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The Politics of Governing Resilience: Gendered Dimensions of Climate-Smart Agriculture in Kenya

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This paper uses climate-smart agriculture (CSA) in Kenya as an empirical entry point for investigating how climate actions reshape or reinforce gender relations, and how they are aimed at improving local resilience that is nested in such relations. While enhancing national food security, CSA practices could however reproduce inequitable power relations, such as gendered authority relations that produce vulnerability and inequalities. Equity and knowledge represent particularly contested aspects of CSA because it largely fails to address who wins and who loses from such interventions, who are able to participate while others are excluded, and whose knowledge and perspectives count in decision-making processes. Gender relations provide a stark illustration of the way that CSA fails to address how enduring inequalities of access in both production and consumption shape who is rendered vulnerable to climate change and who is left food insecure. In this paper, we treat CSA projects as a site of tensions between stability and contestation of gender relations, brought into view through moments where practices and knowledges are (re)shaped. We first review the concepts of authority, recognition, and resilience as a framework to understand how gendered inequalities and struggles over rights to resources are perpetuated within adaptation and resilience responses to climate variability. We analyze evidence from past studies regarding rural adaptation processes and gender dimensions in CSA projects to identify how such projects may modify the space for renegotiating inequitable gender relations. We approach gender relations as authority relations that are constantly internalized, resisted, and contested through practices and interactions between different actors associated with CSA projects, and the different knowledges that direct these practices. The examination focuses on Kenya as an empirical context to gain sufficient depth in understanding the social and political processes in which climate actions and gender relations are nested, enabling us to identify key points of intersection within these two themes. In addition, gendered dimensions of rural resource governance and adaptation are relatively well-described in Kenya, providing lessons for how climate actions can become more gender-responsive.

Keywords: adaptation interventions, resilience, governance, climate change, climate-smart agriculture, gender equity, Kenya

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INTRODUCTION

Climate-smart agriculture (CSA) is defined as practices that sustainably increase agricultural productivity and incomes (as part of livelihoods), build resilience and capacity of agricultural and food systems to adapt to climate change, and reduce and remove greenhouse gases (GHGs) while enhancing national food security (Neufeldt et al., 2013). The importance of practices such as CSA have become particularly relevant in the context of increasing evidence of the need to respond urgently to climate change through implementing greenhouse gas mitigation and adaptation measures to support sustainable development for all, a key message of the recent IPCC Report from Working Group II—Impacts, Adaptation and Vulnerability (IPCC, 2022). Impacts are already experienced and will intensify as global warming approaches and exceeds 1.5°C above pre-industrial levels within the next few decades. At the same time, some human and natural systems are pushed beyond their capacity to adapt, with some locations disproportionately vulnerable, including those characterized by poverty, governance challenges, and high levels of climate-sensitive livelihoods such as smallholder farming. The report states that "Vulnerability at different spatial levels is exacerbated by inequity and marginalization linked to gender, ethnicity, low income or combinations thereof (*high confidence*) (IPCC, 2022). Understanding how approaches that combine social and environmental goals in their implementation of measures to adapt and reduce emissions, such as CSA, is particularly pertinent to enable climate resilient development, both at local and global scales.

However, it has been demonstrated that even adaptation programs and strategies promoting CSA practices could reproduce inequitable power relations, such as gendered authority relations that produce vulnerability, further exacerbating gender inequalities (Arora-Jonsson, 2011; Karlsson et al., 2017; Eriksen et al., 2019). Despite its conceptual innovation, CSA is criticized for depoliticizing the socio-technical changes that it suggests by validating existing policy agendas of specific institutions (Newell et al., 2019). By focusing on narrow technical performance measurements, CSA glosses over the socio-political dimensions of food production and distribution, and minimizes issues of power relations, structural inequalities and access that animate agrarian political economy traditions. CSA also often fails to recognize the interactions between different actors, the multiplicity of food, water, energy, materials, and ecosystem functions within agriculture. Furthermore, it typically ignores the broader social, political and cultural dynamics that perpetuate uneven power relations and grant privileges to those in positions of authority (Clay and Zimmerer, 2020).

Equity and knowledge represent particularly contested aspects of CSA because it largely neglects to address who wins and who loses from such interventions, who is able to participate while others are excluded, and whose knowledge and perspectives count in decision-making processes (Karlsson et al., 2017). International organizations focusing on CSA programs have established themselves as brokers of climate change investments in ways that give further credence to technological expertise, bolstering the power of external actors to make decisions that affect rural livelihoods and land use, and define what counts as "climate-smart agriculture" (Bernier et al., 2015; Crane et al., 2017). As a result, smallholders' risk mitigation strategies are devalued and distributional effects of adoption ignored, which may lead to negative vulnerability outcomes (Clay and Zimmerer, 2020). The transnational agrarian movement *La Via Campesina*, has even characterized CSA as a facade dominated by a corporate oligarchy under which a business-as-usual approach can proceed (Taylor, 2018). Taken together, these concerns have important implications for which equity goals are promoted, as well as the different actors' control over and access to resources—both processes that underpin socio-economic inequalities. Such depoliticized approaches risk constraining the emergence of more "pro-poor" forms of agricultural development and adaptation to climate change (Karlsson et al., 2017; Taylor, 2018), or worse, contributing to the development of paradigms and practices that entrench, rather than transform, power relations and inequities that ground vulnerability to climate change (Mikulewicz, 2019).

Many CSA projects focus on just one of the three pillars (GHG emission reductions, adaptation or food security) (Clay and Zimmerer, 2020). This tendency raises concerns regarding the extent to which CSA interventions recognize or address contextual drivers behind vulnerability among the poorest farmers, and notably whether or not the focus on contested—and as yet unproven—benefits from carbon markets would lead to further marginalization of smallholder farmers in terms of accessing new financial resources and retaining control over their land (Karlsson et al., 2017; Clay and Zimmerer, 2020).

These critiques highlight how CSA projects, despite a well-intended focus on the livelihoods and resilience of marginalized groups, are nested in the multi-scalar politics inherent in resource governance and development aid machineries (Eriksen et al., 2019; Schipper et al., 2020; Scoville-Simonds et al., 2020). It has been argued that gender relations provide a particularly stark illustration of the way that CSA fails to address how enduring inequalities of access in both production and consumption shape who is rendered vulnerable to climate change and who is left food insecure (Taylor, 2018). Very few CSA interventions have addressed how underlying gendered norms and institutions influence smallholder engagement in agriculture commercialization.

