



GENDER-DIFFERENTIATED ROLES AND PERCEPTIONS ON CLIMATE VARIABILITY AMONG PASTORALIST AND AGRO-PASTORALIST COMMUNITIES IN MARSABIT, KENYA

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gender-proactive policies and legislation that promote gender equity at the county level is highly recommended. The study further recommends using conventional weather forecasting to fill in the gaps left by the Indigenous Technical Knowledge Predictions. As a result, this study suggests that the public should be involved in creating agro-weather and climate advisories to lower vulnerability, boost resilience, boost productivity and ultimately improve the ability to adapt to climate impacts.

KEYWORDS: climate variability, pastoralist, gender, spatio-temporal, temperature, precipitation

Introduction

Globally, there exist many gender disparities among household roles, which are likely to be exacerbated by climate variability and its impacts (Denton, 2002; Glazebrook et al., 2020). The depletion of natural resources and the decline in agricultural productivity further pose challenges to women's health. In some African cultures, moreover, the lack of women's involvement in many resource management decisions diminishes their capacity to participate in decision-making on income-generating activities (Abate 2019; Singh et al. 2022). In Kenya, like in many African countries, men are perceived to be family heads and play a crucial role in decision-making and domestic asset management. On the other hand, women play a significant role in household economics by providing labour for agricultural production and domestic purposes – their contributions to decisions, however, go unnoticed. These gender disparities in the food production value chain prevent both men and women from achieving food security (FAO, IFAD, UNICEF, WFP and WHO 2022). Notably, we presume that the impacts of climate change and variability may exacerbate agricultural sector inequalities. In addition, climate variability has negative effects on agro-pastoralists and pastoral communities (Tofu et al. 2023; Gebeyehu et al. 2021). This has the potential to reverse the progress made toward the Millennium Development Goals (King et al. 2018), and the increasing frequency and severity of previous droughts and floods have further accelerated this (Ochieng et al., 2022). Therefore, efforts to facilitate adaptation are necessary to improve agricultural sector resilience, guarantee food security and reduce rural poverty (Bolt 2019). As noted by Amarasinghe et al. (2020), climate variability is increasingly recognised as a global crisis, but responses have thus far been excessively focused on scientific solutions without much focus on gender dimensions. According to some studies, however, women and men experience climate variability differently. In most developing nations, women's livelihoods depend on climate-sensitive industries such as

subsistence agriculture (Eastin and Dupuy 2021; Tieminie et al. 2023). Climate variability directly impacts women's and girls' lives because they frequently shoulder the majority of unpaid household care duties.

Since the dawn of agriculture, agro-pastoralists have adapted their agricultural practices to changing weather patterns in order to maximise agricultural production, guarantee food security and enhance their standard of living. Climate-smart agriculture increases productivity and resilience to severe climatic conditions while advancing national food security and development objectives (FAO, IFAD, UNICEF, WFP and WHO 2022; Zhao, Liu and Huang 2023). Due to gender inequality, men and women do not experience climate change and climate variability equally (Balikoowa et al. 2019). Consequently, climate change may exacerbate the existing gender gap (Rao et al. 2019). According to Aggarwal et al. (2022), gender equality, women's empowerment and climate change have a direct relationship with each other; therefore, it is important to examine how men and women respond to climate change (Graham et al. 2016). According to the World Economic Forum (2020), women are more vulnerable than men due to their lower levels of education and exclusion from political and domestic decision-making processes that affect their lives. Ngigi et al. (2021) assert that responses to climate change must take gender into account if they are to be effective. This they argue for by contending that men and women have different needs, that women due to inequality are more affected by climate change and that men and women can bring different knowledge to the table when it comes to finding solutions. There is a strong connection between gender and climate variability, and both are regarded as cross-cutting issues that must be integrated into national and local planning as well as development cooperation initiatives by cooperating partners and donors. There is sufficient evidence to suggest that women are at the heart of sustainable development and that ensuring greater gender equality in responding to climate change will benefit the entire society (Du et al. 2021).

In climate change adaptation, gender also plays a significant role. It is essential, however, to consider sex, ethnicity, religion, literacy levels, culture, disability and age when addressing gender and climate change adaptation capacity (Du et al. 2021). Van Aelst and Holvoet (2016) argue that it is essential to consider the marital status of farmers and pastoralists because it determines their access to gendered socio-economic resources, such as entitlements and material support from family members, necessary for climate change adaptation. Sonwa et al. (2016) have found that, in northern Kenya's Turkana region, female-headed households lacked labour for herding as well as access to better pastures, which tended to be located in conflict-prone regions. Moreover, it is consistent with the Sustainable Development Goals (SDGs) and Agenda 2063 to address gender issues, for the ability to access, control and own productive

assets – such as labour, land, finances and social capital – enables individuals to live stable, productive lives. At the same time, climate variability has a significant impact on people's means of living and overall state of being. Gender disparities can lead to differential experiences of climate variability between women and men. However, women are disproportionately affected by climate variability and its accompanying consequences. Although there is a substantial amount of trustworthy scientific research regarding the effects of climate variability, there is a significant lack of dependable disaggregated data and evidence concerning the influence of climate variability on gender.

The review in this article indicates that women are disproportionately impacted by climate variability in five specific areas: (i) agricultural production, (ii) food and nutrition security, (iii) health, (iv) water and energy and (v) climate-related disaster, migration and conflict. The ownership of assets by women is a question of justice and human rights, as well as a fundamental driver of economic growth and social progress. Assets produce and diversify income, relieve financial restrictions and are essential for empowerment. Women can decide how to distribute and use the family's financial resources when they have control over household assets. Women's ownership over household assets can boost the family's well-being by encouraging more significant investment in education, health and other areas that benefit the household. Increasing women's ownership over assets is critical not only for gender equality but also for economic development and well-being (Doss et al. 2019). Asset ownership affects each partner's 'fallback' position in discussions about critical domestic and family decisions and, consequently, the exit options available to each.

In the pastoral production system, women also play a critical role. They are referred to as the 'hidden hands' of pastoral production despite their contributions being frequently overlooked (Ambani and Fiona 2014). Pastoral women engage in cultural activities, socio-economic conservation and the management of natural resources, and they are responsible for the households' food supply as well as the care of smaller, younger and ailing animals. Additionally, they are accountable for milking, milk processing and marketing. When men for extended periods migrate to satellite camps in search of pasture or livestock markets, women are left to care for their homes, livestock and camels. Abebe and Flintan (2021) argue that the situation of women and men in pastoral communities is dynamic due to climate risks, which have led to changes in pastoral societies' socio-cultural and socio-economic organisation. Unfortunately, the lack of attention to gender in the literature on climate variability has repeatedly led to an oversimplification of women's and men's exposure to climate risks (McKune et al. 2015). According to new and ongoing research, gender differences in vulnerability to the effects of climate change exist. Nonetheless,

policy approaches aimed at increasing the adaptive capacity of local communities largely fail to recognise the gendered nature of everyday realities and experiences. Therefore, this study aims to determine the gender-discriminated roles and perceptions of climate variability among pastoral and agro-pastoral communities in Marsabit County. Analysing community perceptions and meteorological trends helped achieve this. The results of this study are intended to help improve societal and institutional structures needed to achieve a gender-equal society, with the aim of building resilience.

