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The biased narrative of vulnerable women: gender analysis of smallholder farmers' contextual vulnerability to climate change in the Taita Hills, Kenya

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Abstract

Climate change is increasing challenges in the agricultural sector for smallholder farmers. A key element in successful formulation of adaptation strategies is the analysis of vulnerability to climate change. This study examines smallholder farmers' contextual vulnerability to climate change through their perceived vulnerability and focuses on gendered narratives and power structures in the Taita Hills, Kenya. The key methods are semi-structured interviews (N=28) and a critical discourse analysis. The collected data consists of two-headed household interviews, single-headed household interviews, and key informant interviews with different stakeholders from the agriculture sector. Results indicate that contextual vulnerability can form a baseline for understanding individuals' possibilities to adapt to changing environmental and climatic conditions. Outcome vulnerability analysis, that treats vulnerability as an endpoint output following mitigation actions, offers highly relevant information, but it is not alone enough for understanding the challenges and possibilities of climate change adaptation. Women and men farmers' coping and adaptation response strategies did not differ notably, which supports the criticism of the gendered nature of vulnerability discourse. Differences in strategies appeared to be more linked in intersectional aspects between farmers in single-headed and two-headed households. Furthermore, the vulnerable women narrative did not reflect women farmers' agency and centrality in the agriculture sector. The discourse of climate change adaptation should be corrected towards addressing structural challenges that can place people in a vulnerable position within diverse contextual conditions and intersecting attributes.

Keywords Adaptive capacity · Agriculture · Climate change · Contextual vulnerability · Discourse · Gender analysis

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1 Introduction

Africa faces profound vulnerability to climate variability and change. By 2030, as many as 118 million people in Africa, grappling with extreme poverty, are expected to be exposed to the harsh realities of droughts, floods, and extreme heat (Shepherd et al. 2013; World Meteorological Organization 2021). This underlines the critical necessity for vulnerability assessments to inform effective intervention measures.

1.1 The significance of vulnerability assessment

Vulnerability assessments are pivotal in measuring the current real-world challenges experienced by individuals, particularly in sectors like agriculture, which constitutes the primary source of livelihood for smallholder farmers in East Africa. These individuals are confronting climate and environmental changes driven by anthropogenic drivers like land conversion. Assessing vulnerability to climate change serves to guide policy formulation with the goal of reducing exposure and sensitivity to associated risks (Füssel and Klein 2006). Furthermore, it aids in understanding the root causes of vulnerability, pinpointing the most marginalized groups, and enhancing coping and adaptation strategies.

1.2 Outcome and contextual vulnerability

Vulnerability and climate change are concepts that are deeply embedded in political agendas, concealed power structures, and discursive violence that often frame possible beneficiaries as model adaptation subjects (Mikulewicz 2020). O'Brien et al. (2007) distinguish between two interpretations of vulnerability within different climate change discourses: outcome vulnerability and contextual vulnerability. Outcome vulnerability, associated with a scientific framing, adopts a linear approach that concentrates on impacts and responses. It treats vulnerability as the endpoint output following all actions aimed at mitigating the impact.

In contrast, contextual vulnerability, linked to a human-security framing, considers a spectrum of socio-economic, ecological, technological, and institutional factors and processes contributing to individuals' or societies' incapacity to cope with external pressures and changes, such as climate change (Hopkins 2015). Despite its importance, the concept of contextual vulnerability has been relatively overlooked in mainstream climate science and policy discourse. Correcting this imbalance could foster a more comprehensive understanding of the unequal impacts of climate change on individuals and societies (O'Brien et al. 2007).

Putting a stronger emphasis on contextual vulnerability may facilitate the generation of new knowledge on non-climatic factors and processes that influence the degree of perceived vulnerability to climate change. Furthermore, this approach can enrich more socially oriented policies (Okpara et al. 2016) and support transformational adaptation (Eriksen et al. 2015).

1.3 Narrow framing of vulnerability

In the climate change and vulnerability discourse, the predominant focus has often been on environmental threats and material impacts. This has led to a prevailing technocratic approach that tends to oversimplify social aspects (Fosado Centeno 2020; Kehler and Birchall 2021) while largely overlooking the intricacies of social structures in inequality.

Following this, vulnerability assessments associated with climate change predominantly adopt the concept of outcome vulnerability (O'Brien et al. 2007). Such assessments primarily address environmental hazards and adaptive capacity, neglecting the broader structural and historical inequalities that can impede the ability to cope with and adapt to changing conditions.

1.4 Gender perspective on vulnerability

Within the discourse of vulnerability, gender discussions often center on the portrayal of women only as vulnerable, typically linked to maternal roles (Fosado Centeno 2020). This narrative, however, leaves other perspectives and experiences for a lesser attention. Women farmers, due to their disadvantaged position (Denton 2002; Glazebrook et al. 2020), are often portrayed in stereotypical ways, either as victims or virtuous fighters against climate (Fosado Centeno 2020; Arora-Jonsson 2011), rather than as active participants in agriculture. Furthermore, the discourse overlooks intersectionality that considers the intragroup differences and multiple axes of identity that impacts the farmers relationship to power (Osborne 2015).

This study analyses the narrative of vulnerable women in the context of climate change vulnerability discourse and contrasts them with the perceived vulnerability of smallholder farmers. Our analysis contributes to feminist political ecology by critically examining the gender-environment nexus within vulnerability assessments. Furthermore, it aims to analyse the perceived vulnerability between two-headed households and single-headed households consisting of for example unmarried, widowed, and divorced participants, thus aiming to offer an insight point beyond mere gender binary. It also broadens the evidence base by shedding light on the disparities between lived experiences and the narratives that often underpin vulnerability assessments and adaptation interventions.

1.5 Study scope and objectives

In practice, the results of this study will support better framing of climate change vulnerability assessments. We conducted a gender analysis of smallholder farmers' contextual vulnerability to investigate the roles of social and human capital, social networks, and agency in explaining individual farmers' preferred coping and adaptation strategies in response to climate change in the Taita Hills of Taita Taveta County in southeast Kenya. Our study aims to expose biases in the existing narratives and scrutinizes the constructed discourses of the chosen conceptual framing at various scales. To this end, we pose the following research questions on framing contextual vulnerability, and bridging local and global discourses:

- (1) How does the framing of contextual vulnerability explain perceived vulnerability when analyzing the gendered strategies and opportunities for farmers to adapt to climate change in the Taita Hills, Kenya?

- (2) Why do possible disconnections emerge between local and global discourses on contextual vulnerability, and how can the findings be harnessed in future assessments?

2 Conceptual frameworks

2.1 Gender and climate change discourse

Scholars emphasize that due to the gendered nature of resource use, access, control, and knowledge, environmental and agricultural changes affect the livelihoods of women and men differently (Dankelman 2010; Fontana 2010; Kakota et al. 2011; MacGregor 2010; Sultana 2013). Even as agro-ecological conditions degrade under the influence of climate change, tasks such as fetching fresh water and firewood, as well as the primary responsibility for farming, continue to predominantly fall on women (Dankelman 2010; Fontana 2010; Jost et al. 2016; Sultana 2013). However, the dominant focus of climate change research has revolved around the material impacts on agriculture, particularly in the context of mitigation and adaptation practices and technologies.