In order to deepen our understanding of these dynamics, this paper uses CSA in Kenya as an empirical entry point for investigating how climate actions reshape, or reinforce, gender relations, and how they are aimed at improving local resilience that are nested in such relations. Climate change adaptation has a prominent place in Kenya's policy landscape. The Kenya Climate Change Act of 2016 is the foundation for mainstreaming climate change in broader national agendas. It provides the mandate for the recurrent 5-years National Climate Change Action Plan (NCCAP) (2018–2022), which is formally aligned with other major (non-climate) policy initiatives, such as the current president's "Big Four" agenda, the Vision 2030 economic development plan, and the Global Sustainable Development Goals (Ashley, 2019; Onyango et al., In review). The Kenya's

Climate-Smart Agriculture Strategy represents the NCCAP's manifestation within the agricultural sector. Implementation of adaptation and/or resilience initiatives are also receiving investments from major international donors and lenders, such as the World Bank, the Global Environmental Fund, USAID, GIZ, etc. Furthermore, under Kenya's recently devolved political structure, county governments have funds that are earmarked for climate change actions in their County Integrated Development Plans, though effective implementation of climate change programs varies widely (Onyango et al., In review).

In this paper, we treat CSA projects as a site of tensions between stability and contestation of gender relations, brought into view through moments where practices and knowledges are (re)shaped. We analyze literature through the concepts of authority, recognition, and resilience (Nightingale, 2017; Carr, 2019) to show how gendered inequalities and struggles over rights to resources are perpetuated within adaptation and resilience responses to climate variability. Evidences from past studies regarding rural adaptation processes and gender dimensions in CSA projects specifically are examined in order to identify how such projects may open up or close down space for renegotiating inequitable gender relations. In doing so, we approach gender relations as authority relations that are constantly internalized, resisted and contested through practices and interactions between different actors associated with CSA projects, and the different knowledge that direct these practices. The examination focuses on Kenya as an empirical context in order to gain sufficient depth in understanding the social and political processes in which climate actions and gender relations are nested. Kenya is a context for which substantial enough literature exists regarding both gender relations and climate-smart agriculture that enable us to identify key points of intersection within these two themes. Furthermore, several CSA projects have been implemented in Kenya. In addition, gendered dimensions of rural resource governance and adaptation are relatively well-described.

To frame this literature review and illustrate how CSA interventions in Kenya interact with gender inequalities over rights to resources and adoption of CSA practices, our analysis addresses the following research question: How does the governance of climate resilience, such as through CSA interventions, reshape and reinforce gender relations in Kenya? This question relates to how not only adaptation strategies are gendered, but also to how authority relations are (re)produced in the daily practice of adaptation interventions. How do people face inequitable gender relations within CSA, for example? And how do gender-based power struggles manifest in CSA projects? Of critical importance to the extent to which CSA and other resilience interventions are able to address social inequity and vulnerability is how they engage with gender based struggles. Indeed, do CSA strategies enhance society's recognition of women's roles, decision-making authority, and knowledge? The next section elaborates the conceptual framework through which we analyze these questions. Then, the methods for conducting the review of past studies are described. In the findings section, we describe six moments where the tensions between stability and contestation of gender relations become visible in CSA projects. We argue that the case of gender relations in CSA enriches our understanding of the governance of resilience in three main ways: First, gender-based power struggles in the governance of resilience come into view in multiple practical domains, including in resource rights and access, household-level decision-making authority, knowledge-relations, in the inclusion/exclusion from project resources, gendered local adaptation strategies, and in gendered forms of targeted agricultural support such as women's groups. Yet CSA interventions tend to focus primarily on technology adoption and increasing productivity and incomes. A second observation is, therefore, that CSA and other adaptation programs need to start with the assumption that they are part of shaping gendered power relations and politics. In order for the governance of resilience to effectively address inequity and vulnerability—rather than risk perpetuating marginalization—it is crucial to understand the dynamics through which livelihood systems seek stability as well as the spaces that exist for social transformation within such local livelihood decision-making. Third, they can do so by paying specific attention to how discourses of livelihoods are shaped, identities are mobilized, tools of coercion utilized and authority and recognition (re)produced in livelihood practices, and by analyzing how interventions affect these features in multiple practical domains such as those identified for the context of CSA in Kenya.

CONCEPTUAL FRAMEWORK AND METHODS

In order to produce an analytical framework to examine how CSA interventions are nested in and reshape gender relations and the implications for the governance of resilience, we combine recent and complementary conceptual frameworks by Carr (2019) and Nightingale (2017). Both frameworks are designed to address the common depoliticization in resilience and adaptation work by centering analysis on socio-political relations implicit in climate change adaptation. Though they take different entry points, both frameworks focus on how social relations are continuously reproduced through daily livelihood practices, and thus potentionally transformed when livelihood practices are changed via technical adaptation practices. In combining the two frameworks, we explore how livelihood decision-making (Carr) intersects with the socio-politics of adaptation intervention design and implementation (Nightingale), to shape gender relations in CSA across livelihoods and policy spheres.