Materials and methods

Study area

This study was conducted in four wards in Marsabit County in upper eastern Kenya, located between latitudes N 2° 45' and N 4° 27' and longitudes E 37° 57' and E 39° 21' (Fig. 1). Marsabit County is located in 'Arid and Semi-Arid Lands' (ASALs), where managing short-term climatic fluctuations as well as adapting to long-term changes is critical to sustaining livelihoods. Furthermore, the county experiences structural challenges characteristic of low development levels, high poverty levels, high illiteracy levels and continuous food insecurity. According to the 2019 Kenya Population and Housing Census (KHPC), the county has an estimated population of 459,785 people (243,548 men and 216,219 women) with an annual population growth rate of 3% compared to Kenya's growth rate of 2.2%. The population density within the county is four people per square kilometre. Marsabit is among the counties in Kenya with the highest poverty index (83.2%), ranking 44th out of 47 counties (Republic of Kenya 2016). According to the Marsabit Agriculture Sector Plan 2013–2017, pastoralism employs 81% of the county's population, while agro-pastoralists employ 16%. The remaining three per cent are engaged in formal work, casual waged labour or petty trade.

When it comes to weather and climate, the county experiences a bimodal rainfall pattern ranging from 600 to 1000 millimetres per year. The long rains occur between March and May (MAM), and the short rains occur between October and December (OND). Temperatures in the hot season average 30–35°C, with the highest temperatures experienced in February. The lowest temperatures range from 22 to 25°C and are experienced in March and July (Cuni-Sanchez et al. 2016). Evaporation rates are quite high, with the total annual potential evaporation falling in the 1800–2200 millimetre range.

Marsabit County has four sub-counties: Laisamis, Saku, North Horr and Moyale. The county covers an area of approximately 70,961 square kilometres,

comprising a flat plain whose elevation lies between 300 and 900 metres above mean sea level. Marsabit County was selected for the study on the basis that it has been subjected to historical and recurrent droughts that have left the region vulnerable. The specific study locations are Kargi, Maikona, Dakabaricha and Sololo. Kargi and Maikona are pastoral regions that are located in the Laisamis and North Horr sub-counties. These regions have similar climatic conditions and have very high daytime average temperatures of about 30°C and an annual average rainfall of about 427 millimetres.

Maikona is home to resides the Gabra pastoral community, while the Rendille pastoral community resides in Kargi. The Rendille and Gabra people are a Cushitic-speaking ethnic group inhabiting the northern part of Marsabit County. The communities in both wards (Rendille and Gabra) are primarily camel herders and are considered to have one of the most substantial claims of indigeneity in Marsabit County. The Rendille people are believed to have migrated from Ethiopia and later split from the larger Somali ethnic group. According to their tradition, both Rendille and Gabra men are responsible for herding camels, keeping small stocks and providing security. In contrast, women are tasked with the responsibility of housekeeping, cooking and caring for the young and elderly at home. They are also in charge of the construction of traditional thatched-roofed homes. Young boys and girls are responsible for taking care of young calves and milking herds at home as well as when animals are at grazing buffers. Both communities have similar characteristics and share some cultures despite their language differences.

Dakabaricha and Sololo wards are agro-pastoral areas that are located in Saku and Moyale Sub-Counties, respectively. The Dakabaricha region has daytime average temperatures of about 26°C and an annual average rainfall of about 1170 millimetres. The location's inhabitants are the agro-pastoral Burji community, which practises small-scale subsistence farming and livestock keeping. They grow crops such as maize, beans and sorghum and keep cattle. The Burji community is an ethnic group in Kenya that is mainly found in Moyale and Saku sub-counties. They were initially farmers and share significant linguistic similarities with the Sidama, who are connected to the Amhara. The Burji people are now spread over Kenya, with a considerable concentration in Moyale, Marsabit and parts of Nairobi, where they have established themselves as an economic powerhouse. Burji men, like most traditional societies, are burdened with the responsibilities of security and cultivation. Their women are in charge of caring for the sick, young and older people at home.

Sololo is a ward in Moyale Sub-County with semi-arid climatic conditions, located on the Moyale-Sololo escarpment. It is the fourth largest urban centre in Marsabit County, with a population of 44,822 according to the 2019 population census. The ward receives average rainfall totals of 1197 millimetres and

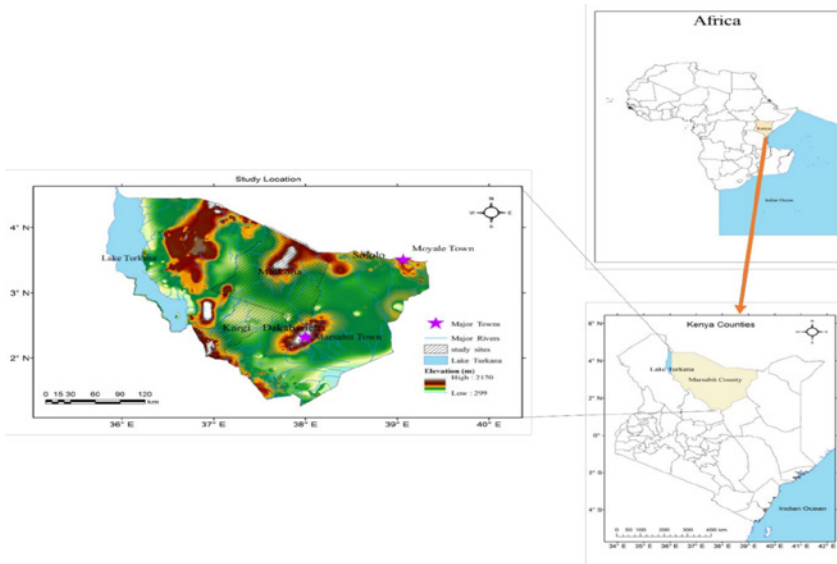


Figure 1:

Location of study area

Source: Analysis of field data, created by the authors.

annual average temperatures of 28 °C. The residents of Sololo ward are an agro-pastoral Borana community that practises livestock keeping and small-scale agriculture. The Borana community is originally from Ethiopia, and in Kenya, they are mainly concentrated in Marsabit County, Isiolo County and Tana River, with a significant population in the Sololo ward.

Study design

The study used a mixed design that included both quantitative and qualitative methods for both primary and secondary datasets. A mixed-methods approach was used because it makes it possible to address more complicated research questions and to collect ‘a richer and stronger array of evidence that cannot be accomplished by a single method’ (Yin 2013; Opiyo et al. 2014).

