for participation from the participants or the participants' legal guardians/next of kin because the only document linking an individual to this research would be the signed consent form and the study posed minimal risk.

Author contributions

All authors participated in the study design and funding acquisition. JM led overall project administration. JM and AQ led data collection and analysis. All authors reviewed the results and approved the final version of the manuscript.

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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.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

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