Built upon Agrawal (2005), Carr's Livelihoods as Intimate Governance (LIG) framework proposes that resilience is a "socio-ecological project" wherein three broad spheres of everyday life shape people's livelihood decision-making spaces: discourses of livelihoods; mobilization of identity; and tools of coercion (see **Figure 1**). The discourses of livelihoods and mobilization of identity typically reinforce each other to create a semblance of cultural stability. However, there are inevitably disruptions to such stability—whether from external interruptions or internal variability—that destabilize the boundaries of these spheres. Such disruptions are addressed through tools of coercion in

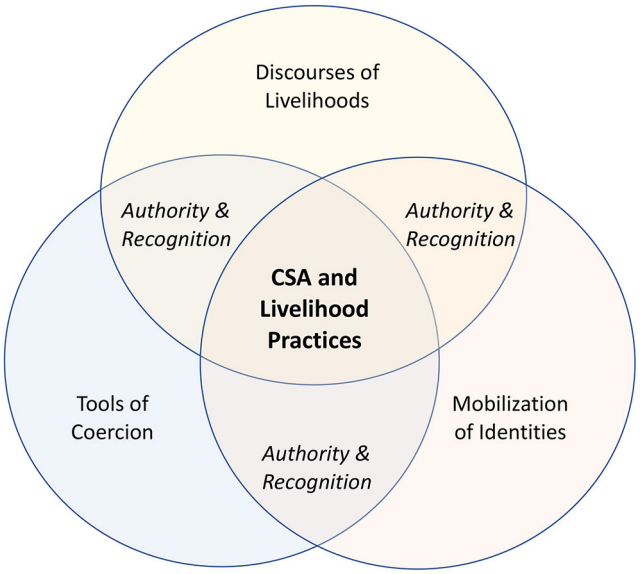

FIGURE 1 | Discourses of livelihoods, mobilization of identities, and tools of coercion are spheres of everyday life that shift in relation to each other to pursue material and socio-political resilience in the face of shocks. The interaction between the three spheres determines the decision-making space for CSA and livelihood practices, leading to socially differentiated outcomes. In turn, CSA projects intervene in authority relations and recognition, thereby shifting the three spheres and gendered space for livelihood decision-making.

TABLE 1 | Conceptual anchor points for analysing gender relations in CSA interventions.

Anchor points	Description
Discourses of livelihoods Carr (2019)	The boundaries of propriety in terms of what constitutes a socially acceptable mode of earning a living.
Mobilization of identities Carr (2019)	The intersectional pressures that inform the distribution of social roles and responsibilities within a livelihood.
Tools of coercion Carr (2019)	The mechanisms of social response to bring a new stability to livelihoods.
Authority Nightingale (2017)	Authority relations continuously reproduced through daily livelihood practices, and thus potentially transformed when livelihood practices are changed through technical adaptation interventions.
Recognition Nightingale (2017)	How adaptation projects address and (re)constitute people's rights as citizens (by being part of projects and gaining access to resources or services), and their socio-political relations through their roles and leadership positions within projects.

order to bring a new stability to livelihoods. Within this dynamic, resilience continually results from agency-driven social contestation and/or legitimization of livelihood practices and social order more broadly.

Within Carr's framework, adaptation interventions, or climatic events and local strategies to adapt to these events, may disrupt the stability of the three spheres of everyday livelihood decision-making. Nightingale's (2017) framework mobilizes the concepts of authority and recognition to explain how socio-political relations are (re)produced and altered in adaptation. Her theorization focuses on adaptation projects as mechanisms of environmental governance through which relational social power—including gendered power—is asserted, contested, reconstituted and institutionalized. This framework specifically highlights the ways that adaptation projects treat the issues of social authority and recognition, whether deliberately or incidentally. We draw on Nightingale to understand recognition and authority as a means through which relations between Carr's three spheres can shift, shaping the gendered nature of livelihood decision-making spaces. In addition, Nightingale's concept of recognition helps to identify project roles and citizen rights as forming part of an expanded understanding of livelihoods. This paper uses the five anchor points derived from the Carr and Nightingale frameworks to analyze the relationships between CSA and gender in existing literature on Kenya. These anchor points, summarized in **Table 1** below, directs our reading of the literature, drawing attention to several different ways that gender relations may become visible in CSA practices.

Carr's framework describes how roles, activities, discourses of livelihoods, rights, and power relations interact in day-to-day practice, especially under conditions of technical change. The three elements of discourses of livelihoods, mobilization of identities, and tools of coercion interact to create livelihood decision-making spaces. "Livelihoods form part of efforts to govern the world, with resilience as a product of a project that works to (re)order and (re)organize the ever-emerging properties of that socioecology to ensure safety and subsistence to the widest number of people possible, which in turn legitimizes that project and its attendant social order" (Carr, 2019, p. 75). Within this understanding, a context-specific configuration of the three spheres that constitute a resilience project can be delegitimized or destabilized if unable to provide wellbeing in the face of climate or other risks. However, agricultural interventions, such as CSA, can also shift the relationships between these three spheres, including the gendered discourses of livelihood activities, roles and responsibilities, and tools of coercion such as land rights. Nightingale's framework zooms into adaptation interventions as a specific kind of change process, thus articulating with Carr's broader spheres, but going beyond livelihoods to include local decision-making spaces.

Combining these frameworks highlights the ways that new technical practices and environmental governance interventions stimulate (re)structuring of social relations, and provide a space for contestation thereof. The five conceptual anchor points—discourses of livelihoods, mobilization of identities, tools of coercion, authority, and recognition—help make visible the relationships between CSA as a socio-technical adaptation intervention and gender relations as a contested and malleable domain. Rather than characterizing separate domains, these conceptual anchor points help describe how CSA practices are

nested in and simultaneously shift gender relations, and hence unpack the politics of resource governance and local resilience.

Not only can such analyses help anticipate how CSA interventions can lead to uneven social distribution of material outcomes (productivity, profitability), but they can also help anticipate how CSA interventions and technologies realign existing social power and knowledges. If such anticipatory analysis can reflexively inform CSA project design, social distributional outcomes could become explicit objectives—alongside the usual technology adoption and productivity enhancement—rather than afterthoughts.

Examining CSA literature for *discourses of livelihoods* highlights how CSA interventions may alter the gendered mix of agricultural practices and how they are culturally construed as desirable or resilient. Such changes simultaneously affect the *mobilization of identities*, in terms of redefining or reinforcing gendered roles and responsibilities. By introducing new practices, and involving particular individuals in such practices, as well as the social organization of projects, an intervention may shift roles and responsibilities, perceptions of who "should" carry out which activities, and legitimize the authority of some individuals over others to make decisions regarding those activities. Hence, a CSA intervention can influence how gendered identities are defined with reference to livelihood practices, producing subjects who understand themselves and others in relation to resilience (the socio-ecological project). By determining who gets to have which roles in projects, CSA interventions also legitimize the *authority* of particular people in local decision-making processes more broadly and become nested in struggles over leadership roles. This illustrates how struggles over project roles and resources often have very little to do with the natural resources and activities themselves, as they are embedded in very specific socio-ecological contexts and power relations that form part of the socio-ecological project. In addition to leadership authority, rights or benefits given by a project can constitute a recognition of particular people's citizen rights and needs in relation to the state. In this way, a CSA intervention can reconfigure which organizations, such as NGOs or aid organizations, come to play state-like roles, taking over such roles from government entities. Critical here is the socially differentiated way in which a project may recognize citizen rights, and how changes in state-citizen relations also affect gender relations.