Data collection

The study focused on gathering information about how men and women in pastoralist and agro-pastoral communities in Marsabit County think about

changes in the weather. Primary data collection entailed conducting 384 household interviews in Marsabit County's pastoral and agro-pastoral communities. Data on perceptions of climate variability, livelihoods, the impact of climate variability on livelihoods and adaptation strategies were collected during household interviews. Eight focused group discussions (FGD) and ten key informant interviews were conducted to discuss climate variability and livelihood challenges. The data was analysed in the software package SPSS using descriptive statistics. Meteorological (secondary) data from the study region was compared with household (primary) data collected from field surveys. Purposive sampling was applied with the guidance of the key informers. Semi-structured survey questionnaires, open-ended interviews, key informant interviews (KII) and FGD were used to collect data from these categories of respondents. Interviews were conducted to improve the content's authenticity.

Data analysis

The unit of analysis was the individual household where data collection was done. The target respondents of the structured survey questionnaires were based on gender (either a woman or a male household head) in an alternating way to give equal opportunity to each gender. To determine the gender-differentiated roles, including changes in the roles occasioned by climate variability impacts, discussions for men and women were conducted separately to allow women to speak freely, as they tend not to talk in front of men due to their religious as well as cultural beliefs. Gender was disaggregated into men, women and youths – the latter comprising boys and girls. Responses from each of these categories regarding their daily routines, involving the tasks and activities they performed, were collected. These responses were triangulated with other findings from the focus group discussions (FGDs) and key informant interviews (KIIs). The household survey data collected was manually coded, entered into an IBM SPSS version 24 spreadsheet, and analysed using descriptive statistics that involved frequencies of gender-specific responses on the role played in the two study livelihood choices (pastoralist and agro-pastoralist). Since gender categories execute multiple roles across livelihood systems, the response with the highest frequency defined the specialised role played by the respective gender category.

Results and discussions

Social characteristics of the respondents

Table 1 depicts the results of this inquiry into the social characteristics of the respondents in the study region. The type of household structure influenced

reproductive, productive and community roles in relation to climate change. The study of households among the respondents in the study area showed that 0.5% were below 24 years of age, 9.8% were young adults (25–34), 72% were adults (45–64) and 17.7% were elderly (75 and above). In a normal pastoral and agro-pastoral set up, children and elderly (18.2%) were supposed to depend on adults and youth from their labour force.

Access to resources and assets is influenced by gender, particularly in rural Africa. According to a study by Adesina et al. (2010), female-headed families in sub-Saharan Africa have less access to financial resources, livestock and land than male-headed households do. Women-headed families are restricted in this regard by limited or no access to natural resources (Wasonga 2019).

An important variable that is anticipated to directly impact the accessibility and availability of resources for production and subsistence is the age of the household head. The accessibility of such resources, a crucial factor in wealth creation and accumulation, determines their availability for household use. Aged household heads are more likely to be wealthy than younger ones, enhancing the likelihood that they will embrace technologies to produce food. This is the typical sub-Saharan African nature of households, which is in agreement with observations in Rwanda (Taremwa et al. 2016), Kenya (Abbasi 2021) and Tanzania (Bradford and Katikiro 2019). At the same time, this is contrary to what has been observed in Jamaica (Ayesha 2015) and in China (Wei et al. 2014). Depending on the context, studies differ on whether male- or female-headed households are more likely to adopt new technologies. Male-headed households are often considered to be more likely to get information about new technologies and take business risks than female-headed households (Sharma 2023).

Other studies have shown that female households are more likely to take up climate change adaptation since they are responsible for much of the agricultural work in the region and have better experience and access to information on various management and farming practices (Shabib and Khan 2014). We therefore identified the gender and age distribution of the respondents to draw some inferences. During FGD interviews with women, it was reported that, during drought episodes, they spent much time walking and looking for water and firewood, for which reason they prepared only one meal a day. This also took away the time needed to care for the vulnerable (sick), elderly and children. The key informants and FGDs in the agro-pastoral region (Dakabaricha, Sololo) reported that, in male-headed households, the landless and men with small plots of land fled their homes to look for work elsewhere, leaving women and children to struggle in the extreme dryness. It was reported that their ability to return to their homes depended on the conditions in the places where they had gone.

Table I.
Social Characteristics of the Respondents (% of respondents)

| Age bracket | Agro-Pastoralists | | | | Pastoralists | | | | Total |
|--------------|-------------------|--------------|------------|---------------|--------------|---------------|------------|--------------|-------|
| | Dakabaricha | | Sololo | | Maikona | | Kargi | | |
| | Men (n= 102) | Women (n=51) | Men (n=84) | Women (n= 45) | Men (n=35) | Women (n= 31) | Men (n=21) | Women (n=27) | |
| 15–24 | 0.0 | | 0.0 | | 0.0 | | 0.5 | | 0.5 |
| 25–34 | 1.5 | | 0.3 | | 1.5 | | 6.6 | | 9.8 |
| 35–44 | 8.8 | | 1.3 | | 2.8 | | 7.6 | | 20.5 |
| 45–54 | 13.1 | | 5.3 | | 5.1 | | 8.1 | | 31.6 |
| 55–64 | 7.3 | | 3.0 | | 5.1 | | 4.5 | | 19.9 |
| 65–74 | 5.8 | | 2.0 | | 2.3 | | 4.3 | | 14.4 |
| 75–84 | 2.0 | | 0.3 | | 0.0 | | 0.8 | | 3.0 |
| 85 and above | 0.0 | | 0.0 | | 0.0 | | 0.3 | | 0.3 |

Perceptions of respondents on changes in rainfall received over the past 40 years by gender

The results presented in Figure 2 below indicate that 94.8% of female and 91.7% of male respondents have noticed changes in rainfall over the past 40 years, while only a small proportion of female (2.6%) and male (6.2%) respondents did not notice any change in rainfall over the years. In the agro-pastoral livelihood zone of Dakabaricha and Sololo, most respondents (88.2%–99.2%) have stated that rainfall patterns have changed over the last four decades. According to 83.7% of the respondents in Dakabaricha and 88.4% in Sololo, the change has been characterised by a reduction in periods of intensity over time. Similarly, in the pastoral livelihood zone of Kargi and Maikona, most respondents (89.6%–93.9%) have stated that there has been variability in the rainfall pattern. The temporal variability of the rainfall pattern change has led to a decline in rainfall over time, as recognised by 93.8% of the pastoral community in Kargi and 93.9% of that in Maikona. Additionally, the analysis reveals that 90.3% of female respondents and 86.8% of male respondents have noticed a decrease in the amount of rain received over time. This will place an undue burden on the most vulnerable members of the community, particularly women, by requiring them to travel long distances in search of water for household use. The vulnerable members of the household (children, the elderly and the sick) will be left unattended since the women who are supposed to take care of them are overburdened. Men are equally affected, however,

since they will be forced to travel long distances with their animals in search of water and green pasture. Drought is a gradual and prolonged catastrophe marked by insufficient rainfall, leading to water scarcity. This might result in a water shortage and lack of lush grazing areas, compelling men to embark on lengthy journeys with their livestock in pursuit of these essential resources. Undertaking this chore can be physically strenuous and time-intensive, exerting a considerable influence on their daily routines.

