



# Climate migration and well-being: a study on ex-pastoralists in northern Kenya

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## Abstract

As the impacts of climate change intensify globally, scholars and policymakers are increasingly interested in determining the factors that lead to the success or failure of climate adaptation strategies. This paper investigates the well-being outcomes of ex-pastoralists in northern Kenya who have migrated to towns in response to severe droughts. Focusing on Marsabit Town, the study employs a comparative design with primary survey data to analyze the well-being outcomes resulting from migration as an adaptation strategy. We contrast two heterogeneous groups of former pastoralists: a “settled group” that was already residing in Marsabit Town before ending their pastoral activities and a “migrant group” that relocated to Marsabit Town at the time of abandoning pastoralism. Our analysis reveals significant differences in well-being outcomes between these groups, with the migrant group often experiencing deterioration in their well-being levels. Key predictors of poorer well-being outcomes include the loss of all livestock, informal housing, and failure to transition into agricultural work, which often results in dependence on casual labor. Additionally, many migrants continue to experience poor subjective well-being—referring to their personal satisfaction with the quality of life—years after their livelihood transition. These insights offer a nuanced understanding of the well-being outcomes of migration-as-adaptation among heterogeneous groups of ex-pastoralists and underscore the need for customized livelihood support strategies for the most at-risk populations.

**Keywords** Pastoralism · Livelihoods · Internal migration · Well-being · Climate change

## Introduction

Over the past two decades, East Africa has experienced an unprecedented series of consecutive droughts, causing distress among millions of households. In the most recent string of failed rainy seasons, the Famine Early Warning Systems Network (FEWS NET) together with its partner organizations issued a joint statement on the alarming drought conditions and their cascading effects on land-based livelihoods:

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Extended author information available on the last page of the article

“Rainfall deficits during the recent March–April–May 2022 rainy season have been the most severe in at least the last 70 years in Ethiopia, Kenya, and Somalia. ... This exceptional four-season drought ... has been devastating to livelihoods and produced repetitive, debilitating and cumulative shocks to herds, crops, water availability, and household incomes” (FEWS NET, 2022: p. 1–2, also see Red Cross Society, 2022; United Nations, 2022a, b). In eastern and northern Kenya alone, FEWS NET reported 4–5 million people in need of humanitarian assistance.

Pastoralists are particularly affected by droughts because of their economic dependence on livestock raising, which is typically done through extensive grazing in rangelands. Drought conditions result in rapid declines in pasture, making livestock production challenging. The escalating frequency and severity of droughts deplete traditional coping strategies and leave pastoralist households searching for alternative ways to get by (Woodhouse & McCabe, 2018). Given that pastoralism and agro-pastoralism constitute the main livelihood systems in East Africa (Stavi et al., 2022; Africa Union, 2010), we can estimate that millions of people in this region will start seeking out alternative livelihoods as climate change impacts worsen.

These alternative livelihood strategies include engaging in agriculture or wage labor, whether intermittently or seasonally, as well as urban migration and the complete abandonment of pastoralism. Migration, in particular, is increasingly recognized as a viable adaptation strategy, with significant discussion in the literature (e.g., Black et al., 2011; Jacobson et al., 2019; Sakdapolrak et al., 2023; Szaboova et al., 2023; Thorn et al., 2023; Tubi & Israeli, 2023; Vinke et al., 2022). However, conceptual criteria for assessing success or failure of migration-as-adaptation have only begun to be debated, with recent contributions of Sakdapolrak et al. (2023) and Szaboova et al. (2023) playing a pivotal role in advancing this ongoing discussion.

In this paper, we contribute to the literature on migration-as-adaptation by investigating the well-being outcomes of ex-pastoralists in northern Kenya. These households abandoned their traditional livelihoods and migrated to Marsabit Town in response to severe drought events. Our primary contribution to this debate is the identification of inherent heterogeneities among ex-pastoralist groups, which, we argue, are directly linked to disparities in well-being outcomes. This heterogeneity is reflected in how the process of sedentarization takes place—the transition from a nomadic to a settled lifestyle and livelihood. Some households experience a gradual integration into town economies, while others endure abrupt, involuntary relocations as part of the sedentarization process. As we will demonstrate, each scenario profoundly affects the well-being outcomes of the households concerned, depending on whether they integrate gradually or are relocated abruptly. Drawing on primary survey data collected from 285 ex-pastoralist households, our study compares the well-being outcomes of two distinct groups: a “settled group” that was already residing in Marsabit Town before ending their pastoral activities and a “migrant group” that relocated to Marsabit Town at the time of abandoning pastoralism. The settled group had the advantage of a gradual transition away from pastoralism due to their existing town residency, whereas the migrant group faced significant challenges in adjusting to a new town environment while discontinuing their pastoral livelihood. This comparative analysis highlights how initial conditions of settlement critically influence subsequent well-being outcomes.

We draw on aspects of the framework proposed by Szaboova et al. (2023) by examining two main dimensions of well-being: (1) material well-being, which is defined as the economic conditions of households, substantially shaped by housing, living conditions, and asset ownership, and (2) subjective well-being, comprehensively defined as households' perceptions of their life satisfaction and the changes in their quality of life before and after abandoning pastoralism. Our research addresses two interconnected questions. First, what patterns of material asset accumulation can be observed among the households belonging to each of these two groups, and how can these patterns be explained? Second, are there noticeable differences in subjective well-being outcomes between both groups after quitting pastoralism, and which factors contribute to these variations?

The remainder of the paper is structured as follows: the “[Understanding pastoralism in transition and pastoral well-being](#)” section provides a background on the pastoral way of life and conceptualizes well-being within the framework of migration-as-adaptation. This section discusses how the pastoral livelihood system, historically known for its adaptability, has recently been stretched by the impacts of climate change. It also elaborates on those pastoralists who exit the traditional livelihood system and migrate to towns as an adaptation strategy. Additionally, we explore the conceptual literature on evaluating complex well-being outcomes for this group. The “[Research design](#)” section introduces the geographical context of our case study in northern Kenya, outlines the research design, and describes our sampling strategy for the survey. The “[Results: well-being outcomes](#)” section presents the empirical results and reports on our well-being analyses. The “[Discussion and conclusions](#)” section reflects on the study's main observations and discusses the relevance of our findings for developing support strategies for the most at-risk populations in this region. The paper concludes by specifying its limitations and proposing questions for further research.