Somewhat less visible, but equally important, are the ways that people seek to contest the roles, responsibilities, and activities, such as covert or overt forms of resistance to the gendered relations inherent in livelihood activities. While CSA may open up spaces for shifting gender relations through the way that projects assign practices, project roles, authority and identities, people also have various strategies to contest these, such as through quiet sabotage, non-participation, or outright conflict. Examining the CSA literature for *tools of coercion* draws attention to how adaptation interacts with social mechanisms and norms that ensure persistence of socio-political relations and practices, including the social sanctions and resource rights that may exclude women from accessing particular resources, practices, or project roles. These mechanisms may be mobilized in response to CSA interventions. At the same time, the interventions may alter the mechanisms of social sanctions, as well as tenure or resource rights. Carr draws attention to how local populations, or elements therein, may mobilize local norms and sanctions to resist an intervention and ensure the stability of existing livelihoods as a socio-ecological project. While CSA interventions are typically designed to reduce agricultural risk in the face of increased climatic variability, the Carr and Nightingale frameworks enable us to see how the same interventions can introduce or even exacerbate aspects of social risk.

In order to look for the types of moments outlined above where gender relations in CSA become visible, we conducted a literature review using Boolean research focusing on the following key words: adaptation, climate change, gender, climate-smart agriculture, and Kenya. We searched for peer-reviewed and journal articles in English only, discussing these topics in Kenya, covering the period 2010–2020. "Climate-smart agriculture" emerged as a prevalent discourse for agricultural development around 2010 (Lipper and Zilberman, 2018). We therefore decided to cover the period from the emergence of this concept to today. We conducted a literature search in a total of 16 databases (see **Annex 1** for the list of databases). Our screening arrived at 47 articles published in the timeframe, focusing on Kenya and including at least one of the keywords. Using the combined Nightingale/Carr framework outlined above, we analyzed the contents of the 47 selected articles for ways that climate adaptation practices and interventions interacted with gender norms and roles. This paper synthesizes the findings extracted from these articles.

The findings are organized by six emergent themes in the literature, through which aspects of gender in CSA become visible in different ways. These focus areas include (3.1) resource rights and access, (3.2) household level decision-making authority, (3.3) knowledge relations, (3.4) inclusion/exclusion from project resources, (3.5) gendered adaptation strategies, and (3.6) gendered forms of governing agricultural support (women's group-based approach). We present our analysis in these six areas—including brief summaries of their significance in terms of the analytical framework—to better highlight the implications for research and development interventions, which are covered in the discussion and conclusions section.

FINDINGS

In this section, we identify six themes emerging from the literature describing moments where contestations, struggles and internalisation over gendered recognion and authority relations come into view. We describe how these struggles have outcomes for resilience in terms of stability—or for transformation of relations between discourses of livelihoods, mobilization of identities, and means of coercion. By using the analytical framework, we examine past evidence of how projects engage with (open up or close down space for) these struggles over recognition and authority, or shift the three spheres defining livelihood decision-making. The emerging themes and their intersection with CSA are summarized in **Table 2**.

TABLE 2 | Summary of emerging themes describing how CSA reshapes gender relations and social differentiation.

Emerging themes	Key issues	Illustrations of key issues
Resource access and rights	Recognition of decision-making authority by actors involved in CSA perpetuate and reinforce gendered inequalities over resource rights, shaping livelihood decisions and social differentiation.	Harrington (2010): Addressing power dynamics is key to increasing access to justice and legal mechanisms in order to strengthen women's access to land. Fischer and Qaim (2012): the establishment of small-scale banana farmer groups and commercialisation led to increased control by men over production benefits. Aberman et al. (2015): Social norms influence which physical assets women can control, such as in climate change adaptation assets and group-based approaches Caretta (2015): Participation in water management is often culturally endowed to men, even in changing waterscapes in smallholder irrigation farming. Muriithi et al. (2017): Despite allowing greater decision-making autonomy for women, female-headed households may display higher vulnerability to climate risks than male headed households.
Household level decision-making authority	Agricultural change is nested in and (re)produces gendered decision-making authority. Cultural identities are often mobilized to perpetuate gendered authority relations, excluding women from alternative livelihood activities introduced by CSA projects. This preserves the stability of the livelihood system and extends socially differentiated vulnerability.	Ezenwa et al. (2018): A Baringo County case study (northern Kenya) shows that men are increasingly involved in alternative sources of income leading to increased decision-making authority by women over some agricultural activities. Karmebäck et al. (2015): In diversified agro-pastoralist populations in West Pokot (northern Kenya), shifting gender roles widen inequities as women often lack decision-making authority in new cash livelihood activities. Bernier et al. (2015): In the adoption of CSA practices, women may have decision-making authority over domestic activities and agricultural practices, but less authority over incomes.
Knowledge relations	There are gendered inequalities over access to information and to adoption of environmental change strategies. Interventions aimed at improving access to climate information services often do not recognize women's needs or gendered authority relations.	Mungai et al. (2017): Experiences from Western Kenya show that women generally have lower education levels, often lack access to relevant information, and thus are more likely to have low adaptation to climate change through crop adjustment and the adoption of climate-smart agriculture practices. Ngigi et al. (2017): An intra-household analysis of gender differences in climate change adaptation strategies demonstrates that a higher percentage of husbands than wives acquire climate information, adaptation ideas, and access to farm inputs through social groups.
Inclusion/exclusion from project resources	A lack of recognition within adaptation programmes of women as a distinct user group with particular needs and positionality limits their access to project resources. Interventions are often implemented with little analysis of gendered outcomes, with project resources directed at men, or men acting as gatekeepers where resources are directed at women.	Ochieng et al. (2014): A study of semi-arid eastern Kenya finds that adaptation measures predominantly focus on technical agricultural or environmental conservation measures, considering local strategies as unsustainable, and hence do not support or undermine the diversity of marginal livelihood strategies, on which women typically depend. Aberman et al. (2015): Gaps exist in integrating gender into project monitoring and evaluation. Bryan et al. (2016): Gender is poorly integrated into adaptation project design, with insufficient local gender-disaggregated data, tools and resources for gender-aware climate change adaptation. Lupao (2016): Critical sectoral environmental policies do not effectively address women's climate change adaptation and mitigation needs in Bungoma County in Western Kenya.
Gendered adaptation strategies	Livelihood decision-making often prioritises social over material goals. Climate change adaptive strategies interact with the mobilization of gendered identities in which men are construed as being primarily responsible for the material well-being of their households. Men are more likely to engage in capital intensive practices in relatively higher value commodities.	Bryan et al. (2013): Due to a lack of access to climate information, income, land, and financial resources, women are less likely than men to take action in response to climate shocks. Kalungu (2014): Reflecting gendered differences in access to financial resources, female farmers in drylands eastern Kenya preferred low-cost measures when dealing with the impacts of climate change and variability. Ochieng et al. (2014): A study of Makueni in semi-arid eastern Kenya showed that some 'principal' strategies could at least in part substitute for farming as a main source of income and counteract the need to sell off productive assets during drought, but are often dominated by men. Ngigi et al. (2017): Gendered differences in adaptation strategies are closely linked with husbands' and wives' roles and responsibilities, social norms, risk perceptions and access to resources.
Gendered forms of governing agricultural support (women's group-based approaches)	Group-based approaches are used as a key strategy for inclusion of women in adaptation and development projects across Africa, and can enhance the uptake of CSA practices.	Fischer and Qaim (2012): Women membership of banana farmer groups increases their control over outputs and incomes. Aberman et al. (2015): Group-based approaches can build resilience by facilitating asset development through group purchase of inputs, group loans, and capacity development. Ngigi et al. (2017): Group-based approaches can improve women's recognition within the household and authority in decision-making over land, as well as their access to productive resources and livelihood diversification. Eriksen et al. (2019): A case study in Uganda shows that when focusing on commercialization as a development model, group-based approaches to CSA can reinforce gendered adaptation strategies and household decision-making.