The discourse surrounding gender and climate change often relies on gender-disaggregated categories of 'men' and 'women,' with the in-written assumption of vulnerable women and less vulnerable men (Macgregor 2010; Thompson-Hall et al. 2016). Describing women solely as victims or virtuous actors in the face of climate change can lead to over-reliance on women's unpaid labor in mitigation and adaptation interventions. This 'women-only' narrative creates a problematic image of women as both victims and solutions, inadvertently increasing their workload without due recognition (Nelson et al. 2002; Dankelman 2010; Sultana 2013; Jost et al. 2016).

This biased discourse significantly influences how vulnerability is framed and assessed. When considering gender within the vulnerability framework, two key approaches emerge: linear or structuring relation, which tends to promote interventions that aim at equalizing the impacts of climate change on both men and women, and another viewing gender as a process, which enables a deeper examination of the underlying dynamics between gender, the environment, and other social aspects (Nightingale 2006).

Besides viewing gender as a process, a key component in addressing the binary perspective in climate change adaptation and vulnerability is intersectionality. Intersectionality acknowledges that a farmer whether woman or man, may belong to multiple disadvantaged groups or identities that complicate their experiences and add compounding effects to vulnerability (Crenshaw 1991, Osborne 2015).

2.2 Conceptual frameworks for climate vulnerability assessment

Climate vulnerability assessments typically involve evaluating exposure, sensitivity, and adaptive capacity (Füssel and Klein 2006; Joakim et al. 2015; Adger 2006; Gallopín 2006; Miller et al. 2010; Engle 2011; Goodrich et al. 2019; Fellmann 2012). This straightforward approach of conceptualising the key components often proves challenging in practical implementation and when conducting vulnerability assessments (Ionescu et al. 2009). Furthermore, the utilization of the outcome vulnerability framing in various scientific discourses can lead to significant variations in the content and methodological approaches of vulnerability assessments (Bisaro et al. 2010). To address some of the inherent ambiguities

in the vulnerability framework, we focus on components that construct individuals’ adaptive capacity.

2.3 The contextual vulnerability framework

Utilising the contextual vulnerability framework allows us to concentrate on two critical contexts that influence individuals’ ability to respond and adapt to climate change. The first context of ecology encompasses elements of vulnerability assessments often explored through exposure and sensitivity analyses (see Fig. 1). Exposure and sensitivity are pivotal factors determining society’s resilience to change and its ability to return to its original state through various coping strategies (Gallopín 2006; Parry et al. 2007).

The second context involves social elements of adaptive capacity, including human capital, social capital, social networks, and agency. These elements strengthen existing coping and adaptation strategies. By framing vulnerability predominantly within a social context, we argue that even when exposure and sensitivity levels appear similar, adaptive capacity elements will dictate whether an individual can embrace more durable adaptation strategies alongside short-term coping measures (see Fig. 1).

2.4 Key components of adaptive capacity

In vulnerability assessments, adaptive capacity depicts individuals’ ability to respond to changing climatic conditions, which impact agricultural practices (Van Aelst and Holvoet 2018). Coping strategies aim to address immediate challenges, while adaptation measures take a more proactive stance by seeking to mitigate potential negative effects.

To assess adaptive capacity, the analysis is typically broken down into several elements, including social capital, social networks, human capital, and agency (Mohan and Mohan 2002; Wagenaar 2014; Adger 2003; MacGillivray 2018). Adaptive capacity is a composite of human, social, natural, physical, and financial capital (Nelson et al. 2007; Carney 1998).

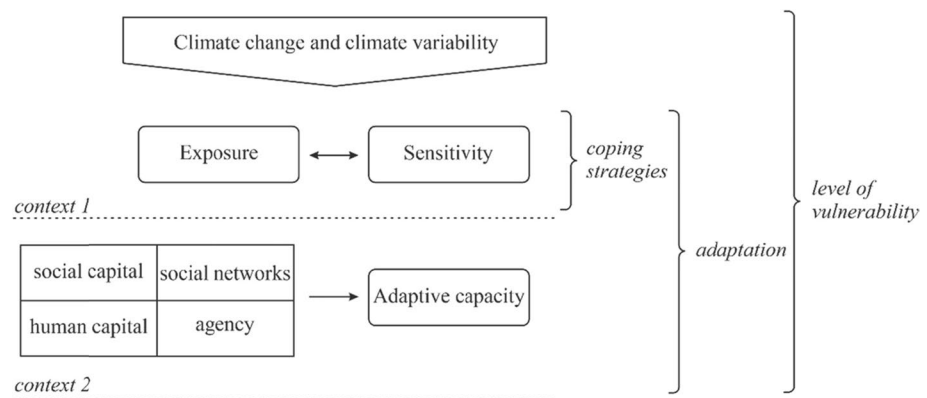


Fig. 1 Conceptualising contextual vulnerability. Context 1 exemplifies two connected elements, the bio-physical (exposure) and sensitivity (resource dependence), which define possibilities to adapt shorter-term coping strategies. Context 2 covers aspects of adaptive capacity, which can enable longer-term adaptation. Climate change and variability, exposure, sensitivity and adaptive capacity conflated together form the level of vulnerability to climate change

This study primarily explores adaptive capacity through the lenses of social and human capital.

2.4.1 Social capital and networks

Social capital reflects a society's characteristics and abilities. It consists of networks built on trust, reciprocity, and other social norms (Mohan and Mohan 2002; Adger 2003; MacGillivray 2018). However, its benefits are constrained by wealth and resources, often leading to connections within the same economic group (MacGillivray 2018). Most studies on social capital make a distinction between bridging/bonding social networks (Patulny and Svendsen 2007). Bridging networks are outward looking and consisting of heterogeneous social groups, while bonding networks are inward looking with a tendency to reinforce exclusive identities and homogenous groups (ibid., citing Putnam 2000).

2.4.2 Human capital

Human capital refers to an individual's characteristics, including skills and competencies (Mohan and Mohan 2002). This study reflects societal aspects through farmers' social networks, varying from neighboring farmers to government-organized meetings. Social capital encompasses common beliefs, past experiences, and norms, all of which play a pivotal role in an individual's decision-making process regarding adaptation and coping strategies (Whitfield 2015; MacGillivray 2018). Knowledge and the ability to implement actions based on human capital refer to an individual's characteristics, but access to information can alter according to an individual's position in society and their assets (Whitfield 2015; Hohenthal et al. 2018).

2.4.3 Agency

Human capital and agency are closely interlinked since actors utilize their human capital (i.e. individual characteristics) to exercise their agency. The exercise of agency is shaped by an individual's attributes and societal structures, and it is closely related to the concept of empowerment (Wagenaar 2014; Ibrahim and Alkire 2007).

2.4.4 Gender and agency in adaptive capacity

Intra-household decision-making reflects social norms, which can create gender-specific opportunities to pursue new adaptation approaches (S. Nelson and Huyer 2016). It's commonly argued in vulnerability assessments that women are often excluded from decision-making processes, while gender sensitivity tends to be formed by limited gender-disaggregated data, overlooking the nuances of how gender influences power dynamics (Ulrichs et al. 2015; Eriksen et al. 2021; Remling and Persson 2014).