## Understanding pastoralism in transition and pastoral well-being

Conceptually, this paper builds on the well-established literature on “pastoralism in transition” (e.g., Fratkin, 2001; Galvin, 2009; Kaye-Zwiebel & King, 2014). This body of work characterizes pastoralism as a dynamic livelihood system adept at coping with change, and it has been suggested that the natural state of pastoralism is one of evolution, continuously adjusting to an unstable environment to maintain the resilience of the livelihood system (Catley et al., 2013; Galvin, 2009; Kaye-Zwiebel & King, 2014; Thornton et al., 2007).

Pastoralists reside in unpredictable climates, characterized by high variability in inter-annual and inter-seasonal rainfall patterns. In response to these variable conditions, pastoralists have historically evolved a number of adaptation strategies, which may include modifying herd migration and mobility patterns, herd rejuvenation to maintain a healthy age and gender-balanced herd, splitting or merging herds, or adopting multi-species herding to utilize diverse grazing environments (De Bruin & van Dijk, 2003; Fratkin, 2001; Galvin, 2009; Little et al., 2001; Magal & Wambua, 2017; Mogotsi et al., 2011; Ng'ang'a et al., 2016). More recently, pastoralists have also adopted herd insurance and engaged in aid or credit

programs (Gebeyehu et al., 2021; Ng'ang'a et al., 2020). These strategies are, however, incremental ways to adapt to an unstable environment and differ significantly from the distinct strategy that is known as sedentarization.

Sedentarization, extensively studied in East African pastoralism research (e.g., Roth & Fratkin, 2005; Witsenburg & Adano, 2004), refers to the transformation of nomadic individuals, households, or communities into a settled existence. The process is increasingly recognized as a coping and adaptation strategy in response to environmental stressors. This is evidenced in various contexts in the sub-Saharan drylands, including Kenya, Nigeria, and Ethiopia, where migration serves as a mechanism to mitigate the impacts of environmental change (Aremu & Abraham, 2019 on Nigeria; Gebeyehu et al., 2021 on Ethiopia; Ng'ang'a et al., 2020 on Kenya; Pollini & Galaty, 2021 on Kenya). Sedentarization involves significant structural changes in traditionally mobile ways of life, as evidenced by shifts in livelihoods (Witsenburg & Adano, 2004), gender roles (Smith, 1998), dietary habits (Fujita et al., 2004; Nathan et al., 1996), and vulnerability levels (McPeak & Little, 2005). At the heart of this transition is the pressing need for pastoralists to diversify their livelihood portfolios, which necessitates settling down (Fratkin & Roth, 2005). By choosing to settle in or near established towns, pastoralists can access a broader range of opportunities for livelihood diversification.

Sedentarization has long been considered a process that can involve multiple smaller steps along a continuum, ranging from full mobility at one end to a completely sedentary existence at the other (e.g., Roth & Fratkin, 2005; Symanski et al., 1975). Formerly fully mobile pastoralists may settle in or near permanent settlements while maintaining their commitment to livestock raising, but retaining a smaller degree of mobility. For example, Borana pastoralists in northern Kenya who have settled near a town are known to continue to graze their livestock away from the settlement during the wet season, typically at distances of 10–20 km, and move back closer during the dry season (Northern Rangelands Trust, n.d.). This example demonstrates that sedentarization does not necessarily lead to a complete break from the pastoral economy and lifestyle.

In other cases, however, sedentarization may involve a significant separation from former pastoralist livelihoods and identities. When herders face livestock losses beyond herd recovery and traditional coping strategies are exhausted, pastoralists may migrate to towns as a last-resort strategy (McPeak & Little, 2005; Mogotsi et al., 2011). Such sedentarization processes can be considered involuntary, sharing conceptual similarities to what is elsewhere termed “forced migration”.<sup>1</sup> It is important to recognize, however, that the term forced migration is a subject of ongoing debate within the climate mobility literature. This debate revolves around the extent

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<sup>1</sup> Forced migration and displacement is defined as “the movement of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence ... in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or human-made disasters” (United Nations, 2004: p.1). This terminology is still used in connection with climate change impacts in some studies (e.g., Kamta et al., 2001), increasingly linked to

to which individuals, families, and communities still have agency and can influence decision-making processes in the face of environmental crises like droughts (Call et al., 2017). In the context of environmental changes, this degree of agency retained by individuals during migration thus remains a subject of debate (Piguet et al., 2018). Conceptually important for our purposes is the understanding that sedentarization can be a gradual, step-by-step adaptation process that enhances the resilience of a household's livelihood portfolio over time, or it can be an abrupt, undesired, and last-resort survival strategy in response to severe drought events. In the latter scenario, families engage in so-called involuntary migration, moving to and settling in cities under compulsion (Gebeyehu et al., 2021; Hoffman et al., 2022; Silchenko & Murray, 2023).

We know from earlier research that the processes of sedentarization and migration are multifaceted and lead to a wide range of outcomes (Hoffmann et al., 2022; Wiederkehr et al., 2018); it can be deployed as an adaptation strategy, but can also reflect the limits of in situ adaptation (Sakdapolrak et al., 2023; Szaboova et al., 2023). Migration-as-adaptation entails significant challenges, such as concerns about cultural and economic integration in the destination (Tubi & Israeli, 2023; Wafula et al., 2022), mental and physical strains (Heaney & Winter, 2016; Lindvall et al., 2020), and, important for our purposes, well-being concerns (Jowell et al., 2018). Migration-as-adaptation can lead to a range of outcomes among seemingly homogenous groups, and we are only just beginning to understand its intricate connections to well-being outcomes for pastoralists.

Earlier studies have long recognized the challenges in conceptualizing or designing research on well-being post-migration, particularly within pastoral contexts (Little et al., 2008; Tache & Sjaastad, 2010). Traditional quantitative measures of well-being, such as comparing income versus expenditure to determine poverty, have proven inadequate in pastoralist socio-cultural settings (Tache & Sjaastad, 2010). These metrics often overlook the complexities of subjective well-being outcomes and fail to capture the full spectrum of factors contributing to well-being in these communities. Well-being is now often assessed through multidimensional frameworks, an approach catalyzed by the work of the University of Bath's Well-being in Developing Countries (WeD) research group. According to their framework, well-being integrates (1) objective conditions or circumstances, (2) subjective perceptions of these conditions, and (3) a relational aspect that considers individuals' interactions with others to fulfill needs and achieve goals (Gough & McGregor, 2007).