The study results indicate that both genders in pastoral and agro-pastoral communities are aware of climate variability in their areas. The findings further show that respondents' perceptions of climate variability in the study area varied

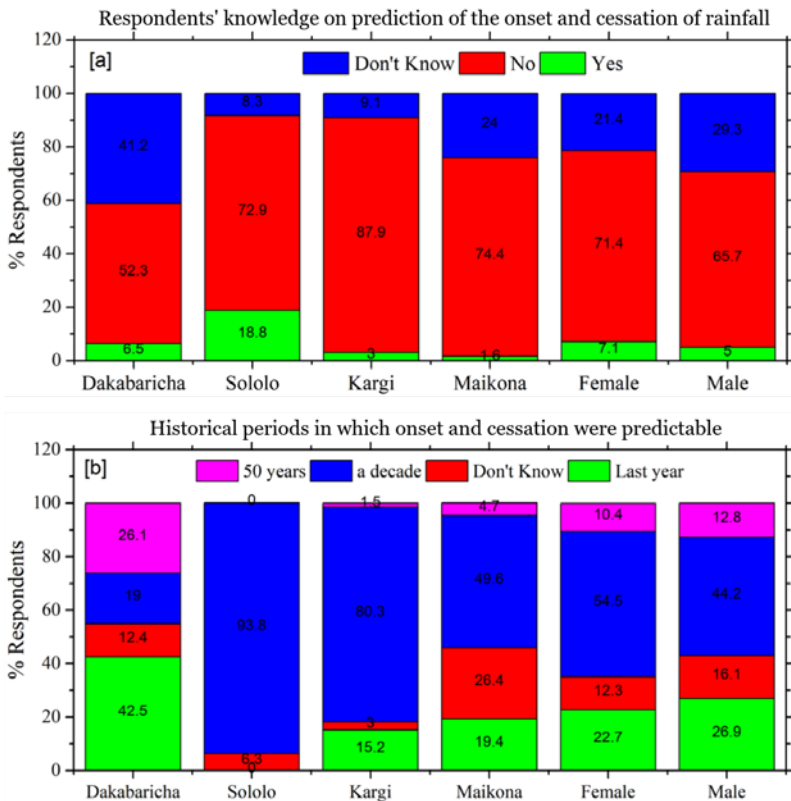


Figure 2.

Perception of the respondents to climate variability and trends.

Source: Analysis of field data, created by the authors.

by sex, marital status and ethnic group. This finding is in line with research by Ansel et al. (2017), who found that limited control of household assets is one of the causes of increased vulnerability to climate variability for women.

In addition, the findings reveal that 71.4% of female and 65.7% of male respondents are unable to predict the onset and cessation of the rainy season, while, conversely, 21.4% of female and 29.3% of male respondents are able to do so (Figure 3). Likewise, 52.3% and 72.9% of the agro-pastoralists in Dakabaricha and Sololo stated that they were not able to predict the onset and cessation of this season. In the pastoral livelihood zone, most of the respondents in Kargi (87.9%) and Maikona (74.4%) indicated that they could not accurately make such forecasts. This implies that the rainy seasons in Marsabit County are no longer predictable to the locals, and this affects their planning in terms of land preparation and planting. They noted that there is an increasing frequency of climate extremes that have reduced the predictability of weather and climate events for the locals. Consequently, it was evidenced from the study findings that forecasts based on Indigenous and Traditional Knowledge (ITK) have lost popularity, and most elderly people who were the custodians of this information have passed on without transferring this information to the young upcoming generations. Most of the young generation is no longer interested in ITK skills since no information is known about them. This finding was also reported by Kongnso (2022), in whose study the youth experienced challenges with past climate predictability capacity, as also corroborated by the findings of Marty et al. (2023) and their work with the Maasai pastoral community.

Furthermore, 54.5% of female respondents and 44.2% of male respondents in the present study cannot recall the last time they predicted the start of the rainy season. This means that agro-pastoral households cannot prepare and plant their crops on time. Pastoral households may also lack the time to prepare micro-water harvesting structures properly for their livestock and household use. Another 22.7% of female and 26.9% of male respondents remember predicting the start of the rainy season 50 years ago, while 12.3% (female) and 16.1% (male) of the respondents remember predicting the start and end of the season a decade ago (Figure 3). The KII informant observed that the rainy season in Marsabit county is marked by a delayed onset and that the rainy season ends very early in most of the agro-pastoral and pastoral livelihood zones of the study area. The unreliable rainfall pattern has negatively affected the livelihoods of the local community, which is very dependent on rainfall. The analysis of focus group discussions and key informant interviews further revealed that rainfall in the region has decreased over the years, while temperatures in the study region have increased from 1981 to 2021. The study findings from the survey related to the trend of anomalies in meteorological

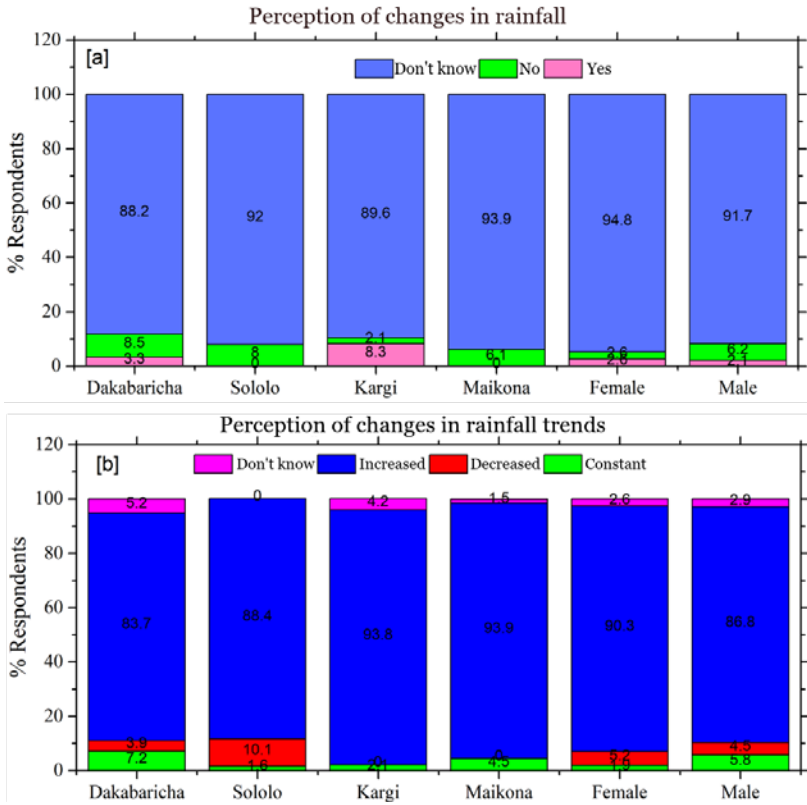


Figure 3.