Resource Rights and Access

Social norms about women's roles and their domestic responsibilities can lead to gender inequalities in terms of their rights and access to different types of resources, often limiting women's adaptive capacity and resilience to climate change (Goh, 2012; Ongoro and Ogara, 2012; Coulter et al., 2019). Resource rights and access are a moment where livelihood discourses and gendered identities come into view in terms of how social norms shape the livelihood decision-making space and what is seen as socially acceptable ways of living in a particular place.

Our analysis of the literature shows that women in Kenya may have access to a narrower range of skills, information, labour and/or capital than men. This lack of access, compounded by unequal social relations, can lead to the exclusion of women from decision-making concerning access, control and management of resources (Lee et al., 2015; Ifejika Speranza and Bikketi, 2018). A study by Bikketi et al. (2016) based on a highland-lowland case-study of participants of Farmer Field Schools in Kakamega Central Sub-County (highland) and Mbeere South Sub-County (lowland) shows that patriarchy prevails, determining institutional design, access and control of resources and benefits. Thus, social norms in patriarchal societies may determine not only which physical assets women can own or control but also how they gain ownership of them (Aberman et al., 2015; Caretta, 2015; Bikketi et al., 2016). For example, the concept of "gender-species positionality" describes how gendered power relations shape men's and women's relationships to livestock resources and how these relations are deeply embedded in social hierarchies and structures (Tavenner and Crane, 2018). Based on a qualitative study undertaken in Tanzania and Kenya to examine women's access to and ownership of irrigation pumps, and the implications on their ability to make major decisions on crop choices and use of income from irrigated crops, gendered disparity in access to adaptive resources can be seen in the fact that less than 10% of the water pumps in Kenya are purchased by women (Njuki et al., 2014). Furthermore, participation in water management and governance is a privilege that is culturally endowed mostly to men, due to strict patriarchal norms that regulate control over water, which may cause women's exclusion from irrigation management (Njuki et al., 2014; Caretta, 2015; Ifejika Speranza and Bikketi, 2018). In a study interviewing 153 women living in three different watersheds in the Laikipia region of central Kenya about their views on water resource management and interest in participation in water resource user associations as members and leaders, Coulter et al. (2019) show that marginalization of women from water resource user associations participation is steeped in entrenched and normative beliefs and behaviors about women's roles and her domestic responsibilities. However, Kenyan national policy has institutionalized various measures to reduce gender inequality, such as the requirement that limits the representation of either men or women to two-thirds in any governance arrangement. While this policy has trickled down into local collective water governance institutions, a relevant domain for climate change adaptation, it has not yet been mainstreamed into climate change adaptation interventions, which continue to focus on household practices. In any case, while policies can create useful leverage points, they cannot quickly change socio-cultural beliefs and norms to support a more gender-equitable access and management of resources (Ifejika Speranza and Bikketi, 2018).

Studies also suggest that women may have less access than men to other common property resources, especially land (Harrington, 2010). Harrington's study indicates that the lack of access to land for women in Kenya's agricultural communities cannot be framed as a failing of either formal or informal systems, but as problems with both. Harrington (2010) demonstrates that the key to increasing access to justice and legal mechanisms for women to access land, at both the community formal and informal levels, is to address power dynamics and understand further how they operate to the detriment of women. Although some women may be aware of their legal rights to inherit and own land, they can be reluctant to claim land resources, due to social pressure to maintain the gender dynamics within households and their contingent, relational access to land and other livelihood resources (Po and Hickey, 2018). In this situation, land tenure may become a tool of coercion which ensures that men distribute future landholding in a manner compliant with social expectations. This tool of coercion helps to explain the persistence of CSA as a strategy which, while aimed at safety and stability, can simultaneously preserve existing gendered relations of power and privilege in a manner that is not only unequal, but limiting of the material returns on agricultural assets at the household level (Carr, 2019).