In migration studies, this conceptualization has more recently been embraced in studies such as Woodhouse and McCabe (2018) and Szaboova et al. (2023), exploring well-being through (1) material, (2) subjective, and (3) relational lenses. For instance, Woodhouse and McCabe (2018) in their study of Maasai pastoralists,

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Footnote 1 (continued)

scenarios involving fleeing armed conflict or development-driven displacement, where individuals are displaced by human actions rather than natural events (Jaji, 2021; Lakshman & Rajan, 2023). For these reasons, we favor the term "involuntary migration" to underscore the agency pastoralists may exercise within their decision-making processes, recognizing migration as part of a broader adaptation strategy.

highlight land and livestock as key material assets, future security concerns as a subjective element, and autonomy and social unity as essential for understanding the relational dimension of well-being. Szaboova et al. (2023) extend this model to migration-as-adaptation, operationalizing the three dimensions of well-being through indicators such as housing and living conditions, healthcare and social protection coverage, income changes, school attendance, the use of remittances for investment in productive assets versus consumption, food security, nutrition, and social capital.

## Research design

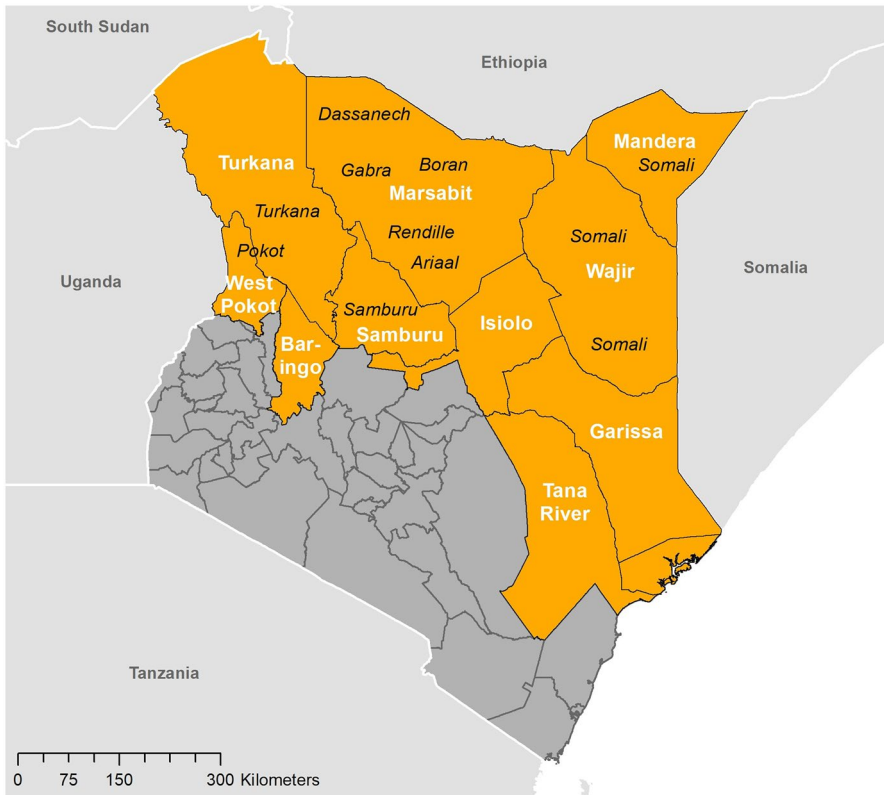
Having delineated the potential variations in sedentarization processes as either gradual, smaller shifts, or abrupt and complete transitions, and conceptually linking it to the complexity and contested nature of typologies of migration (i.e., “forced”, “involuntary”, or “voluntary”), our study highlights the inherent heterogeneity among ex-pastoralist groups. This heterogeneity is conceptually critical as we argue that it influences subsequent well-being outcomes of ex-pastoralists.

## Study area

The study’s empirical focus is on northern Kenya, a region where a significant portion of the population relies on pastoralism. Figure 1 highlights the arid and semi-arid counties of the region: Turkana, West Pokot, Baringo, Marsabit, Samburu, Isiolo, Wajir, Mandera, Lamu, Tana River, and Garissa. Our geographic emphasis is on Marsabit County, which has an approximate population of 450,000 people (Government of Kenya, 2019). This county is widely recognized as one of the driest in Kenya, with an annual precipitation average of around 700 mm/year (see Supplementary Information 1).

Older accounts estimate that about 80% of households in Marsabit County made a living through pastoralism (Krätli & Swift, 2014; Witsenburg & Adano, 2004). The large barren deserts in the county are devoid of any type of vegetation to sustain pastoral livelihoods, but the lowlands, covered irregularly by scrub vegetation and grasses, can support nomadic pastoralism. The highlands support more livelihood options, including rain-fed agriculture. In the foothills of Mt. Marsabit, many residents grow crops such as maize, beans, teff, wheat, potatoes, coffee, and others. Furthermore, the mountain’s sub-humid climate offers a suitable environment for (semi-)sedentary pastoralists.

Primary data collection took place in Marsabit Town, located on the north side of Mt. Marsabit. It is the biggest settlement in the county and the one with the longest history, dating back to the start of the twentieth century (Witsenburg & Adano, 2004). The town serves as the county’s administrative center and is an important regional trading, market, and commercial hub, offering a range of casual labor opportunities that attract migrants from the region. The latest census reported a total population of over 30,000 people (Government of Kenya, 2019).



**Fig. 1** Pastoralist counties and communities of northern Kenya. Indicated in white are county names; indicated in black and italics are dominant pastoralist groups (Sources: FEWS NET Livelihood Zones, 2011; GADM - Database of Global Administrative Areas, n.d.; authors' adaptations)

## Methods and data collection

Data collection took place in October 2017 and involved administering a survey with respondents from 285 households. The sample consists solely of households that were once engaged in pastoralism but abandoned this livelihood due to drought. This effectively excludes non-pastoralist households or those that abandoned pastoralism due to reasons other than drought. To accurately reach our target group, we implemented screening questions at the beginning of the survey. In these questions, participants provided detailed responses about the year they transitioned away from pastoralism, the specific drought that triggered this shift, and the impacts of this drought on their livestock. The unit of analysis in our study is the household, which we considered to be a stable, homogeneous unit (however, we recognize that households can be trans-local, with parts of extended families spread across different towns and rural hinterlands; see Sakdapolrak et al., 2024).