Decision-making and intra-household bargaining reflect an individual's ability to participate in society and pursue their goals (Ibrahim and Alkire 2007). Challenges in adaptation may, in some cases, stem from the disconnect between decision-making and related institutional factors (Bisaro et al. 2010). As social norms and institutional factors vary in scale and by geographical location, we study the contextual vulnerability through a case study of the Taita Hills, Kenya.

3 Study context: Taita Taveta County

3.1 Geographic and climatic features

The Taita Hills, situated in the northernmost region of the Eastern Arc Mountain range, constitute a distinct topographical area within Taita Taveta County in southeast Kenya (Fig. 2). Taita Taveta County's topography ranges from 600 to 2200 m above sea level, and the region experiences a bimodal rainfall pattern, with the long rainy season occurring in March/May–June and the shorter rainy season in October–December.

3.2 Demographics and economic activities

As of 2019, Taita Taveta County had a population of 340,671 (Kenya National Bureau of Statistics 2019a). The most prominent ethnic groups in the region are the Wataita and Wataveta (Bravman 1998). Rain-fed agriculture serves as the primary economic activity in the county, employing nearly 70 percent of the population (Boitt et al. 2015; County Government of Taita Taveta 2018).

3.3 Gender dynamics in agriculture

Traditionally, Taita women were not granted land ownership or inheritance rights, contributing to the establishment of a patriarchal society that reinforced male dominance (Mkangi 1983). While the Kenyan constitution guarantees the rights of both men and women to own land, land inheritance practices in the region still favor men (Kenya LO 2013; Schürmann et al. 2020).

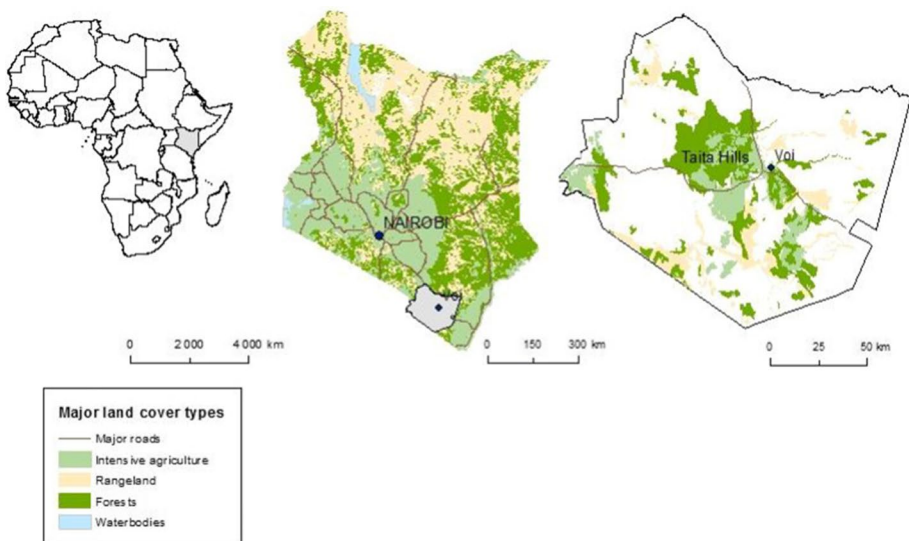


Fig. 2 Locating Kenya, Taita Taveta County and the Taita Hills. When reading from left to right, the grey area indicates the location of the following smaller-scale area. Sources: Africover Multipurpose Land Cover Databases for Kenya (FAO 2000) and Base Map for Africa (Map Library, 2019)

Regardless of the land ownership situation, women in Taita Taveta County have historically played more labor-intensive roles in agriculture and household chores, with a lower socio-cultural status (Mkangi 1983). The division of labor within the Taita community has been culturally defined, with men responsible for clearing the land and women handling cultivation and harvesting (Vogt and Wiesenhuetter 2001).

Recent trends, including men out-migration due to employment opportunities, have led to a higher percentage of women-headed households in Taita Taveta County (Smith 2008). Despite this shift, men are still commonly recognized as the heads of households and the primary earners from farming, even when women are de facto responsible for farming activities (ibid.).

3.4 Case study locations

The case study was conducted in four locations within Taita Taveta County, Kenya: Wundanyi, Mgange, Ngerenyi, and Werugha (see Fig. 3). Wundanyi, situated at 1400 m above sea level (m.a.s.l.), represents a more urban environment with a population of 14,509. In contrast, Mgange (1800 m.a.s.l., 9028 inhabitants), Ngerenyi (1600 m.a.s.l., 3836 inhabitants), and Werugha (1800 m.a.s.l., 8913 inhabitants) are located in rural areas of the Taita Hills (Kenya National Bureau of Statistics 2019b).

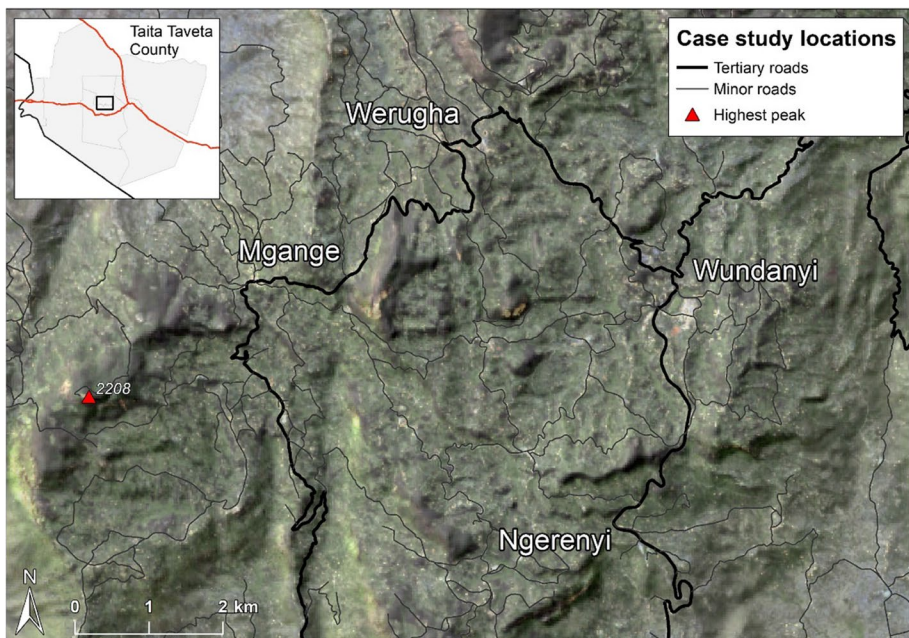


Fig. 3 Case study locations of Wundanyi, Werugha, Mgange and Ngerenyi. Sources: Sentinel 2 median composite for 2019 processed using Google Earth Engine, ALOS Global Digital Surface Model 'ALOS World 3D—30 m' (Japan Aerospace Exploration Agency 2015) and map data © OpenStreetMap contributors (2019)

3.4.1 Agro-ecological zones

These locations share fairly similar agro-ecological zones, including the semi-humid maize and marginal cotton zone, as well as the humid wheat/maize – pyrethrum zone (Jaetzold et al. 2012). Agriculture predominantly consists of small-scale terraced farming due to the region's varied topography. Notably, Mgange is partially situated in the rain shadow side of the Taita Hills, receiving less rainfall compared to the other three locations (Pellicka et al. 2013).