Women may be increasingly disadvantaged by the commercialization of agriculture because of persistent gender disparities in access to productive resources. For example, Fischer and Qaim (2012) used a survey data of small-scale banana producers in Kenya to investigate the gender implications of recently established farmer groups. They found that the groups can contribute to increasing male control over banana production. Furthermore, when new marketing or technological opportunities emerge, farm production is often centralized under men's control, which typically intensifies men's control over benefits from production. A study by Tavenner et al. (2019) exploring the gender impacts across different farming systems and gender-respondent-household typologies in 2,859 households in Kenya reveals that women have greater control over decisions related to consumption than decisions related to sales, although the gap between the two were less pronounced in less-valued livestock products. However, the analysis suggests that as sale of crops and livestock increase, female control over these areas could likely diminish, regardless of specific activity. This tendency can have negative implications for women's ability to generate income, as economic gains from commercialization are not shared equally within households (Fischer and Qaim, 2012; Tavenner et al., 2019).

One of the outcomes of these deeply-rooted gendered inequalities in resource entitlements, production and land use options is social differentiation: while serving resilience as a socio-ecological project, vulnerability to elevated climatic risks is simultaneously unevenly experienced across households (Clay and Zimmerer, 2020), as well as between household members

depending on their access to assets and decision-making (Quandt, 2019). In particular, despite allowing greater decision-making autonomy for women, female-headed households may display higher vulnerability to climate risks than male headed households. For example, female headed households in the West Pokot area of northern Kenya showed higher vulnerability levels and poorer adaptation strategies to the adverse effects of climate change on food security (63%) compared to male headed households (53%) (Muriithi et al., 2017). This social differentiation in climate vulnerability can be partially explained by women's lower capacity to adopt new agricultural technologies and CSA practices, due to unequal access to resources, including lowered income, lack of access to financial resources and information, and their decision-making authority over different household activities. As explained in the next section, their female roles and identities in the household are disproportionately related to domestic chores and less to commercial forms of production than men (Alinovi and Romano, 2010; Kristjanson et al., 2017). This pattern reflects how livelihoods, depending on specific social context, can fail at providing safety and stability for all in the context of climate change (Carr, 2019).

CSA interventions often promote market-oriented production as a precondition to incentives for CSA technology adoption, potentially contributing to gender inequality through the often false assumption that markets are gender neutral spaces (Tavenner and Crane, 2018). This critical issue of gender power imbalance has been framed by development interventions in economic efficiency and social justice perspectives, but few CSA interventions in the sector have addressed how underlying social-market mechanisms embedded in gendered ideology influence smallholder engagement in agriculture commercialization, as formal market participation are imbued with gendered meaning that creates legitimacy around men's privilege over agricultural, dairy and livestock proceeds (Tavenner and Crane, 2018).

Gender disparities over access and rights to resources in Kenya can illustrate how the power is exerted through agricultural change. The pattern of commercialization—a frequent factor associated with adoption of adaptation practices—leading to men's appropriation of higher value production clearly exemplifies the application of *tools of coercion*. It is particularly evident how inequalities and other dimensions of social stratifications are performed in everyday livelihood practices and discourses, where social, political and economic differences are the outcome of the exercise of power rather than indications of power held (Nightingale, 2017). The reproduction of authority relations is also evident in the ways that recognition of decision-making authority by different actors—including public and private external, governmental and non-governmental organizations involved in CSA interventions—perpetuate and reinforce inequalities over rights to resources within environmental change responses (Nightingale, 2017). As such, power relations and gendered social differences are central to explaining observed livelihoods decisions and outcomes, such as women's unequal access, control and management of resources (Carr, 2019). It also highlights that ignoring gendered identity constructs associated with recognition within political struggles risks disregarding the rights and needs of marginalized groups (Nightingale, 2017).

Household Level Decision-Making Authority

Household level decision-making represents a second moment where struggles over authority and recognition in relation to livelihoods and resilience come into view. Gender is a social dimension where the reproduction of uneven authority relations outcomes is particularly stark. In Baringo County, for example, several household roles are male dominated, such as land preparation (60%), livestock keeping/feeding (56%), pesticide application (70%) and fence construction (73%). Women play a dominant role in agricultural planting (59%), in water supply (56%), in domestic chores, including domestic reproductive work (77%), and in sales of agricultural produce (61%) (Ifejika Speranza, 2011; Ezenwa et al., 2018). These roles can reflect how agricultural change is nested in, and reproduces, gendered decision-making authority. The dominance by women in many agricultural activities and household activities is due to a recent shift in the labour of men. In many rural smallholder farming communities in Kenya, most of the agricultural activities are now carried out by women because men are increasingly involved in alternative sources of income such as livestock breeding, formal and informal businesses and employment in towns. While this shift reflects increased decision-making authority by women over some agricultural activities, in West Pokot County, for example (Karmebäck et al., 2015), it tends to widen rather than narrow gendered inequities. Since household chores and agricultural activities largely bind women to the home, they can lack necessary access to resources and information coming from outside the household, as well as involvment in decision-making regarding several of the new cash livelihood activities (Ezenwa et al., 2018).

These shifts illustrate how, in the context of agricultural change and the introduction of alternative livelihood activities such as through CSA projects, cultural identities can be mobilized to perpetuate gendered authority relations. Even if women have gained more influence in some economic and agricultural decision-making with changes in livelihood activities, they are still mostly excluded from male-dominated spheres such as the sale of cattle and the handling of larger amounts of financial resources. Hence, decision-making authority is most likely differentiated, retaining the stability of the system, but at the same time leading to socially differentiated vulnerability outcomes.