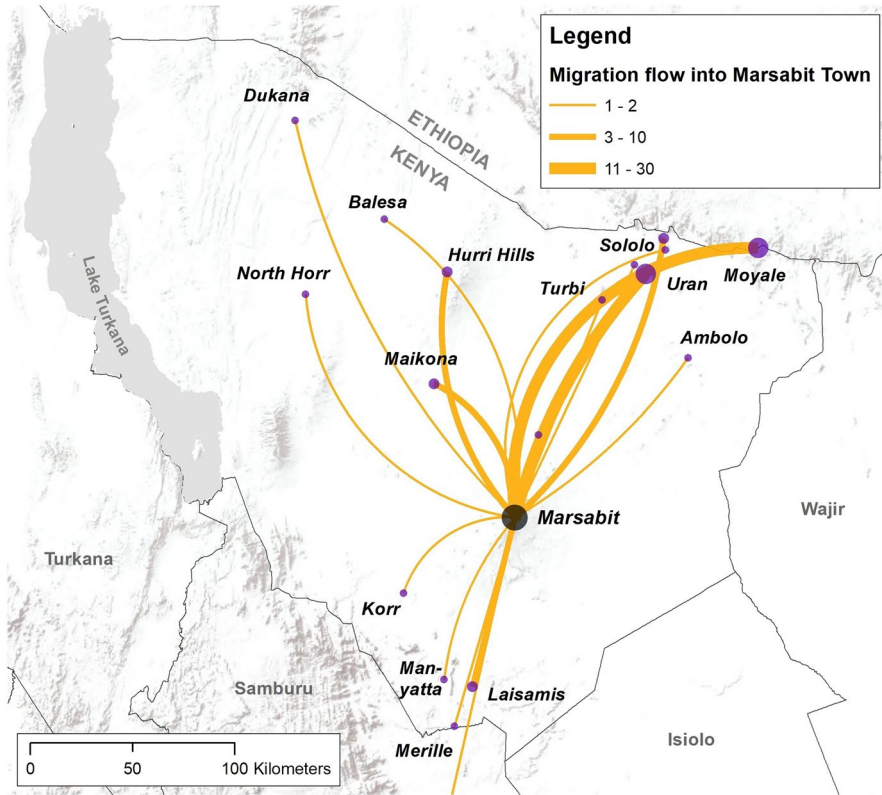
We define “former pastoralists” as those households that previously claimed pastoralism as their main occupation, but now collect more than 50% of their earnings in other sectors of the town economy. These households thus substantially shifted their economic dependency away from livestock raising. However, these former pastoralists may still own some livestock to supplement dynamic livelihood portfolios. As described earlier, our study compares the material and subjective well-being of two groups of former pastoralists: the “settled group” consists of ex-pastoralist households that were already residing in Marsabit Town and could gradually transition their livelihood portfolio away from pastoralism. This group is composed of households that did not engage in physical relocation when they dropped out of pastoralism. The “migrant group” consists of those households that moved into Marsabit Town at the time of quitting pastoralism as their main source of income. Households in this group migrated over distances of 100–300 km. The distinction between these groups of households was made through survey questions that capture the nuances of migration and sedentarization patterns. Our approach to these questions establishes the geographical roots of households, which was particularly important because many had made the livelihood transition a long time ago, potentially leading to recollection issues. The survey questions were designed to distinguish between those with prior (sometimes long-standing) residential ties to Marsabit Town and those whose origins are elsewhere. For this latter group, we also crafted questions to understand their migration journey and patterns. The following questions allow us to capture these nuances:

1. “What is the respondent’s district of birth?”
2. “What is the respondent’s sub-location of birth?”
3. “Where did the household live before (location + sub-county)?”
4. “What was the route followed during migration?”
5. “Where did you stop over last before coming to Marsabit Town?”

This key distinction between the two groups enables us to explore the differential impacts of migration on well-being outcomes. We compare the experiences of those who underwent physical relocation to a town setting as part of their livelihood transition with those who had an existing town residency. In our sample, 93 households were identified as “migrant” and 192 households were identified as “settled”.

The settled group resided within the township and its surrounding contiguous wards, locally known as Sagante, Jaldesa, Dakabaricha, Badasa, Dirib Gombo, Qilta, Gar-qarsa, Qachacha, Parkishon, and Hula Hula. This group is composed of former semi-sedentary and sedentary pastoralists, and their transition away from pastoralism did not involve physical relocation. During the wet season, they traditionally moved their herds from these settlements to nearby grazing zones, located 10–20 km from Marsabit Town. However, this practice was discontinued when they quit pastoralism and reoriented livelihoods towards the town economy. The migrant group, in contrast, relocated over substantial distances (see Fig. 2). Migrant households came from the Hurri Hills, Durkana, North Horr, Balesa, Laisamis, Korr, and from the vicinity of Sololo, Walda, and Turbi.





**Fig. 2** Migration flow of former pastoralists into Marsabit Town,  $n=93$  (Source: authors’ primary household survey data, 2017)

Supplementary Information 2 presents the general characteristics of survey respondents, divided into migrant and settled groups, as captured in our survey questions on “average household size,” “number of children under 18,” “number of working-age adults,” and “household gender composition”. Both groups exhibit generally similar characteristics across these dimensions. The data also show that most livelihood transitions for both groups occurred between 1991 and 2010. These similarities are significant, as they enable a more confident attribution of any observed differences in well-being outcomes to the distinct migration statuses of the groups.

In preparation for data collection, several stages of groundwork were undertaken, including reconnaissance fieldwork, enumerator recruitment and training, and field piloting. During the reconnaissance phase, we familiarized ourselves with the local pastoral communities (Gabra, Rendille, Borana, Burji) and the various wards in and around Marsabit Town. This phase also involved introductions to local area chiefs across these administrative domains and securing their permissions for the research. The local area chiefs played a pivotal role in our purposive sampling strategy. Owing to their knowledge of residents’ current and former occupations within their

jurisdiction, their insights were useful in the detection of the target group. Leveraging their local knowledge allowed us to effectively locate respondents for the study, which then enabled us to reach the wider ex-pastoralist community through snowball sampling. Our sampling approach aimed for spatial representativeness, systematically selecting households from every ward in Marsabit Town to ensure proportional representation across the town's diverse localities. This method was intended to capture variability and ensure that our findings could be generalized to the broader ex-pastoralist household population within this specific geographical context.

Through the County Statistical Office, we assembled a gender-balanced team of enumerators. A week-long training program was conducted, focusing on the research objectives, the survey questionnaire, and the usage of tablets and survey software for recording the responses. The main data collection tool is a 50-question survey, which covered a broad spectrum of topics related to livelihoods, migration, and well-being, including details about new occupations, the timing of livelihood change, previous household residences, migration routes, birthplace of the household head, household composition, household assets, dwelling characteristics, and subjective well-being indicators.