Perception of respondents on onset and cessation of rainfall by gender.

Source: Analysis of field data, created by the authors.

data from the Kenya Meteorological Department for the 1981–2021 period that was looked at, which showed a significant decrease in rainfall amount. This amounted to a decline of 0.1316 millimetres and 1.8494 millimetres in Kargi and Dakabaricha (MAM) for the last 40 years as well as a substantial increase in mean minimum and maximum temperatures for Marsabit. The magnitude of warming was found to be twice that of cooling, with 2021 and 1985 experiencing the highest deviation of temperatures from the mean with 0.62°C and -0.36°C in Maikona, Kargi, Sololo and Dakabaricha, indicating that variations in rainfall onset and distribution may be more affected than variations

in rainfall amount. The findings also agreed with climate change literature and other scientists' predictions of increased temperature and decreased rainfall in Kenya and other parts of Africa (Ochieng et al. 2022; IPCC 2014).

Respondents' perception of changes in temperature over the last 40 years by gender groups

The study results reveal that 95.5% of female and 95.9% of male respondents have noticed changes in temperature over the past 40 years, and a small proportion of female (2.6%) and male (2.9%) respondents did not notice any temperature change over this period (Figure 4). Likewise, 92.2% and 99.2% of the respondents in the agro-pastoralist areas of Dakabaricha and Sololo alluded to the fact that there have been changes in temperatures over time in the study region. These changes have translated into warmer temperatures over the years according to 85.6% and 98.40% respectively of the respondents in the study region. Meanwhile, in the pastoral livelihood region, most of the respondents in Kargi (93.8%) and Maikona (98.5%) agree with their counterparts in the agro-pastoral region that the temperature has indeed changed. This temporal variability has led to warmer temperatures in the region over time. The analysis also reveals that 93% of female and 92.3% of male respondents have perceived that temperatures in the region have become warmer over the years, while a small proportion of male (3.50%) and female (3.70%) respondents perceive that they have become cooler. This is an indicator of climate variability and implies that both genders in pastoral and agro-pastoral communities are fully aware of such variability in their regions.

Due to the existing gender inequality, however, men and women do not experience climate variability equally, as shown by Giudice et al. (2021). Thus, climate variability may worsen the current gender inequality. There is a direct relationship between gender equality, women's empowerment and climate variability (ibid.); therefore, there is a need to focus on how men and women respond to such variability (Lau et al. 2021). According to Hafsah and Rehman (2022), women are more vulnerable because they have less education and are not involved in household and political decision-making processes that have an impact on their lives. Feindt (2020) has also reported the tendency of men's decision-making to make women's adaptation to climate change a big challenge among rural communities. To address this challenge, Annan et al. (2023) has noted the need for women's empowerment and inclusion in decision-making processes, a finding corroborated by the present study, which explains the high vulnerability reported by the female respondents.

The responses were in line with trends of anomalies in meteorological data, which demonstrated that rainfall had decreased in Marsabit County and

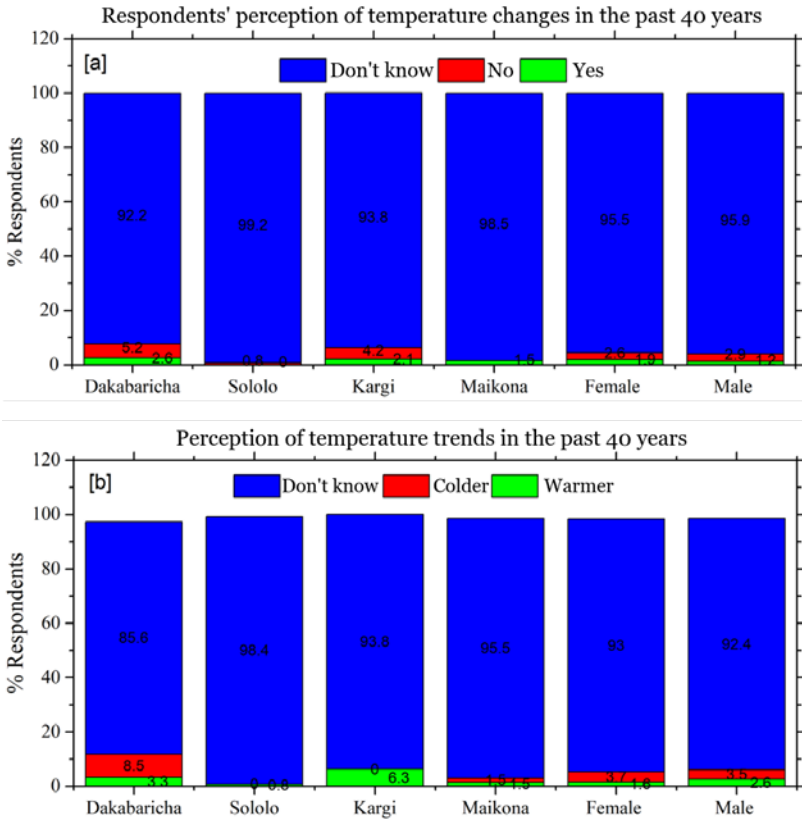


Figure 4.

Perception about change in temperatures by gender.

Source: Analysis of field data, created by the authors.

that both the minimum and maximum mean temperatures had increased. The same observations were reported in some climate change literature, including IPCC (2022) and Ochieng et al. (2022), showing an increase in temperature, drought (especially in semi-arid areas) and a decrease in precipitation in parts of Tanzania and other areas of Africa.

The study was conducted in two pastoral livelihood zones (Kargi, Maikona) and agro-pastoral regions (Dakabaricha, Sololo). The household questionnaires were collected in the local villages away from town settlements, where research on climate variability was inadequate and the education level was

low. These are hard-to-reach areas due to their harsh climatic conditions and bad road networks. The county has an illiteracy level of about 68%, attributed to the resource-base conflict between communities and the lack of opportunities for education. This is in addition to the fact that the region is semi-arid, meaning that drought is prominent. Still, they managed to differentiate the condition they were experiencing currently from the situation they had experienced in 1981.

According to Opiyo et al. (2014), pastoralists' perceptions of climate variability are significantly related to the gender of the household head, with male-headed households perceived to be less vulnerable than female-headed households. According to a study conducted in Vietnam, perceptions of global warming appear to be disaggregated at the household level rather than at the individual level (McKune et al. 2015). According to Shisanya and Mafongoya (2017), resilience to climate variability varies significantly even within the same locality. As a result, there can be no blanket recommendations for climate variability vulnerabilities, even at the household level. Furthermore, Jiri et al. (2017) discovered that the age of the household head, gender and the fitness of household members for work all play a role in selecting an adaptation strategy. Women in various parts of the world are more vulnerable to climate variability and change because they have less access to the education and information needed to manage climate-related risks to agriculture, including pastoralism (Jost et al. 2016). The findings show that, if the changes are easily visible, both men and women notice them. As a result, forming a successful climate change adaptation policy would necessitate a critical understanding of the relationship between other socio-economic and ecological factors and the construction of perceptions of climate variability. Furthermore, more rigorous research is needed to draw more concrete conclusions because the findings are based on an exploratory and cross-sectional study.