This tendency of preserving the resilience of the livelihood system and gendered authority relations therein, and simultaneously extending socially differentiated vulnerability, is illustrated by gendered decision-making authority over financial resources. According to a study exploring the relationships between access to different types of financial resources among male and female-headed households and women and men use of financial resources, and its relationship to food security, female-headed households are generally less likely to have access to financial resources and formal loans than male-headed households (Carranza and Niles, 2019). However, one study

examining the factors associated with adoption of a wide range of CSA practices by women and men in Nyando and Wote in Kenya shows that while women's access to credit may be positively associated with the adoption of CSA practices, the household's access to credit does not influence the uptake of CSA practices, and is most likely used for non-farm purposes (Bernier et al., 2015). Women's credit access can increase household and child food security, while men's access to credit has shown fewer effects on nutrition and food security for the family. This can be linked to the prescriptive gendered role of women within households—the mobilization of identities. Women tend to be more in control of food preparation in the house, including but not limited to tasks like collecting water, gathering wood and the physical cooking of the food. Furthermore, in many cases, women are required to hand over received loans to their husbands, or have little say in income spending, potentially eliminating positive benefits seen with women's access to financial capital. For example, 75% of women surveyed in Nyando mentioned being able to decide on how to use crops, however, only 50% of the women reported that they were able to then make decisions on how the income from those crops was spent (Bernier et al., 2015).

Patterns of activity and identity within households suggest that the sources of these different strategies, decision-making and outcomes are more than material. In wealthier and more secure households, women can have more freedom to choose their activities without attracting concern from men. This is most likely because (1) those activities and their material outcomes are not a threat to achieving subsistence, and (2) men leading those households and concessions are confident in their status and identity, because they know they are able to not only meet their subsistence responsibilities, but also generate a surplus beyond it in all but the most challenging situations. On the other hand, in more stressed and vulnerable households, there is less evidence of deviation from expected roles, responsibilities, and activities.

Women's decision-making power in adaptation is thus circumscribed not only by access to financial, material and information resources, but also by their degree of authority within household social relations. Masculine authority as heads of household and other social institutions appears to be non-negotiable. The range of women's decision-making authority can expand under these circumstances, but never to the point where it eclipses, or even matches, men's. Even in female-headed households, women's authority is bounded. Constrained access to material resources may limit the opportunities for innovation in these households, and in such a situation, all deviations from expectation could threaten both food/income and their status, and therefore must be controlled and eliminated to ensure that livelihoods remain resilient enough to achieve subsistence and legitimize their authority (Carr, 2019).

Knowledge Relations

Adaptation interventions may interfer directly into knowledge relations, by legitimizing particular types of existing practices and related knowledges, and recognizing project participants as "capable" adopters/holders of new adaptation knowledges. By assigning leadership, model farmer or expert roles to particular people, both among farmers and among local government and project staff, interventions may (re)produce or shift authority relations. Yet access, participation and roles assigned in interventions are often highly gendered. Interventions that seek to address gender inequities may also be met with resistance or attempts at "elite capture" of resources, including claims to knowledgable/capable/leadership roles in order to restore the stability of discourses of livelihoods and gendered identities. Our analysis identifies knowledge relations as a third moment where struggles over livelihood discourses and gendered identities, as well as the reproduction of gender relations, come into view.

A study by Mungai et al. (2017) conducted in western Kenya investigating how a gendered intersectionality lens can be used to explore how, and the extent to which, farming communities are coping with climate change, found that a large portion of farmers (85%) are willing to adopt climate-smart agriculture (CSA) interventions if constraining factors—including economic conditions, levels of education and the availability of information—are resolved. However, women are generally less aware than men of climate change as well as of climate-smart agriculture (CSA) practices, due to their lack of access to climate information from different sources, as they may be neglected by information and service providers (Kristjanson et al., 2017). For example, in Nyando, 80% of men and only 40% of women report having access to seasonal weather forecasts (Twyman et al., 2014). Also, a higher percentage of husbands than wives acquire climate information, adaptation ideas, and access to farm inputs through social groups they are involved in (Ngigi et al., 2017). Those with access to information report using it to make changes to their agricultural practices, such as switching varieties or the types of crops planted and changing the planting dates (Twyman et al., 2014; Bernier et al., 2015). However, providing information to one spouse (usually the husband), does not mean that the other spouse also learns about options and opportunities that meet their needs (Bernier et al., 2015). Importantly, while women are most likely less aware of CSA practices than men, if they know about the practice, women are equally likely to adopt most practices. Moreover, women's access to credit is generally positively associated with the adoption of CSA practices, although access to credit does not influence the uptake of CSA practices, and thus is likely being used for non-farm purposes (Bernier et al., 2015).

Because women generally have lower education levels, they are more likely to lack access to relevant information, and thus are more likely to have low adaptation to climate change through crop adjustment and the adoption of climate-smart agriculture practices (Mungai et al., 2017; Atsiaya et al., 2019). This demonstrates that education level, coupled with other socio-economic dimensions of marginalisation, may influence the level of vulnerability to climate variability and capacity to adapt (Omolo and Mafongoya, 2019). Smallholder farmers with higher levels of education are likely to have better awareness of changing climate and existing climate-smart agriculture practices, due to their access and understanding of information for effective climate variability adaptation, and thus, have a better level of planning (Mugi-Ngenga et al., 2016). For example, using the case of Laikipia West Sub-County in Kenya, Atsiaya et al. (2019) demonstrate that increasing levels of education and

exclusive dependence on agriculture increased the probability of introducing new breeds, while access to extension services increased use of terraces. Therefore, local institutions that facilitate the access to information are likely to initiate changes in key household characteristics, which positively affect response to effects of climate variability.

Degree of access to climate adaptation information is a function of multiple intersecting factors. On one hand, women's poor access to information can reflect structural disadvantages (i.e., lower education) associated with livelihood discourses that disincentivize investment in women's education, as well as women's relatively limited access to off-farm information networks. On the other hand, initiatives aimed at improving access to climate information services appear not to recognize women as an information market that requires different outreach strategies. The concept of authority here captures inequalities over access to information and to adoption of coping strategies within environmental change responses, as it shows that power relations influence who gains access to what information and knowledges, thus perpetuating gender inequalities and other dimensions of social stratifications on a daily basis (Nightingale, 2017).