### **Operationalization of material and subjective well-being**

Building on parts of the well-being framework described above (Szaboova et al., 2023), we specifically focus on comparing the material and subjective well-being of the “settled” and “migrant” group. In our material well-being analysis, we primarily applied inductive logic and reasoning, examining the data to identify patterns, trends, and relationships between certain household characteristics and material well-being outcomes. Material well-being is operationalized through the following survey questions:

1. Which assets does the household own
  - (a) Radio
  - (b) TV
  - (c) Mobile phone
  - (d) Water tank
  - (e) Bicycle
  - (f) Motor bike
  - (g) Car
  - (h) Other
2. Does the household still own any livestock?
3. What is the main material used for the walls, flooring, and roof of the home?

We follow self-reported criteria to operationalize the subjective well-being of households. We collected information on the level of satisfaction with the “quality of life,” before and after quitting pastoralism. Inferential statistics were applied to

the subjective well-being dimension through the construction of an ordinal logistic regression model, centered on a dependent variable we termed “change in subjective well-being.” This variable was derived from self-reported well-being levels before and after the livelihood transition, using ordinal rankings from “Very dissatisfied” to “Very satisfied.” We converted these qualitative, subjective well-being outcomes into a quantitative variable by assigning numerical values to the corresponding well-being levels. Assignments for this “Change” variable were as follows: for both pre- and post-livelihood change, Very dissatisfied was assigned the numerical value of  $-2$ , “Dissatisfied” was  $-1$ , “Neutral” was allocated  $0$ , “Satisfied” was  $+1$ , and Very satisfied was  $+2$ . In the new Change variable, the most positive outcome is denoted by  $+4$  (indicating a household moving upward in subjective well-being level from Very dissatisfied to Very satisfied, which is a four-step upward shift), and the most negative outcome is denoted by  $-4$  (a household moving downward in subjective well-being level from Very satisfied to Very dissatisfied, which is a four-step downward shift).

This approach to our data allowed us to identify which households moved up or down in their overall level of subjective well-being in their current situation. We subsequently devised a binary logistic regression model to calculate the probabilities that a former pastoralist household became Very dissatisfied after the livelihood transition ( $0$  for all satisfaction levels apart from  $1$  which was Very dissatisfied) and explored the most influential predictors for these adverse well-being outcomes.

## Results: well-being outcomes

In this article, we aim to answer two research questions: First, regarding material well-being, what patterns of material asset accumulation can be observed among the households belonging to each of the two groups of ex-pastoralists, and how can these patterns be explained? Second, regarding subjective well-being, are there noticeable differences in outcomes among these groups after quitting pastoralism, and which factors contribute to variations in these outcomes?

Evaluating material well-being significantly hinges on the possession of household assets. Table 1 presents asset ownership data, split into the migrant and settled group, and the disparities are striking across all asset categories evaluated. The settled households consistently surpass their migrant counterparts in every asset category, be it television ownership, direct access to a private water supply within their dwelling, smartphone possession, or owning a motorbike. Another key aspect to consider regarding household assets is the enduring prevalence of livestock ownership among former pastoralist households. Despite livestock no longer being the primary income source, it frequently remains a (small) component of a household’s diversified livelihood portfolio. Table 1 illustrates the proportion of households that continue to own livestock: while  $27\%$  of the settled group retained livestock, this figure drops to  $10\%$  for the migrant group. These data hint at a stronger detachment from pastoralist livelihoods, lifestyles, and identities among migrant households and could imply that migrant households sell any remaining livestock to cover migration-related expenses. As we will demonstrate later in this section, the inability to

**Table 1** Material well-being of ex-pastoralists, measured here by way of ownership of household assets, split by Migrant and Settled group

<i>Material well-being</i>	<i>All</i> ( <i>N</i> =285)		<i>Migrant group</i> ( <i>N</i> =93)		<i>Settled group</i> ( <i>N</i> =192)	
	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>
<b>Asset ownership</b>						
<i>Owning a TV</i>	44	15.6	12	12.5	33	17.3
<i>Owning a private water tank</i>	83	29.1	18	19.3	66	34.6
<i>Owning a smart phone</i>	179	62.7	45	48.9	135	70.5
<i>Owning a motorbike</i>	27	9.4	7	8.0	20	10.3
<i>Livestock ownership</i>	60	21.1	9	9.7	51	26.6

Source: Authors' primary household survey data

Chi-square tests show significant associations between migration status and ownership of various household assets. There is a significant association with owning a TV (Pearson  $\chi^2(2)=10.136$ ,  $p=.006$ ), a private water tank (Pearson  $\chi^2(2)=15.792$ ,  $p<.001$ ), a smartphone (Pearson  $\chi^2(2)=20.925$ ,  $p<.001$ ), a motorbike (Pearson  $\chi^2(2)=9.464$ ,  $p=.009$ ), and owning livestock (Pearson  $\chi^2(1)=11.376$ ,  $p<.001$ ). These results suggest that the differences in asset ownership between migrant and settled households are unlikely due to chance

retain any livestock is strongly associated with poor subjective well-being post-livelihood transition.

Turning now to questions of subjective well-being, we examine self-reported levels of satisfaction with the “Quality of Life” before and after the livelihood transition (Table 2). For the settled group, the trend appears relatively linear at first glance, as well-being levels seem to have generally improved. We can observe a substantial reduction in the proportion of households reporting being Very dissatisfied or Dissatisfied (a shift from a combined 58% prior to the livelihood change, down to 27% after). Similarly, we can see a notable increase in the percentage of households claiming they were either Satisfied or Very satisfied after the livelihood change (an upswing from 15% prior to the shift, to 44% after).

The situation for the migrant group, however, is more complex. A combined 87% of migrant households reported feeling either Very dissatisfied (26%) or Dissatisfied (61%) with their standard of living prior to the livelihood change. This reinforces the notion that for migrant households, abandoning pastoralism is an adaptation strategy compelled by circumstances, effectively constituting involuntary migration. It also highlights that the two groups did not start from the same baseline of subjective well-being before quitting pastoralism; the migrant group was in a much more precarious state compared to the settled group. Very few migrant households reported being Satisfied (3%), and none reported being Very satisfied prior to the move and livelihood change. Upon moving away from pastoralism, the proportion of migrant households reporting Very dissatisfied doubled, reaching 50%. This indicates further declines in well-being for a large group of migrant households. That number is three times as high as compared to the settled group (17%). It therefore appears that

**Table 2** Self-reported levels of subjective well-being among migrant and settled households, before and after livelihood change away from pastoralism, in percentages

Percentage of households that report being:	Migrant households before livelihood change (N=93)	Migrant households after livelihood change (N=93)	Settled group before livelihood change (N=192)	Settled group after livelihood change (N=192)
<i>Very dissatisfied</i>	25.8	49.5	20.8	16.7
<i>Dissatisfied</i>	61.3	5.4	37.0	10.4
<i>Neutral</i>	9.7	11.8	27.6	29.2
<i>Satisfied</i>	3.2	31.2	13.0	41.1
<i>Very satisfied</i>	0.0	2.2	1.6	2.6

Source: Authors' primary household survey data

migration-as-adaptation further reduces the subjective well-being for a substantial proportion of households moving away from pastoralism.