Smallholder farmers in the area cultivate staple crops such as maize (*Zea mays*), common beans (*Phaseolus vulgaris L.*), kale/cabbage (*Brassica spp.*), macadamia (*Macadamia tetraphylla*), bananas (*Musa spp.*), cassava (*Manihot esculenta*), potatoes (*Solanum tuberosum*) and avocados (*Persea americana*).

3.4.2 Climate challenges and agricultural development

Climate change and variability have adversely impacted food production in the Taita Hills due to erratic rainfall patterns and extreme climatic events like droughts and floods (Boitt et al. 2015). Increasing temperatures have also exacerbated crop pest infestations and led to the arrival of new harmful insect species, causing crop losses and decreased agricultural productivity (Mwalusepo et al. 2015).

In addition to climatic challenges, factors like population growth, expansion of agricultural lands, and increasing demand for climate-resilient farming practices are contributing to the complex agricultural landscape in the region (Maeda et al. 2010). Without effective responses, this could lead to growing food insecurity and significant socio-economic challenges (Boitt et al. 2015).

3.4.3 Support and interventions

Smallholder farmers in the Taita Hills receive agricultural extension services, guidance, and training from the Ministry of Agriculture, as well as from private providers such as agrochemical companies (Autio et al. 2021). Agricultural higher education is locally available at Taita Taveta University. Moreover, both government agencies, parastatals, and various Kenyan and international NGOs have implemented climate change adaptation interventions in the county. These interventions include climate-smart agricultural training programs, beekeeping initiatives, and the creation of farm ponds, all aimed at sensitizing farmers to adaptive strategies.

4 Methods

We employed a post-structuralist approach to assess smallholder farmers' vulnerability to climate change. This approach focuses on discursive structures and content-related knowledge, challenging dominant narratives and social constructions, including gender roles and norms, within the vulnerability discourse (Abrahams and Carr 2017). Through

concentration on the individuals' experiences and perceptions of the world, this study contributes to the discourse on climate change vulnerability.

4.1 Data collection

Primary data were gathered through 28 semi-structured household interviews, including 17 women and 11 men, as well as seven key informant interviews, comprising four women and three men. These interviews took place in the Taita Hills, Kenya, in February 2018. The household interviews involved 12 two-headed households (THHs), in which both men and women farmers were interviewed (23 in total), and five interviews with women from single-headed households (SHHs), which were analyzed separately due to their distinct socio-economic conditions.

4.2 Participant demographics

In THHs, women respondents' ages ranged from 20 to 68 years, while men respondents' ages ranged from 30 to 80 years. In SHHs, women respondents were between 31 and 80 years old. All respondents in THHs had completed primary school education, with most men and half of the women having completed secondary education. In SHHs, women's education levels were generally lower.

In addition to earning income from agriculture, a few men were also employed off-farm or received pensions, typically working as casual laborers or in construction and masonry. Land sizes among the respondents varied between 0.2 and 4 hectares (ha), with an average size of 1 ha. It is essential to note that land size did not necessarily reflect individual land ownership, as many households reported sharing land with parents or siblings.

The heads of the household, along with their spouses, were considered the decision-makers for agricultural practices. Additionally, farming had to be the primary source of employment for at least one of the spouses. The key informant interviews included experts in the agriculture sector, such as those working for the county, non-governmental organizations (NGOs), or involved in agriculture-related research.

4.3 Interview structure

Semi-structured interview questions covered topics related to gender roles in agriculture, self-assessment of vulnerability, and evaluation of adaptive capacity. These questions were based on theoretical conceptualizations and similar research (Alkire et al. 2013; Bikketi et al. 2016; Singh et al. 2016; Anderson et al. 2017; Ngigi et al. 2017; Wangui and Smucker 2018), and the Climate Risk Profile of Taita Taveta report (MoALF 2016). The interview structure was tested and refined by local research assistants and interpreters familiar with farming conditions in Taita Taveta County.

4.4 Sampling and interview procedure

4.4.1 Household interviews

Household interviews were conducted in two rounds: first with women, facilitated by a woman interpreter, and then with men, facilitated by a man interpreter. This approach

allowed for the inclusion of both women's and men's perspectives on vulnerability to climate change and gendered roles in agriculture. Households were selected from similar agro-ecological zones, using semi-random sampling within 500 m of the main tarmac and gravel roads.

4.4.2 Key informant interviews

For key informant interviews, we selected participants from each of the four villages (Wundanyi, Mgange, Ngerenyi, and Werugha) based on the relevance of their backgrounds. A total of seven key informant interviews were conducted, involving three men and four women. The key informants included four county agriculture extension officers, two agriculture-related researchers, and one NGO representative. Key informant interviews provided supplementary data to deepen our understanding of farmers' contextual vulnerability.

4.5 Data analysis

The interview data underwent a coding process using theory-based etic codes to establish categories and subcategories (see Fig. 4). Subsequently, we engaged in cyclical coding, leading to the creation of descriptive codes and meta-codes, which formed the foundation for a comparative and relational gender analysis. The codes were further organized into clusters and analyzed using queries (see e.g. Saldana 2011). This analysis allowed us to identify patterns and frequencies within responses and explore interconnections among the data.

5 Results

5.1 Social capital and social networks

Our findings indicate that social capital among smallholder farmers in the Taita Hills encompasses information sharing, reciprocity, exchange, and trust (see Table 1). Reciprocity and exchange emphasize the importance of collective problem-solving and mutual support within various social groups, including family, friends, neighbors, informal farmers' collectives, and registered cooperatives. Both women and men in the community recognize the value of social groups, although some individuals face barriers to participation, such as registration fees and issues related to fund mismanagement.

5.1.1 Gendered perspectives on social capital and social networks

Among women, participation in social groups was primarily motivated by access to loans, followed by access to information (Table 2). These groups provided opportunities to enhance income levels, participate in training, and foster mutual support. Women interviewed predominantly engaged in bonding networks, often preferring women-only groups (homogenous) or groups with familiar individuals such as friends and neighbors. For men, the most significant driver for joining social groups was access to markets, followed by access to information and loans. Men's social networks were more diverse, typically bridging (heterogeneous) networks. The reasons for not participating in social groups showed slight variations between women and men (Table 2).