Gender-differentiated roles among pastoral and agro-pastoral households in Marsabit County

In Kenya, men are regarded as family heads in most pastoral and agro-pastoral communities, and they have a significant role in decision-making and in the control of domestic assets. However, women, who play an essential role in the household economy by providing labour for agriculture production and domestic purposes, are overshadowed; thus, their efforts go unnoticed.

Community roles across pastoral and agro-pastoral livelihoods in Marsabit County are quite diverse and assigned to various categories of gender, though there are many overlaps among the gender groups. According to key informant analysis results, the study found that 63% of the male respondents are the main

decision-makers in the family, 38% financially support their family, 17% arbitrate issues in the community, a small proportion (4%) claim control over the main family assets, 29% provide security and 17% perform productive roles. In comparison, 33% of the female participants affirm that they fulfil the role of household domestic managers. Furthermore, 21% of women are responsible for overseeing the production of agricultural goods and animals, 13% for caring for cattle in their own homes and 4% for managing the utilisation of water resources. These gender-based inequalities along the food production chain impede equal attainment of food security for men and women (Sango et al. 2023). Thus, climate variability may increase the existing inequality in the agricultural sector. Moreover, climate variability will affect the agro-pastoralists, with pastoral communities likely to experience adverse impacts from changing climate. This may reverse the achievements gained through the Millennium Development Goals (Hafsah and Rehman 2022). This is due to the frequency and severity of droughts and floods already experienced (Ochieng et al. 2022). Therefore, efforts to facilitate adaptation are needed in order to enhance the resilience of the agricultural sector, ensure food security and reduce rural poverty (Amarasinghe 2020).

Table 2 presents the distribution of roles by gender within the pastoral-based livelihoods in Marsabit County. The majority of men is responsible for nearly all the activities performed in pastoral-based livelihoods, except in the case of controlling and monitoring poultry (only 22.7% hold this responsibility), which is under the control and monitoring of women. Women and girls have significantly lower livestock ownership (33.8%) and financial control (3.0%) than men and boys, as shown in Table 2. This is very common in many African societies, which are typically patriarchal in nature, with men controlling the household wealth (Brockington 2001). In pastoral communities, the disproportionate wealth distribution between men and women begins at birth, with girls typically receiving half the wealth of their sons (Balehegn and Kelemework 2013). Across the roles within the pastoral systems, the combined roles of men and women are generally predominant, except when it comes to the control of livestock, where women have no role to play. Women mostly care for households and livestock keeping, especially small stock, as well as for the fetching of water and firewood and small-scale business endeavours – e.g. milk marketing and *miraa* selling. KII informants reveal that the roles of boys and girls, whether singly or combined, are dismal and only appear to be supportive of men and women-defined roles. Youths comprising both boys and girls assist older women and men in taking up different roles, attending school and colleges, providing security and herding livestock.

The gender-differentiated roles, however, change depending on the adversity of the season. According to FGD discussants, during dry seasons, women

and girls are most affected, as they must take on an increased workload, involving walking long distances to fetch firewood and to bring water for household use from wells or other water sources, and then carrying these on their backs and/or heads. More often, the water supply becomes scarce, inadequate or inaccessible. Women and girls often carry out these duties, cooking food and serving meals to men and boys. Household tasks such as cleaning, washing utensils, collecting and making fire and washing family clothes often fall under the responsibility of women and girls. Women and girls also set market prices for the sale of firewood and charcoal and shop for groceries (vegetables and fruits). Moreover, women and girls are shopkeepers and run family errands.

On the other hand, men and boys look after family livestock and do laborious work like watering family herds, dragging and removing sand or de-silting water sources in shallow wells. They also trek long distances searching for pastures and water for the herd. Men and boys are always at risk during ethnic conflicts as they are the ones looking after the family herds, even in the satellite field camps away from home or the *manyatta*. Middle-aged men and boys, on their part, labour much on the family stock herds as stock herders, who often, apart from herding activities, risk their lives for encountering ethnic hostilities or conflicts and bear the brunt of it all.

Table 2.

Gender-differentiated asset ownership and roles in pastoral households in Marsabit County, Kenya

| Ownership | Responsible household members among the pastoral community of Marsabit County (% of responses) | | | | | |
|--------------------------|--|---------------|--------------|---------------|-----------------------|------------------------|
| | Men (35–65) | Women (35–65) | Boys (15–34) | Girls (15–34) | Men and women (35–65) | Boys and girls (15–34) |
| Camels ownership | 51.3 | 23 | 3.5 | 0.3 | 48.2 | 9.1 |
| Monitoring camels | 49 | 2.3 | 6.6 | 0.3 | 51 | 11.6 |
| Cattle ownership | 48.2 | 2.3 | 4.3 | 0 | 51.8 | 8.1 |
| Monitoring cattle | 45.7 | 2 | 8.1 | 0.3 | 54 | 12.9 |
| Shoats ownership | 46 | 3.3 | 5.1 | 0.5 | 54.8 | 9.3 |
| Monitoring Shoats | 42.9 | 3 | 8.3 | 0.3 | 56.3 | 12.9 |
| Poultry ownership | 21.5 | 22.7 | 1.5 | 3 | 56.3 | 16.9 |
| Monitoring Poultry | 21.5 | 22.7 | 2.8 | 7.1 | 56.1 | 18.7 |
| Grazing livestock | 51.3 | 2 | 1.5 | 2.5 | 36.1 | 6.6 |
| Controlling grazing land | 97.2 | 24.5 | 0 | 0 | 0 | 0 |
| Control of livestock | 95.2 | 33.8 | 0 | 0 | 29 | 0 |
| Controlling finances | 37.9 | 3 | 0 | 0.5 | 60.9 | 7.1 |
| Monitoring finances | 35.6 | 3.5 | 0 | 0 | 63.1 | 9.8 |

The findings of the study overwhelmingly indicate that the effects of climate variability on women and men vary and are more significant in arid lands and for pastoral and agro-pastoral communities in Marsabit County. Differentiation is predominantly attributed to extensive historical and current disparities and multifaceted societal influences – rather than being solely determined by biological sex. This aligns with the IPCC Fifth Assessment Report 4 findings, which acknowledged the varying effects of climate variability resulting from characteristics such as gender, social class, ethnicity, age and handicap.