However, Table 2 also reveals a notable decline in the cumulative percentage of Dissatisfied and Very dissatisfied migrant households: from 87% prior to the livelihood shift to 55% afterwards. Interestingly, a marked segment of the migrant group now reports being Satisfied or even Very satisfied post-transition, a combined 33% (up from a mere 3% before the transition). This shift points to a marked improvement in subjective well-being levels among some migrant households. Hence, these data reveal within-group variations, underscoring that migration into Marsabit Town results in considerable polarization and discrepancies in subjective well-being outcomes. For more detailed analyses of these within-group variations, which can be observed in both the settled and the migrant group, we refer to Supplementary Information 3.

We further analyzed these data by transforming the subjective well-being outcomes into an ordinal variable, "Change in subjective well-being". This variable assigns numerical values based on well-being outcomes before and after the livelihood change: Very dissatisfied = -2, Dissatisfied = -1, Neutral = 0, Satisfied = +1, and Very satisfied = +2. Changes are then calculated, ranging from +4 (a household shifting from Very dissatisfied to Very satisfied) to -4 (a household shifting from Very satisfied to Very dissatisfied). This variable facilitates a more precise tracking of households that have experienced upward (positive observations) or downward (negative observations) mobility on the subjective well-being scale following the change in livelihood.

Is the household's migration status a substantial predictor for upward or downward movement on this new subjective well-being scale? To investigate this, we constructed an ordinal logistic regression model for the Change in subjective well-being variable, using the household's migration status as the predictor variable, while controlling for household size, gender composition of the household, year of the livelihood transition of the household, and number of working-age adults (Table 3). Results yield an odds ratio of 0.53 in this model. This means that migrant households are nearly half as likely as settled households to experience an improvement in subjective well-being following the livelihood change. Correspondingly, settled households are about twice as likely as migrant households to advance to a higher

**Table 3** Logistic regression model with “migrant household” as the main independent variable predicting “Change in subjective well-being,” controlling for year of livelihood transition, the number of working age adults in the household, number of males in the household, household size, livestock ownership, and occupation

<i>Variable</i>	<i>B (log-odds)</i>	<i>Std. error</i>	<i>p-value</i>	<i>Odds ratio Exp(B)</i>	<i>95% CI lower</i>	<i>95% CI upper</i>
<b>Controls</b>						
<i>Year of transition</i>	0.364	0.117	0.002*	1.44	1.14	1.81
<i>Working age adults</i>	0.165	0.108	0.125	1.18	0.96	1.46
<i>Males (total)</i>	0.159	0.103	0.123	1.17	0.96	1.44
<i>Household size</i>	-0.236	0.077	0.002*	0.79	0.68	0.92
<i>Livestock</i>	0.858	0.310	0.006*	2.36	1.29	4.33
<i>Farming HH</i>	0.449	0.382	0.240	1.57	0.74	3.31
<i>Casual labor HH</i>	-0.015	0.345	0.965	0.99	0.50	1.94
<b>Main independent</b>						
<i>Migrant household</i>	-0.634	0.254	0.013*	0.53	0.32	0.87

Source: Authors' primary household survey data

The logistic regression model provides a significant improvement in fit over the intercept-only model ( $-2 \log \text{likelihood} = 761.353$ ,  $\text{chi-square} = 38.312$ ,  $\text{df} = 8$ ,  $p < .001$ ), indicating that the inclusion of the predictor variable and control variables meaningfully contributes to explaining the variance in household well-being outcomes. Pseudo R-square values (Cox and Snell = .136, Nagelkerke = .142) suggest a modest but non-negligible explanatory power of the model. Deviance chi-square's non-significant result ( $p = 1.000$ ) suggests an adequate fit to the observed data

Significance levels: \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

well-being category after the livelihood change. The findings from the model are statistically significant.<sup>2</sup>

What can explain the observed disparities in both material and subjective well-being outcomes between these two groups? We hypothesized that a significant factor is the nature of the new livelihoods acquired by the main breadwinners in town. Table 4 presents workforce data for the migrant and settled groups. A notable observation from our data is that migrant households are less likely to transition into agricultural work compared to the settled group. Only 15% of migrant households shifted into agriculture after abandoning pastoralism, a stark contrast to the 40% observed within the settled group. This discrepancy highlights potential inherent disparities and unequal opportunities in accessing agricultural livelihoods in Marsabit Town and in the foothills of Mt. Marsabit.

To provide further context, the agricultural work referred to in our study primarily involves seasonal and permanent roles in small-scale farming, integral to the local Marsabit Town economy. These roles often entail labor-intensive tasks such

<sup>2</sup> Note that some of the control variables are not statistically significant but were included to account for additional variance and to ensure that the effects of the main predictor were not confounded by these factors.

**Table 4** Newfound primary occupation of former pastoralists, split by Migrant and Settled group

Newfound primary occupation	All (N=285)		Migrant group (N=93)		Settled group (N=192)	
	N	%	N	%	N	%
Business owner	24	8.4	11	11.3	13	6.8
Casual laborer <sup>a</sup>	158	55.4	67	72.0	91	47.4
Farmer	91	31.9	14	15.4	77	40.1
Other <sup>b</sup>	12	4.2	1	1.3	11	5.7

The data depict the occupation of the household's main breadwinner working in Marsabit Town. Source: Authors' primary household survey data

Chi-square tests show significant associations between migration status and current primary occupation of the main breadwinner (Pearson  $\chi^2(3)=24.304$ ,  $p<.001$ ), suggesting that these observed associations are not due to chance

<sup>a</sup>This includes a mixed group of manual laborers, ranging from security jobs/watchman, sanitation workers, construction workers, mining/quarry workers, drivers/transporters, maids, vendors, etc.

<sup>b</sup>This category includes those reliant on relief aid, individuals who resort to begging, and the unemployed

as planting, harvesting, and tending to crops like maize, beans, teff, wheat, potatoes, and coffee, which are crucial for local food security and trade. For many, engaging in this type of work offers a more stable income compared to casual labor, thus significantly influencing well-being outcomes. However, access to these agricultural opportunities is limited by factors such as land availability, initial capital outlay for tools and seeds, and knowledge of farming techniques, which are more accessible to settled households already residing in or near the agricultural zones. This finding is significant because, as we will show below, transitioning from pastoralism to farming is associated with substantially higher subjective well-being outcomes.