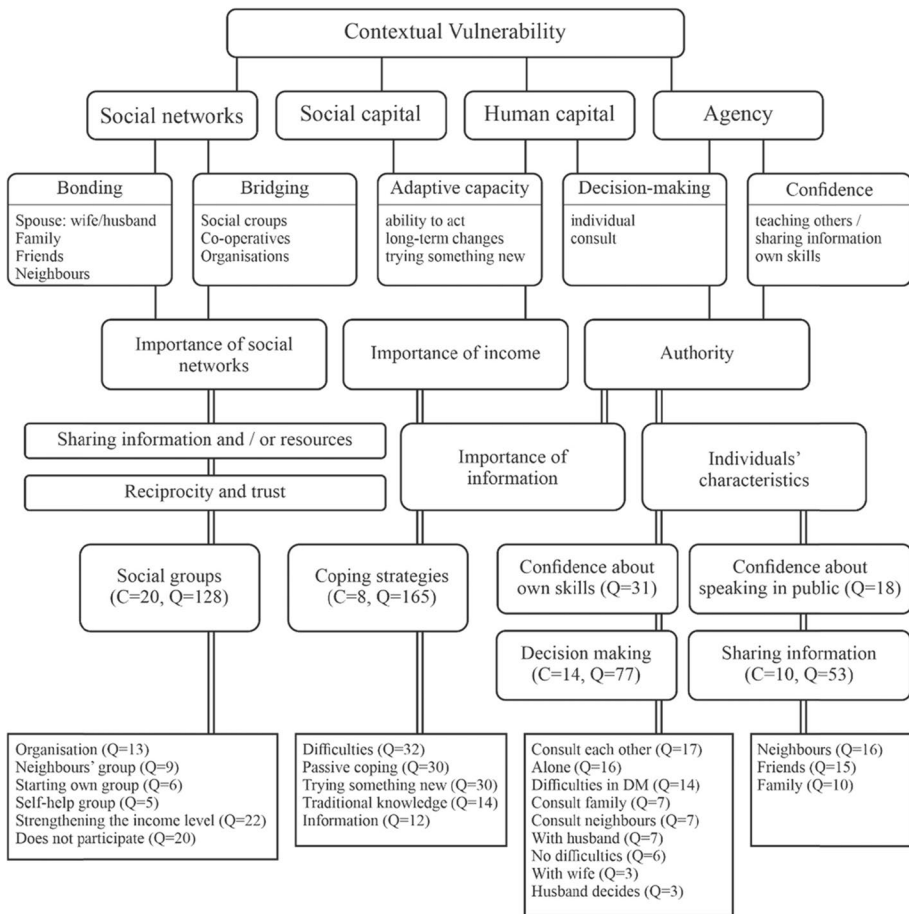


Fig. 4 Representation of different layers of the coding process (C = code, Q = quotation)

It is worth noting that young women who did not engage in social groups tended to downplay their involvement in farming when questioned directly. Age appeared to be a significant factor influencing women’s confidence in their own skills and knowledge. In contrast, both young and older men demonstrate confidence in their farming roles.

5.1.2 Perspectives from single-headed households (SHHs)

In the case of SHHs, only one respondent reported participation in a social group, specifically a women’s self-help group established for access to loans and financial stability. However, she noted that the group’s potential success was hindered by members’ inability to make membership payments. All SHH respondents acknowledged the usefulness of social groups and expressed interest in participating, but they faced obstacles due to unaffordable registration fees (Table 3). For SHHs, bonding networks dominated due to their homogenous nature, with social capital and social networks taking a secondary role compared to human capital.

Table 1 Social capital and society's characteristics, positive and negative dimensions

	Positive characteristics			Negative characteristics		
women farmers N = 12	Information sharing friends (3), friends and neighbours (2), neighbours and family (2), family and friends (1)	Reciprocity, exchange sharing good experiences about farming (2), community volunteer (1), strong reciprocity within groups (1), inclusive; women's self-help group for disadvantaged (1)	Trust strong willingness to participate in groups, groups are considered a good opportunity	Information sharing does not share (2), seldom (1)	Reciprocity, exchange groups are exclusive because of the registration fee (4)	Trust misuse of funds in a group (1)
men farmers N = 11	family (4), neighbours (3), wife and friends (2), friends (2), within groups (2)	discussing the problems with neighbours (3), starting a new group together, sharing (2), strong within a group (1)	strong willingness to participate in groups, groups are considered a good opportunity	No responses	groups are exclusive (2), most people do not want to participate in society (1)	misuse of funds in a group (2), people make rumours about other people's problems (1)

Table 2 Participation in social groups and individuals' social networks

	Reasons for participating	Importance	Bridging	Bonding	Reasons for not participating
women farmers N=12	loans (7), information (3), better access to markets (1), volunteering (1)	strengthening the income level (4), helping each other (2), trainings (2), children's education (1)	4	5	cannot pay the registration fee (2), already has the information, might join again (1), does not have time to participate, husband does (1), better to work alone (1)
men farmers N=11	better access to markets (4), information (2), loans (2), water project and goats (1)	strengthening the income level (4), stronger as a group (2), helping each other (1), security (1)	4	3	intending to join (2), previous bad experiences (misuse of funds in a group) (1), does not have time (1)

Table 3 Illustrative farmer quotes of the negative experiences related to social groups (SHHs)

Woman farmer (f26): ‘In order to participate, you need to have some money. You cannot be in the group with empty buckets. In the group, there are always contributions that you have to pay. But according to me, I have nothing’

Woman farmer (f25): ‘I cannot afford the registration fees, and also there are some groups that usually just take your money. You are saving money in the group, and they take it and won’t give it back to you’

Woman farmer (f28): ‘I am in the women’s self-help group, but it is not very successful because people who have been given loans are not repaying them back so it is hard for each member to continue in the group’

5.1.3 Implications for contextual vulnerability

The limited accessibility of social groups among SHHs highlights the intersectionality of contextual vulnerability and constraints within the powers structures and governance of social institutions, which has potential implications for interventions aimed at enhancing climate resilience through social groups.

5.2 Human capital and agency

Our examination of human capital and agency indicate gender-based disparities. While our overall assessment points to seemingly high levels of human capital and agency, a closer look at intra-household differences highlights some conflicting aspects.

5.2.1 Elements of perceived human capital and agency

Most women in THHs demonstrated strong human capital and agency and reported elements illustrating these qualities. However, five women either lacked access to information or were not actively involved in decision-making processes, and some perceived a deficit in agricultural knowledge (Table 4). In contrast, all men in THHs reported elements falling within the category of strong human capital.

Table 4 Elements of stronger and weaker human capital and agency based on theory and interviews

Elements illustrating strong human capital and agency	Elements hampering strong human capital and agency
individual’s authority: a role model for others	individual’s authority: little or none
confidence in own skills: teaching others and thinking that people took their advice	confidence in own skills: does not share information or believe that people follow advice
knowledge: information or traditional knowledge	knowledge: does not know much about agriculture, new in agriculture
ability to act: in case of challenges or for the purpose of achieving a goal	ability to act: passive, follows other people’s advice
participation in decision making: resources, income and agricultural practices	participation in decision making: partner decides or cannot decide without hearing their opinion, passive

5.2.2 Human capital and agency in single-headed households (SHHs)

For SHHs, human capital revolved around individuals' perceived skills and knowledge about agriculture, empowering them to take action despite the challenges they faced and their disadvantaged position. All SHH farmers emphasised their reliance on traditional agricultural knowledge and their ability to recognize climate-related changes, such as shifting rainfall patterns and prolonged drought periods. Two respondents reported good access to information, primarily due to regular meetings organized by extension officers who frequently visited their farms. However, the remaining respondents reported limited to no access to information, either due to the scarcity of relevant information during extension officers' meetings or their inability to join social groups. Geographical distance also played a role in determining access to training opportunities. When faced with difficult decisions, individuals nevertheless sought advice from extension officers or neighbors.