In regards to livestock production in Marsabit County, gender-differentiated roles in agro-pastoral livelihood systems are similar to those of pastoral livelihood systems. Table 3 presents the distribution of farming activities undertaken under agro-pastoral-based livelihoods by gender. In agro-pastoral-based livelihoods, men played dominant roles in the preparation of land (61.9%) and the control of production inputs (94.9%), public services (92.9%), capital (94.4%), water points (92.7%), information use (90.9%), education (92.7%) and of who among the children attends training (93.4%). Women, on the other hand, are responsible for seed preparation (57.6%) and the control of water (72.5%), house (51.8%) and firewood (55.6%). Moreover, they are chiefly responsible for monitoring firewood (57.8%) and house (60.1%) and for the selling of food crops (67.9%). Gender equality was only observed in weeding (71.7%), harvesting (72.7%), planting (60.1%), processing and storage (75%) and the monitoring of land (53.8%). Boys provide support services mainly in the areas of land preparation, seed preparation, planting, weeding, harvesting and processing and storage. Girls, on the other hand, notably provide support in land preparation, preparation of seeds, planting, weeding, harvesting, processing and storage, as well as in selling cash or food crops and controlling and monitoring houses, firewood and water. The roles of boys and girls were shared in all activities except for the control of production inputs, public services, capital, watering points, information, education and training.

In Marsabit County, gender roles are clearly defined between couples, and women do most of the household chores such as taking care of children, cooking for the family, fetching water and firewood, cleaning, managing finances and participating in farming or herding small stocks. This applies to both business and employed mothers. For men, their main role is, among other activities, to provide security, farm or herd, seek casual work, defend the family, provide for most of the family's basic needs, create wealth, educate the children and cloth the family.

Table 3.

Gender-differentiated roles in agro-pastoral livelihoods in Marsabit County

| Farming activities | % of the responsible persons among agro-pastoral households in Marsabit County | | | | | |
|------------------------------------|--|------------|-----------|------------|---------------|----------------|
| | Men only | Women only | Boys only | Girls only | Men and women | Boys and girls |
| Land preparation | 61.9 | 4.5 | 2.3 | 1 | 38.6 | 10.6 |
| Preparation of seeds | 41.7 | 57.6 | 4.5 | 3.3 | 9.3 | 15.4 |
| Planting | 43.2 | 9.1 | 7.6 | 5.6 | 60.1 | 20.5 |
| Weeding | 33.1 | 10.4 | 9.3 | 8.3 | 71.7 | 25.8 |
| Harvesting | 33.3 | 10.4 | 8.6 | 8.3 | 72.7 | 29.5 |
| Processing and storage of crops | 29.3 | 10.4 | 7.1 | 6.8 | 75 | 27 |
| Selling cash or food crops | 27.3 | 67.9 | 0.8 | 2.3 | 9.6 | 17.9 |
| Controlling land use | 54.5 | 3 | 0 | 0.3 | 44.9 | 5.1 |
| Monitoring land use | 46.2 | 3 | 0.5 | 0.3 | 53.8 | 11.9 |
| Controlling household items | 35.4 | 51.8 | 0 | 13 | 17.7 | 6.1 |
| Monitoring household items | 23.5 | 60.1 | 0.5 | 3.5 | 20 | 11.4 |
| Controlling the use of firewood | 5.8 | 55.6 | 0 | 14.4 | 39.9 | 7.3 |
| Monitoring the use of firewood | 6.1 | 57.8 | 0.3 | 18.7 | 35.4 | 5.8 |
| Controlling water use | 15.2 | 72.5 | 0.3 | 2.3 | 16.2 | 14.6 |
| Monitoring water points | 13.6 | 14.9 | 0.3 | 2.3 | 75.5 | 17.2 |
| Controlling production farm inputs | 94.9 | 43.4 | 0 | 0 | 38.4 | 0 |
| Controlling public services | 92.9 | 48.7 | 0 | 0 | 41.7 | 0 |
| Controlling capital allocation | 94.4 | 39.6 | 0 | 0 | 34.1 | 0 |
| Controlling the watering point | 92.7 | 37.6 | 0 | 0 | 0 | 0 |
| Controlling information sharing | 90.9 | 42.7 | 0 | 0 | 33.6 | 0 |
| Controlling education | 92.7 | 55.1 | 0 | 0 | 47.7 | 0 |
| Controlling who attends training | 93.4 | 52.3 | 0 | 0 | 45.7 | 0 |

Impacts of climate variability on gender roles in pastoral and agro-pastoral livelihood activities

The present study analysed the impacts of climate variability within the thematic impact areas of gender roles.. The impact of climate variability transcends livelihood choices and disrupts routine gender roles among households in Marsabit County. The major impact of climate variability on gender roles was manifested in an increased workload for both women (48%) and men (32%). The increased workload for both the males and females was occasioned by drought, which brought about a scarcity of water, firewood and pasture resources, which in turn increased the distances to water points, firewood sources and grazing grounds. Extreme drought also led to a migration of men with livestock, leaving the women behind and adding additional roles for them to perform, including providing for the family's food needs, protecting the community against the invasion of humans or animals/pests, selling animals to provide food for the family and overall decision-making.

Traditionally, the role of men has been to protect and provide for family needs and handle hard and physical activities such as warfare, whereas women take care of household chores in general, cooking, fetching water and firewood and babysitting, among other activities. However, climate variability has disrupted this norm. The effects of climate variability disproportionately affect women and girls, exacerbating pre-existing gender disparities and presenting distinct risks to their means of living and security. Climate variability exacerbates fluctuations in agricultural productivity, often resulting in disparate effects on the human, ecological, physical, social and financial resources of both women and men. Walker et al. (2022) demonstrate that during droughts, herd composition undergoes a transition from cattle or camel to sheep and goats, with women assuming the responsibility for the latter. This shift results in an escalation of women's work and obligations, surpassing those of men.

In the southern region of Tanzania, households are facing challenges such as unpredictable rainfall patterns, decreasing soil quality, fluctuating crop yields and overall reduction in agricultural productivity. As a result, these households are compelled to expand their cultivation areas, which in turn requires additional labour (Nelson and Stathers, 2009). During times of heightened drought, climate variability separates pastoral families since men migrate with livestock to distant areas in search of pasture and water for their animals. This leaves the female gender to perform their routine chores and to assume additional cultural roles of the male gender, such as fending for their children and families, as well as activities in satellite camps, such as engaging in food loans or credit from local retail shops and searching for casual jobs. Generally, however, climate variability-induced droughts overwhelm both genders, inducing both

psychological and physical distress when dryness threatens food security and catalyses disease outbreaks in humans as well as in livestock. In most cases, climate variability triggers calamities such as droughts and famines, which lead to hardship, social disruption and deviation from norms in the form of food production – and resource shrinkage and scarcity have direct implications for the quality of life.

The findings show that both men's and women's responsibilities exceed the performance of boys and girls (whether combined or disaggregated). The low score for boys and girls may be attributed to children attending school at the expense of the ability to involve themselves in cropping activities. In comparison to what men and women do in terms of farming activities, men generally participate more, as shown in Table 4. Land preparation is one area where men outperform women, as 61.9% is conducted by men alone, while the remaining activities were mostly performed by both genders: seed preparation (57.6%), planting (60.1%), weeding (71.7%), harvesting (72.7%), processing and storage (75.5%) and cash/food crop sales (67.9%).