A significantly higher proportion of migrant households, 72%, find new livelihoods in casual labor, compared to 47% of the settled group. The term "casual work" encompasses a wide range of often low-paying and insecure manual labor positions, including roles as watchmen, sanitation workers, construction laborers, mining or quarry workers, drivers, transporters, cleaners, and vendors of various goods such as milk, fruit, vegetables, or firewood. Thus, even though many migrant households transition to wage-paying employment, these roles are often unstable and poorly compensated, undermining their overall well-being.

We conducted a logistic regression analysis to determine the likelihood of a former pastoralist household becoming Very dissatisfied after changing their livelihood. The findings, detailed in Table 5, identify three significant predictors, ranked by their impact: (1) livestock ownership; (2) dwelling quality; and (3) the main breadwinner's capacity to transition into agricultural work. Of these, the absence of livestock after the transition emerges as the strongest predictor of extreme dissatisfaction with subjective well-being. Specifically, households that could not retain any livestock post-transition are 23 times more likely to report high levels of dissatisfaction compared to



**Table 5** Logistic regression model for all households ( $N=285$ ) being “Very dissatisfied” with their subjective well-being level in Marsabit Town after pastoralism, while controlling for household size, number of working-age adults, total number of males/females

		Coefficient (B)	Std. error	Odds ratio Exp(B)	p value
<i>Household owns livestock</i>	Yes			1	
	No	3.116	1.041	22.551	0.003
<i>Quality of the home</i>	Formal <sup>a</sup>			1	
	Informal <sup>b</sup>	2.482	0.498	11.965	<0.001
<i>Farming household</i>	Yes			1	
	No	1.377	0.463	3.962	0.003

Results are listed by odds ratio. Source: Authors' primary household survey data

Control variables representing household composition and demographics—household size ( $\text{Exp}(B)=1.090$ ,  $p=.796$ ), number of working-age adults ( $\text{Exp}(B)=0.872$ ,  $p=.443$ ), total number of males ( $\text{Exp}(B)=1.185$ ,  $p=.617$ ), and total number of females ( $\text{Exp}(B)=1.305$ ,  $p=.443$ )—did not show statistically significant effects. This lack of significance suggests that within the context of this model and sample, these aspects of household composition did not have a discernible impact on the likelihood of a household becoming very dissatisfied post-transition. They were included to account for additional variance and to ensure that the effects of the main predictors were not confounded by these factors

<sup>a</sup>Brick/cemented walls, cement floor, iron sheet roof

<sup>b</sup>Defined by the dominant usage of building materials for the wall, flooring and roof (e.g., mud, cow dung, grass/reeds/wattle)

those who managed to retain some, holding the other variables constant. This strong association likely reflects not only economic losses but also a profound cultural disconnection from the traditional pastoral ways of life, indicating a loss of pastoral identity and heritage. As demonstrated earlier in this section, migrant households are significantly less likely to retain livestock than the settled group.

Dwelling quality, characterized by the materials used in constructing the walls, floor, and roof, serves as the second significant predictor of extreme dissatisfaction. Former pastoralists residing in informal housing are 12 times more likely to report being very dissatisfied compared to their counterparts in formal housing. Formal structures typically feature concrete floors and iron-sheet roofs. Finally, as mentioned above, the primary breadwinner's transition into a new occupation holds weight. Households where the main breadwinner has transitioned to agriculture are significantly less likely to express extreme dissatisfaction in subjective well-being levels, holding all other predictors constant. Conversely, those unable to shift to farming and are forced to rely on unstable casual labor are four times more likely to be very dissatisfied. While the exact reasons for the association between moving into agriculture and higher levels of well-being are not clear from our data, we can speculate that it may relate to farming's closer alignment with traditional pastoralist lifestyles and identities, or land ownership enhancing connectedness and thus subjective well-being, as supported by literature (Woodhouse & McCabe, 2018). Nevertheless, as mentioned above, our data indicate that only about 15% of migrant households transition into farming, which helps further explain why the migrant group is less likely to experience improvements in subjective well-being levels.

Lastly, an important question that remains is the persistence of the observed disparities in well-being outcomes between the migrant group and the settled group over time, or whether these differences eventually level out. We can postulate that as migrant households become more integrated into Marsabit Town, their well-being levels may take some time to rise compared to settled households that had already established themselves in the town and therefore had more time to seek out new livelihoods and improve their well-being levels. Our survey data includes information on the timing of the livelihood change, which we can cross-reference with the earlier computed Change in subjective well-being variable.

The result of this cross-tabulation is presented in Supplementary Information 4. Notably, it is the earlier migrant cohorts, particularly those households that transitioned livelihoods between 1991 and 1995 and between 1996 and 2000, who still reported lower well-being levels in 2017, the year of the survey. These observations suggest that the negative well-being impacts have remained persistent over time, with many migrants unable to move upward on the well-being scale, even years after their livelihood transition. Interestingly, it is the later cohorts of migrants, particularly those transitioning between 2006 and 2010, who report increased well-being levels.

## Discussion and conclusions

Recently, the literature on climate migration has seen a renewed interest in exploring the success or failure of migration-as-adaptation (Jacobson et al., 2019; Sakdapolrak et al., 2023; Szaboova et al., 2023; Vinke et al., 2022), particularly with respect to pastoralist communities and households (Thorn et al., 2023; Tubi & Israeli, 2023). Our position aligns with the recent contribution by Szaboova et al. (2023), stating that migration is a successful adaptation to climate change if it increases well-being, sustainability, and equality, looking at the origin, moving, and destination areas. In this study, we investigated material and subjective well-being outcomes of migrants in destination areas.

However, we also recognize that there is a substantial knowledge gap in this literature due to the heterogeneity among groups and sub-groups understood to be vulnerable to climate change impacts. As Tubi and Israeli (2023, p.9) contend, “Elucidating the entire landscape of migration outcomes will provide more accurate and contextualized knowledge that is grounded in migrants’ realities.” Our well-being study conducted among former pastoralists contributes to and intersects with this expanding body of literature in three important ways.