In terms of agency, the significance of labor and its value was a prevailing theme among the respondents in SHHs. These women bore the primary responsibility for maintaining food production and ensuring food security for their households. This observation aligns with the prevalent stereotype of the virtuous woman often found in the literature (Fosado Centeno 2020).

5.3 Intra-household-level differences

The experiences of decision-making and agricultural responsibilities within households revealed intriguing disparities between spouses.

5.3.1 Decision-making dynamics

In households where women reported making decisions independently, both men and women demonstrated elements of high human capital. All men consistently reported enjoying robust access to information and resources, while half of the women reported good access, with the remaining two facing challenges in implementing their ideas. Men, who were typically responsible for cattle, implied that their substantial access to information empowered them to make informed decisions regarding farming practices. Surprisingly, none of the men reported seeking their wives' support when encountering challenges. Conversely, most women reported seeking their husband's assistance or opinion when faced with unexpected difficulties.

5.3.2 Division of labor

The division of labor within these households appeared to be influenced by traditional gender norms prevalent among the Taita community, emphasizing the man as the provider and the woman as the caregiver (Harris 1962). Men often described women's roles as more limited, emphasizing their contributions to land preparation and occasional planting, but primarily focusing on household work (Table 5). This perspective was narrower compared to their own roles. Strikingly, none of the men mentioned their wives' responsibilities for cattle, even though half of the women respondents reported caring for the cattle as part of their agricultural duties.

Table 5 Perceived household duties for women and men by the interview respondents

Common duties for women farmers	Common duties for men farmers
farm work: planting, weeding watering, digging, carrying manure, other heavy and light work	farm work: digging, planting, tending the plants and planting
household work: preparing children for school, making food, and other household work	labour work outside the farm: masonry, carpentry and other casual labour
looking after the cattle: feeding, milking, and giving water to drink	looking after the cattle: feeding, milking, and giving water to drink
supervising hired labourers	

In contrast, women described men's roles as primarily involving casual labor or cattle care. Some women characterized their husband's workday as assisting in farm activities. Men often started their day by tending to the cattle in the morning, engaging in casual labor, and occasionally participating in farming activities if time allowed. However, regardless of their varied primary roles, men consistently played a dominant role in the decision-making processes related to agriculture.

The apparent dissonance between these responses may be attributed to the enduring influence of traditional gender norms within the Taita community, and some respondents might have found it challenging to express norm deviance. Nevertheless, these findings underscore the critical role of women as key stakeholders in agricultural practices, significantly shaping vulnerability and climate-related responses in the local context. Furthermore, the findings highlight the complexity of gender roles in agriculture and suggest that these roles can be flexible and context-dependent. For example, Autio et al. (2021) indicate that gender roles in agricultural tasks in TTC can shift depending on whether the produce is intended for consumption or sale, with subsistence products being primarily associated with women and commercialized products with men.

5.4 Farmers' response strategies against environmental and climate-related changes

Both women and men in the study demonstrated a range of positive adaptation strategies in response to environmental and climate-related changes.

5.4.1 Positive adaptation

Women's Strategies: Women primarily engaged in adaptive actions such as discussing problems within their families and communities. They explored novel approaches, such as enhancing farming practices with new resources and inputs and experimenting with different seed varieties.

Men's Strategies: Men participated in training programs and experimented with new ideas, which included changing seed varieties, diversifying crops, and planting trees. A common theme among both genders was the adoption of drought-resistant crops as a central element of positive adaptation. Notably, women rarely mentioned seeking new agricultural knowledge as a means of responding to changes.

Gender Differences: While women's adaptation actions were centered around applying pesticides, using additional water sources, and utilizing traditional knowledge for pest control, men extended their strategies to include the use of farmyard manure or fertilizer to enhance soil fertility. It's important to note that the strategies mentioned above primarily revolved around resource-intensive approaches and, in some cases, might be maladaptive in the long term.

5.4.2 Passive coping strategies

Respondents, especially men, occasionally employed passive coping strategies in the face of climate change. A common approach among both women and men was to wait for the situation to change. Men, in particular, expressed a preference for leaving their problems to divine intervention, often attributing their inability to cope to resource constraints. Passive coping mechanisms were typically utilized when individuals deemed the situation too challenging.

Gender disparities seemed prevalent in coping strategies, with women showing greater reluctance to respond passively compared to men. The women's responses did not exhibit maladaptive tendencies, while one male respondent acknowledged that, at times, he had to sell his cattle to repay loans.

5.4.3 Coping strategies in SHHs

In the case of SHHs, the choice of coping strategies was mainly influenced by traditional knowledge or advice received from extension officers. However, even those without access to extension officer training demonstrated a capacity for progressive adaptation, for example by implementing more permanent changes in crop protection measures. Despite the presence of effective coping and adaptation strategies, all respondents reported employing passive coping mechanisms as well.

5.5 Contextual vulnerability and farmers' response strategies

5.5.1 Factors affecting positive adaptation strategies in THHs

In THHs, the six women who reported positive adaptation strategies shared common characteristics. These women exhibited elements indicative of high human capital and were active participants in social groups. They fell within the age range of 40 to 56 years, signifying likely extensive experience in agricultural practices. An interesting commonality among these women was their slightly larger landholdings, averaging around 2 hectares, and the household having possession of land titles. Furthermore, most of their spouses were engaged in off-farm employment, indicating improved financial stability for the entire household. While they demonstrated a range of coping strategies, their focus remained on shorter-term solutions. At the intra-household level, it was observed that women's partners also implemented positive adaptation strategies.

In the case of THH men, the three with both high human capital and strong social networks demonstrated positive adaptation strategies. Likewise, the men who did not participate in any social groups but had high human capital also reported positive adaptation

strategies. However, some men who exhibited both high human capital and participation in social groups primarily relied on shorter-term coping strategies.

5.5.2 Emphasis on traditional knowledge in SHHs

A notable distinction between THHs and SHHs was the emphasis placed on traditional knowledge. SHHs showed a stronger reliance on traditional knowledge compared to their counterparts in THHs, for whom traditional knowledge served as a supplementary method. It is important to note that this reliance on traditional knowledge might present challenges in the face of changing climatic and environmental conditions, where traditional practices may not be as applicable. Another key characteristic of SHH respondents was their relatively older age. For SHHs, the lack of access to resources and income emerged as a prominent factor, limiting their ability to modify their farming practices.

5.6 Identified drivers of farmers' vulnerability

In identifying the most vulnerable farmers, key informants highlighted the significance of financial resources to allow access to farm inputs, echoing MacGillivray's findings (2018). They consistently emphasized that a farmer's income level is a pivotal determinant of vulnerability. Income was often perceived as closely linked to land size (Table 6), as it can affect a farmer's ability to diversify food production due to space constraints. Land also serves as collateral for obtaining loans from financial institutions. Some respondents specifically pointed out marginalized groups such as widows, orphans, and the elderly as the most vulnerable within the community.

In terms of information accessibility, all respondents stressed its crucial role in enhancing farming practices through training and learning new methods. Key informants indicated that an individual's income level might hinder their access to information or, conversely, that information may be available but insufficient financial resources impede its implementation.

It was commonly noted by key informants that women take greater responsibilities in farming, while men often engage in casual labor or pursue alternative income-generating activities. However, traditional gender roles still confer men with resource ownership and greater decision-making authority. Consequently, women were viewed as more receptive and adaptable when introduced to new farming practices (Table 7).