According to the study, men own, control, monitor, use and access most assets, such as land and all livestock (camel, cattle, shoats and poultry), while women are perceived to have more significant control and monitoring of poultry and their products than men. Women are also climate-smart and are perceived to be ahead of men regarding water control, use and monitoring. This means that women are able to take the lead in water resource management. Women (14.9%) outnumber men (13.9%) in terms of access to the house, but men continue to outnumber women in ownership, control, monitoring and usage. Men are also perceived to be financially and laboriously superior to women. In terms of firewood, however, women and girls outnumber boys and girls, which is typical of pastoral households. Additionally, because of their perceived control, use and access, women and girls can be of great value in woodland or forest management. Empowering women and girls so that they can manage livestock and more considerable assets such as land, livestock, houses and finances is critical. Younger farmers and household heads are more risk-taking, and they are more willing to accept new technologies in order to improve their farming methods and increase their revenue sources than their older counterparts. As a result, the current study hypothesises that the adoption of fodder production is negatively correlated with age. As a demographic indicator, the age of the household head in years was collected and analysed descriptively. Assets are crucial for impoverished individuals as they enable them to manage better and withstand various challenges, such as climate-related shocks and the consequences of extreme climate events. Research conducted since the 1990s on asset-based approaches to development and poverty alleviation has demonstrated that having control over assets is crucial for increasing

incomes, reducing vulnerability, and empowering individuals to escape poverty (Bebbington 1999; Moser 2007; Sen 1997; Sherraden 1991). Assets, in a comprehensive sense, encompass various forms, such as natural, physical, financial, human, social and political capital (Meinzen-Dick et al. 2011).

Table 4.

Gender roles in agro-pastoral livelihood activities in adapting to climate change impacts.

| Farming activities: | Responsible Person | | | | | |
|----------------------------|--------------------|----------------|---------------|----------------|-------------------|--------------------|
| | Men only (%) | Women only (%) | Boys only (%) | Girls only (%) | Men and women (%) | Boys and girls (%) |
| Land preparation | 61.9 | 4.5 | 2.3 | 1 | 38.6 | 10.6 |
| Preparation of seeds | 41.7 | 9.3 | 4.5 | 3.3 | 57.6 | 15.4 |
| Planting | 43.2 | 9.1 | 7.6 | 5.6 | 60.1 | 20.5 |
| Weeding | 33.1 | 10.4 | 9.3 | 8.3 | 71.7 | 25.8 |
| Harvesting | 33.3 | 10.4 | 8.6 | 8.3 | 72.7 | 29.5 |
| Processing and storage | 29.3 | 10.4 | 7.1 | 6.8 | 75.5 | 27 |
| Selling cash or food crops | 27.3 | 9.6 | 0.8 | 2.3 | 67.9 | 17.9 |

Conclusion and recommendations

Conclusion

Based on the above analysis, this research made the following concluding statements:

Gender plays an important role in how the Marsabit community perceives the trends and effects of climate variability, thereby deviating from the path taken by gender-dependent roles in their society. Climate variability impacts gender roles through climate-induced social disruptions and deviations in cultural norms associated with gender-differentiated roles. Control of natural resources and domestic assets is gender- and age-dependent and, therefore, affects climate adaptation livelihood decisions, which should be considered in climate adaptation support interventions.

The roles assigned to gender as per the pastoral and agro-pastoral communities have overlapped. Especially during extreme climate conditions women are left behind to assume the roles of men, when the latter travel with animals to far-away regions in search of green pasture and water. Thus, women's empowerment is critical for greater decision-making on climate adaptation in the absence of men. In the past, men were usually the decision-makers in pastoral and agro-pastoral areas, which, in the face of climate variability, is no longer the case.

The analysis indicates that pastoral households in Marsabit County are well aware of the changes in their local climate. As a result, policy interventions that address climate variability should combine social understanding of change with scientific findings and trends. As Gay-Antaki (2020) has emphasised, a critical mass of women with clear and in-depth knowledge of climate change will generate gender-friendly climate policies automatically.

Analysis also indicated that climate extremes, especially drought, robs women of precious time by necessitating long-distance travel in search of water and firewood, hence negatively impacting their role as caregivers for household members.

Due to the adverse effects of climate variability, men have been forced to migrate to places far away from their families for better access to livelihood options, grazing resources and other socioeconomic benefits, hence impacting their role as heads of their families.

Recommendations

Based on this study, we recommend:

Enactment and enforcement of gender-proactive policies and legislation that promote gender equity at the county level. This should ease pressure on gender roles by creating awareness and empowerment for both genders. This should also see all genders involved in decision-making at the county level equally through appointments to critical committees.

Support of capacity building of pastoralists in relation to diversified livelihood initiatives, with a focus on gender mainstreaming of roles in decision-making and asset ownership.

There is a need for a community support training program focused on leadership, decision-making and communication to enable pastoralist women to effectively participate in negotiations on all issues that affect their ways of life amidst the changing climatic conditions with gender role considerations.

The study highly recommends the use of conventional weather forecasting to fill the gap left by the Indigenous Technical Knowledge (ITK) predictions, which have gradually died out with time but whose predictability is reported to

be important by the community from their past experience.

Lastly, this study suggests that there is a need for climate scientists to work with agro-pastoral and pastoral communities through public participation, to the end of developing agro-weather and climate advisories in order to reduce vulnerability, increase resilience, maximise productivity and thus enhance adaptive capacity.

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Conflicts of interest

The authors declare no conflicts of interest regarding the publication of this paper.

Compliance with ethical standards

The study involved the use of household-survey and satellite-meteorological data obtained from the Climate Hazards Group InfraRed Precipitation with Station (CHIRPS), gridded at a resolution of $0.05^\circ \times 0.05^\circ$ (approximately 5km x 5km over land), and daily temperature information was incurred from the European Centre for Medium-range Weather Forecasts Re-Analysis, ERA5. Permission to conduct the study was sought from the National Commission for Science, Technology and Innovation (NACOSTI) via a formal subscription fee to conduct the study in the area. The study upholds anonymity and confidentiality as moral imperatives in all its undertakings. This manuscript contains no

violation of any existing copyright or other third-party right or any material of an obscene, indecent, libellous or otherwise unlawful nature, and, to the best of the authors' knowledge, the manuscript does not infringe the rights of others.

Data availability

The data used to analyse this research is available through the corresponding author (agalwab@gmail.com) upon reasonable request.

Author contribution statement

Armara M. Galwab was responsible for the conceptualisation of the research idea, developing the theory, methodology, funding accusations, analysis and interpretation and writing the original manuscript.

Oscar Koech, Vivian Wasonga and Geoffrey Kironchi supervised and verified the analytical methods and reviewed, edited and critically revised the manuscript. All authors provided critical feedback and helped shape the research, analysis and manuscript.

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