First, our well-being analyses explored migration outcomes using a predefined set of variables to quantify the migrants’ subjective experiences. This approach, while structured, allows us to illuminate new aspects of well-being and inequalities by providing quantifiable and comparative data across different groups of ex-pastoralists. Although we do not directly elicit what constitutes success or failure from the migrants themselves, as suggested by Tubi and Israeli (2023), our methodology facilitates understanding of how migration impacts are subjectively perceived, and

how these can be compared. Our results show that the likelihood of migrant households moving into a higher well-being category after the livelihood change is almost half that of settled households. The majority of migrant households were absorbed into casual labor roles, with a substantially smaller proportion being able to transition into agricultural work or keep livestock. The limited access to the agricultural sector for migrant households, relative to already settled households, underscores inequalities faced when securing new livelihoods. Our well-being analysis demonstrated linkages between town-based livelihoods and well-being levels: a successful transition into agriculture significantly predicts higher well-being and, conversely, reliance on casual labor tends to align with lower well-being levels (Cheng et al., 2023).

Second, by distinguishing between heterogeneous sub-groups of ex-pastoralists, we were able to scrutinize their diverging well-being outcomes separately, and more precisely contribute to the migration-as-adaptation literature. While migration status served as a reliable predictor for downward (migrant households) and upward (settled households) shifts in well-being, we also observed variations within these groups. Of particular interest were migrant households that saw a significant improvement in subjective well-being and settled households that experienced a marked decrease. We designed a model predicting if households ended up with higher or lower levels of subjective well-being after the livelihood transitions away from pastoralism. A complete loss of livestock, living in informal housing, and a failure to transition into agricultural work significantly increase the likelihood of extreme dissatisfaction following the change in livelihood.

Third, our study contributes conceptual insights to the evaluation of well-being criteria and metrics, as proposed by Szaboova et al. (2023) and Sakdapolrak et al. (2023), by illustrating the intricate connection between material and subjective well-being outcomes. Our analysis reveals that predictors of material well-being can effectively forecast subjective well-being outcomes. Specifically, factors such as livestock ownership and the type of housing households end up in emerged as statistically significant indicators of extreme dissatisfaction with subjective well-being, underscoring the interdependence of material conditions and subjective well-being perceptions in our study population.

While our findings reveal interesting and curious trends, the study has limitations. First, the survey was designed with screening questions to precisely identify ex-pastoralists who primarily attributed their transition out of pastoralism to drought, thereby ensuring a focused investigation into climate migration. However, it is crucial to recognize the complexity of livelihood decisions, which may also be influenced by a multiplicity of entangled economic, demographic, or personal factors. Second, some of the households now residing in Marsabit Town migrated many years ago, at times more than two decades before data collection. This time lapse can lead to challenges in accurately recalling the circumstances, reasons, and timing of migration, often resulting in more accurate memories of recent events due to recency bias. Consequently, the observed lower well-being levels among older migrants may be (partially) due to mis-recollections. In our sample, respondents generally reported lower subjective well-being levels for migrations that occurred decades ago. Although this raises questions about recollection accuracy,

the consistent trend across our data indicates that these reflections are meaningful. Third, our data indicate that settled households adapt more efficiently to town economies than their new migrant counterparts; however, the precise processes driving the observed discrepancies in livelihood and well-being outcomes warrant further qualitative research. Emerging questions for such research are: do settled households fare better due to their establishment of local networks and social capital prior to the livelihood transition? Or could it be that migrant households turn to towns as a last resort after exhausting all other resources, reaching towns in a state of destitution that subsequently casts long-lasting shadows on their well-being? How are processes of unequal access to new livelihood opportunities shaped and reshaped, i.e., why did households that had migrated into Marsabit Town long ago not find occupation in agriculture? These are compelling questions that future qualitative studies could illuminate. Fourth, it is noteworthy that the data collection occurred in 2017, a year characterized by drought. This environmental condition during data collection might have influenced respondents' perceptions. However, our sample primarily consists of individuals who migrated during the periods 1991–2000 and 2001–2010. Therefore, we anticipate minimal bias in our findings due to the 2017 drought. Fifth, our conceptual framework was guided by the well-being model proposed by Szaboova et al. (2023), which includes material, subjective, and relational dimensions. However, our study primarily focused on the material and subjective dimensions because the relational aspects of well-being necessitate deeper qualitative insights into social capital, social networks, community interactions, social unity, and support systems. Future qualitative research could enhance our findings by incorporating these relational measures, thus providing a more comprehensive picture of the well-being impacts of migration-as-adaptation among ex-pastoralists.

Echoing previous studies, our findings underscore that dropping out of pastoralism has complex consequences; it opens up new opportunities for some, while leading to greater precarity and hardship for others (Fratkin & Roth, 2005; McPeak & Little, 2005). In this paper, we aimed to dissect key predictors and evaluated probabilities to recognize material and subjective well-being outcomes and determine which households fall into which of these categories. Generally speaking from a material and subjective well-being perspective, a gradual sedentarization process (as observed in the settled group) tends to correlate with an increase in well-being outcomes. However, if the livelihood shift is abrupt and migration is a last resort (as observed in the migrant group), households are twice as likely to end up with worse subjective well-being levels post-pastoralism. We find support for this “involuntary migration” proposition in the differential subjective baseline well-being levels between migrant households and the settled group. Before the shift in livelihood, many migrant households were already reporting states of despair, suggesting their move to town might indeed have been a last resort.

Climate forecasts indicate a rising trend in drought episodes, which may lead to an increase in drought-induced migration among pastoralist populations. While this research focused on Marsabit Town, the insights regarding material and subjective well-being outcomes may have implications for other regions in East Africa. In these areas, small towns and settlements increasingly act as critical support hubs for the surrounding rural pastoralist communities (Mainet & Edouard, 2016). However,

it is important to note that while our findings could resonate with similar contexts, specific outcomes may vary based on local socio-economic, environmental, and cultural factors.

Our findings may also inform policymakers and aid agencies in crafting livelihood support frameworks for former pastoralists (e.g., United Nations, 2022b; World Food Programme, 2022). Interventions that enable former pastoralists to retain some livestock, cultivate plots of land, and access concrete housing can significantly improve the overall well-being of affected households. While there are inherent limits to such policies, particularly concerning agrarian land availability in towns like Marsabit, these adaptive frameworks could help alleviate some of the most severe negative migration outcomes.

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**Author contribution** Van Duijne: conceptualization, methodology, writing, data analysis, visualization. Ogara: data collection, data curation. Keeton: writing, review and editing. Reckien: conceptualization, methodology, writing, reviewing, supervision.

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**Data availability** The primary household survey data that this article builds on is available through the DANS Data Station Social Sciences and Humanities repository under <https://doi.org/10.17026/dans-xhn-bhry>.

## Declarations

**Conflict of interest** The authors declare no competing interests.

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