Table 6 Illustrative key informant quotes on the vulnerability of small-scale farmers

Key informant (k3): 'In terms of practicing inputs like pesticide, they cannot afford them. In terms of harvesting water, they cannot pay tanks and harvest the water for the drought periods. The small-scale farmers are the most vulnerable. They cannot even access fertilizer; they cannot afford them'

Key informant (k5): 'Sometimes the challenge is space availability. Like when we tell them to plant macadamia, which will take five to seven years to grow, they will ask what I will eat in the meantime. Maize will take only three months to grow so of course they will plant that one. So, the problem is land availability, because they do not have enough space for the trees and food crops. We are trying to make them do terrace lines and to plant trees in these spots'

Table 7 Illustrative key informant quotes on gender roles

Key informant (k6): 'I can say that the men farmers are dominating in terms of resources. Even if women are active and responsible for the farming, the man is the one who is controlling the resources. It is according to the traditional roles'

Key informant (k6): 'Women are more responsible for food production. It is a cultural thing. It is easier to convince women to take up new methods than men. So, if the farm is woman-dominated, it will more likely adapt new methods'

6 Discussion

Based on the results, it seemed that the differences in contextual vulnerability were the most drastic between farmers who implemented positive adaptation strategies and farmers who had only passive coping strategies or coping and passive coping strategies. In line with the theoretical background (Engle 2011; Gallopin 2006), this means that farmers with higher adaptive capacity could more likely apply positive adaptation strategies.

6.1 Importance of social groups for response strategies

Farmers who participated in social groups most often shared information and felt that their knowledge was useful and valuable. To agree with Cassidy and Barnes (2012), the connectivity of a household tends to increase availability of response strategies. Women who applied only short-term coping strategies did not report participation in successful social groups, which might indicate that to have long-term positive adaptation strategies, it could be helpful to participate in social groups for increasing access to loans or information, which are essential resources for positive adaptation strategies.

In line with Mohan and Mohan (2002), even though social capital can have importance for an individual, it does not overcome a complete lack of resources or income, which results in a narrow bargaining set (Van Aelst and Holvoet 2018). Despite having challenges with resources, THH farmers who were connected by bridging or bonding networks and had financial resources did not perceive themselves vulnerable because of the possibilities to react. Farmers with fewer networks and resources also had coping strategies but could not often implement their ideas. In the context of the SHHs, social capital and networks could substitute a more notably existing lack of income and other resources. Therefore, it could be argued that social capital and networks, especially through organised social groups, can work as a way towards having a more stable income level. In a case of more severe poverty, social groups can be considered too expensive and exclusive. To approach farmers who are in the most disadvantaged position, it could be beneficial in adaptation programmes to aim at increasing those farmers' participation who are not already involved with social groups and who could not otherwise afford to register or access such groups. This is in line with Gannon et al. (2022), who argue that homogenizing women as a single one-size-fits-all category will not work in identifying particular challenges and unique climate change adaptation needs of the most vulnerable women farmers.

According to this study, it appears that social groups in the Taita Hills have more meaning for THH women than for men when it comes to improving farming. The effect of strong social capital and social networks is two-fold. First, the social groups or bonding networks can offer an opportunity to have access to loans or resources that would otherwise be hard

to get (Adger 2003). Even though this aspect is equal for men, women most often do not have any other sources of income except farming, which means that for them, group loans and sharing of resources is highly important. Second, participation in social groups can work as an opportunity to learn how to recognise one's own talents and value of their work, which in turn can have empowering outcomes.

6.2 Decision-making power on intrahousehold level

Decision-making power is often considered to work as an indicator of empowerment and individual's agency (Ibrahim and Alkire 2007). Many women reported participating in decision making either together with their spouse or alone. This can reflect that women might participate more than is assumed. This could also be explained with migration trends, where men have often moved to other places in search of employment, giving women the main responsibility over farms (Smith 2008). The implications are in line with Jackson (2007), who argues that marriage is not necessarily a social relationship in which men exploit women, and thus vulnerability analyses should treat vulnerability and gender as an open question requiring consideration contextuality. Nevertheless, despite the central role in farming, most of the women noted that they cannot make decisions without consulting their husbands, whereas men did not report the same obligation. Adaptation measures are mediated between the spouses in marriage through dynamic changes and performances of conjugality, which can have both adaptive and maladaptive results. As Jackson (2007) further states, a properly contextualized analysis seeks also to understand the changing value of marriage and the fragmentation of domestic groups in diverse settings.

6.3 Land tenure dynamics impacting agricultural roles

Furthermore, to be considered in the context of Taita Hills, as also Nyantakyi-Frimpong (2017) argues, is that households may have intrahousehold level differences between the women in accessing different agricultural resources and decision-making, based upon their wifely status, especially in polygamous minority groups, but also with women-headed households including for example widows, divorced and unmarried women who are typically in a less favourable position when it comes to land tenure. According to Kenya Land Alliance (2018), only 1 percent of registered land titles are held by women in Kenya, and around 5–6 percent are held in joint names, and as land in Taita Taveta County is traditionally inherited in a patrilineal way, meaning that the challenge of women's marginalization is culturally influenced, it implies that situational analyses should generally involve the custodians of the culture in design (Bukari et al. 2017).

As discussed earlier, farms and households have traditionally been perceived as manifesting men's efforts and success because of ownership and inheritance of land and other assets. It has also been a tradition for women to move into their husband's home (Harris 1962). Apart from the SHH women, all the farmers reported that their land was owned by the family, which in this context could be taken to refer to the husband's side. However, women perceived themselves as responsible for farming and performed a notable amount of the work, sometimes being solely in charge of the farm, which demonstrates a strong sense of ownership. This sense of responsibility and ownership reflects the more complex nuances of household roles that have traditionally involved extended family such as sons-in-law to help in the agricultural tasks, land transaction negotiations in which all women enter and crop assignment that emphasises men's flexibility to perform agricultural tasks

associated with women when the production shifts from subsistence to commercial (Harris 1972).

6.4 Gendered aspects in participation to social groups

When analysing the results on a household level, it can be argued that a positive effect of high social and human capital was related to individuals rather than households. In other words, it was not enough to have a spouse participating in social groups or having good knowledge of agriculture because it did not always increase the response strategies of the whole household. However, if the women had positive adaptation strategies, most of their husbands enjoyed elements of social and human capital and were not perceived as vulnerable in the contextual vulnerability analysis. If the household's income level was high enough, both spouses could participate in social groups, which require registration fees. If the level of income was not sufficient for both spouses to participate, a man farmer was most often the one to be involved in the groups with registration fees. This can be argued to reflect how men might perceive themselves as the heads of a household in terms of bringing income and information to the household and, on the other hand, indicate that women's participation in social groups may benefit the whole household and demonstrate the actual agency of women farmers. Daoud (2021) furthermore argues that gender norms, and the unequal gender relations they create, pressure masculinity and femininity in ways that can increase vulnerability to climate change.

6.5 Agency of women in the vulnerability discourse

This study has demonstrated that the narrative of vulnerable women (e.g. Fosado Centeno 2020; Arora-Jonsson 2011) does not fully reflect the agency of women farmers in the context of Taita Hills, whose response strategies are not that different from men. Even though there are differences in the elements of contextual vulnerability, women and men are nevertheless facing the same biophysical challenges caused by environmental and climate change. These differences do not turn women into being vulnerable but rather underline the structural elements of inequality and prevailing gender roles. Scientific and policy-level discourses and the narratives that they encompass determine the way international and national actors describe and understand the farmers' realities, which can prevent them from seeing stories that differ from the main discourse. Contextual vulnerability analysis takes into consideration individual and society characteristics and socio-economic aspects, which take place in cultural and historical structures.

The Taita Taveta's Climate Risk Profile (MoALF 2016) states that men have higher access to resources, and a stronger position in decision-making processes, which contributes to their stronger adaptive capacity. In line with this statement, key informants from the county sector argued that men are in a better position in terms of having multiple response strategies. However, according to our study, both women and men can apply a variety of response strategies either on short-term bases or with longer-term goals. This is also in line with Autio et al. (2021), whose research in TTC demonstrates high knowledgeability in climate-related agricultural responses to climate change among both women and men. Despite the gendered differences in access to resources or elements of contextual vulnerability, both men's and women's adaptive capacity was paramount for a household's food production. In this context, women were central actors, and therefore, their agency should be better acknowledged rather than contributing households' adaptation only for men.

Discourses on men's adaptive capacity reflect reality, but if the women's role is not articulated more thoroughly, the narrative is biased.

6.6 Inconsistencies and exclusions in the vulnerability discourse

The discourse analysis in this study, while not necessarily representative or generalizable at a regional or national level due to the small sample size and diversity of social and cultural contexts, sheds light on some of the inconsistencies and exclusions within the prevailing vulnerability discourse. This aligns with the observations of Forsyth and McDermott (2022). Vulnerability discourse not only mirrors decision-making practices and opinion formation but also reflects social relations, interests, and power dynamics, as noted by Cannon and Müller-Mahn (2010) and Taylor (2014). Nyantakyi-Frimpong (2020) extends this argument, emphasizing that while gendered inequalities certainly influence vulnerability to climate risks, other social differences may be equally or even more relevant. Moreover, failing to move beyond binary gender categories in vulnerability analyses can inadvertently reinforce existing vulnerabilities.

6.7 Shortcomings of the study

On the level of data interpretation, gender analysis provides a lens through which existing gender-based power structures can be examined. However, the very nature of the binary woman versus man dichotomy is highly questioned and problematic (Rose 1993). It's essential to consider whether this study deconstructs or inadvertently perpetuates the very structures it criticizes. Similarly, the heteronormative construction of a household as a research unit deserves scrutiny. Furthermore, focusing on THHs and SHHs limits the understanding of intersectional social structures forming vulnerability in the case study context.

Although the dichotomy is problematic, this study's structure aligns with common practices in vulnerability analysis, which allows for comparable results within the broader discourse. In the patriarchal context of TTC, the gender-dichotomized heteronormative household serves as a representative setting that can be justified as a research unit. Furthermore, the inclusion of SHHs challenges this constructed dichotomy by representing marginalized experiences. As stated by Kuran et al. (2020), an intersectional perspective uncovers besides social differences also multiple power structures that reproduce vulnerability. In this sense, further studies could for example concentrate on how these marginalized experiences are constructed through power structures in the context of TTC. Still, the results highlight a dissonance between the narrative of vulnerable women farmers and the lived realities within the case study context. Nevertheless, it's important to acknowledge that the small sample size and not including intersections of various social structures that shape vulnerability may exclude views of some of the most marginalized farmers.

7 Conclusions

7.1 Leveraging the contextual vulnerability framework

The utilisation of the contextual vulnerability framework has provided a comprehensive insights on the construction of response strategies and untapped localized opportunities to

enhance individual climate resilience within the agricultural sector of TTC. This implies incorporating contextual vulnerability into vulnerability assessments as beneficial to guide effective adaptation planning. Furthermore, the differences in social and human capital between the THHs and SHHs indicate a need to consider intersectionality in understanding the underlying social constructs that form vulnerability. Without a thorough comprehension of the socio-political and historical context, as well as existing power structures, vulnerability assessment outcomes may fall short of capturing nuanced realities. Consequently, they might fail to ensure the viability of agricultural practices in the face of climate change.

7.2 Unveiling the gaps in vulnerability discourse

Vulnerability to climate change is inherently a discursive concept aimed at portraying the concrete realities of individuals grappling with its impacts. The conflicts in conceptualizing vulnerability within the scientific discourse become evident in the gaps revealed by this case study. In this specific context, these gaps involved the misrepresentation of women farmers' lower adaptive capacity and limited opportunities for response strategies. While this research does not assert that women's position is equivalent to men's in terms of resource access or participation in social groups across diverse contexts, it emphatically underscores that these differences do not inherently diminish women farmers' abilities or their strong commitment to adapting to climate change. Some of the challenges in vulnerability discourse can be attributed to its inclination to primarily apply the framing of outcome vulnerability. In addition, focusing solely on environmental factors, the analysis may overlook gender roles that diverge from the global discourse, thus simplistically categorizing women as merely vulnerable without acknowledging their agency.

7.3 Shifting focus from symptoms to root causes

The current discourse predominantly seeks to alleviate the symptoms of vulnerability rather than addressing the root causes of disempowering structures. The contextual vulnerability framework, when combined with gender analysis, presents an opportunity to shift the focus from immediate symptoms toward addressing root causes at different scales. If vulnerability assessments disregard gender dynamics, adaptation processes at both the policy and implementation levels may become mired in the narrative of vulnerable women, undermining their agency. Furthermore, the responsibility for implementing widely advocated response strategies, such as agroecology, climate-smart agriculture, regenerative agriculture, or sustainable intensification, should not rest solely on the shoulders of small-holder farmers.

7.4 Rethinking vulnerability assessments

Vulnerability assessments are often perceived as the counterpart to adaptation analysis. From this perspective, it can be argued that the contextual vulnerability framework, with its context-centered approach, could potentially serve as a more natural pathway to effective adaptation programs, especially when incorporating an intersectional approach. Nevertheless, despite the promising outcomes of this case study, the value of the contextual vulnerability framing remains a subject of debate in a broader perspective. If the objective

of vulnerability assessments is to provide context-specific information for adaptation programs, the focus should shift from constructing vulnerability indices alone to encompass the analysis of intersecting social contexts. This case study serves as an example of the importance of understanding the impacts and implications of discourses, as they can construct a perspective of the world that may not truly reflect reality. By comprehending the power structures and misrepresentations associated with different framings, we can begin to dismantle the root causes of vulnerability.

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Data availability To protect the privacy of the interview participants, the interview data will not be made publicly available.

Declarations

Competing interests The authors have no competing interests to declare that are relevant to the content of this article.

Ethics approval The research has been licensed by the National Commission for Science, Technology and Innovation (NACOSTI) of Kenya (research permit no. P/18/97336/26355). A specific ethical approval was not required because the data collection does not include health-related delicate personal data, and informed consent was acquired from all participants.

Consent An informed consent was acquired from all interview participants.

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