Inclusion/Exclusion From Project Resources

The way that women are included or excluded from project resources represents a fourth moment where the way interventions can be nested in and may reproduce gendered identities, roles and authority relations come into view. Several studies document that gaps still exist in integrating gender into projects, both during the phases of project design (Bryan et al., 2016), and particularly during the monitoring and evaluation (M&E) phases (Aberman et al., 2015). A study by Bryan et al. (2016) examining the extent to which organizations involved in climate change and resilience and working in Kenya are incorporating gender-sensitive approaches into their programs, highlights that programs are often implemented with little analysis of gendered outcomes. This results in generic assessments that gendered outcomes would have improved, without any evidence to support the statements (Bryan et al., 2016). According to a study on the Kenya Agricultural Carbon Project—aiming to carbon sequestration through the adoption of sustainable agricultural land management practices in Western Kenya—women have, in practice, less access to join resource management projects than men, likely because they do not have the same level of influence in decision-making at a household level (Lee et al., 2015). Also, public and private external organizations that foster agriculture and livestock production projects tend to provide support primarily to men, and thus implicitly neglect women. Some external organizations ostensibly support women's groups, but their support to women is limited and generally mediated by the men of the village, as they are in most cases the interlocutors with the external organizations, and thus assume the role of gatekeepers for women (Perez et al., 2015).

The reproduction of gender inequities takes place not only as projects become enrolled in local power relations; marginalization processes along gender dimensions can be pervasive at all levels of resilience governance. Bryan et al. (2016) find that organizations generally have less access to local, context-specific gender-disaggregated data (particularly related to gender and climate change), tools and resources for gender-aware climate change adaptation approaches, and thus may be an obstacle to gender-sensitive climate change adaptation programming. In terms of knowledge integration, NGOs in particular experience a lack of information-sharing regarding local gendered specificities and contexts, between international NGOs, local NGOs and government entities. This poor knowledge integration limits NGOs ability to take an explicit gender perspective in implementation and better tailor their activities and interventions (Bryan et al., 2016). In a study of Makueni in semi-arid Eastern Kenya, Ochieng et al. (2014) observe that development agency interventions to strengthen the management of drought and adaptation to climate change predominantly focus on technical agricultural or environmental conservation measures. These measures are aimed at curbing natural resource harvesting practices and minimizing the use of local coping strategies, often considered environmentally and socially unsustainable. Development and adaptation interventions therefore often do not support, and in some cases may even undermine, the strategies and adaptive capacity of marginalized groups, in particular the diversity of marginal livelihood strategies on which women typically depend during drought, such as petty trade or artisanal production carried out close to home. At the same time, marginalized groups are often excluded from the more technical and agricultural production-oriented measures because they may lack cash, land, labour, or political influence. Both national and county governments have made some efforts to tackle the effects of climate change. However, based on a case study of women in eastern Kenya investigating gender resilience to climate change adaptation, Salome (2016) finds that neither of the levels of government has developed clear strategies to address gendered dimensions of climate change adaptation. A study in Bungoma County in Western Kenya similarly shows that critical sectoral environmental policies do not effectively address women's climate change adaptation needs, potentially due to the disengagement of governmental services (Lupao, 2016).

As demonstrated in the above paragraphs, women's limited access to adaptation project resources can emerge from a lack of recognition of them as a distinct user group with particular needs and positionality. This section represents how programmatic interventions institutionalize that presumption. A lack of recognition within adaptation programs thus becomes evidence of how certain people have been unable to claim authority or assert their rights as political and cultural citizens, issues which citizens complain about vehemently. The study on the Kenya Agricultural Carbon Project, for example, illustrates how adaptation programs are both simultaneously deeply embedded in the ability of nation-state and development actors to assert authority, and also potent symbols of whether citizens feel they belong to the nation or the community they live

in. Who gets involved and how they make programs fit their needs becomes clearer when programmatic objectives are understood to intersect with pre-existing identities, needs and relations (Nightingale, 2017). Put simply, such adaptation projects tend to emphasize stability, which reinforces existing power relations and the privileges they grant to those in positions of authority, especially when these projects and their attendant livelihoods successfully navigate shocks and stresses. This can be problematic, as these projects can reinforce prevailing gender inequalities, limiting opportunities for transformative change in the context of significant and rapid economic, environmental, and social change that will likely challenge existing resilience in the future (Carr, 2019).

The gender gaps in adaptation and CSA projects show that power and politics are threaded—whether implicitly or explicitly—through nearly all aspects of adaptation programs, including in their inception and design. Power is thus constitutive of adaptation interventions rather than an emergent externality that requires management during or after implementation. This also illustrates how projects which seek to empower certain actors produce realignments of power and knowledge that then shape who is invested and included in projects, and in what manners. Institutional and project designs fail to adequately regulate this dimension, meaning that authority in adaptation projects needs to be understood as a dynamic relation that is continually renewed and, most importantly, linked to processes of recognition (Nightingale, 2017).

Gendered Local Adaptation Strategies

The adoption of agricultural adaptation strategies can significantly differ across gender and other social differentiations within a community (Eriksen and Lind, 2009; Bryan et al., 2013; Kalungu, 2014; Mwenda et al., 2019). Prioritization of and access to adaptation options are closely linked with husbands' and wives' roles and responsibilities, livelihoods options, social norms, risk perceptions and access to resources (Kristjanson et al., 2015; Ngigi et al., 2017). This differentiation is a manifestation of cultural livelihood discourses.

For example, a household survey conducted in various agro-ecological and pastoralist zones in Kenya [i.e., Garissa (arid), Mbeere South (semi-arid), Njoro (semi-arid), Mukurweini (temperate), Othaya (temperate), Gem (humid), and Siaya (humid)] showed that farmers adopt a range of practices in response to perceived climate change. The most common responses included changing crop variety (33%), changing planting dates (20%), and changing crop type (18%). Other responses included planting trees (9%), decreasing the number of livestock (7%), diversifying, changing, or supplementing livestock feeds (7%), changing fertilizer application (7%), and soil and water conservation practices (5%). Also, among desired adaptation strategies, almost half of the farmers interviewed mentioned that they would like to invest in irrigation (49%) and agroforestry (39%). Statistical analysis show that more than 20 social and geographical variables, including the gender of the head of household, determine adaptation strategies at a household level (Bryan et al., 2013).

An intra-household survey involving 156 couples in the semi-arid and pastoral Baringo County (Marigat and Mogotio sub-Counties) which is located in Northern Kenya, reveals that a higher percentage of wives (82%) were found to adopt crop-related strategies compared to husbands (72%), whereas husbands employ improved livestock-related management practices such as changes in feeding practices, changes in species, migrations of livestock (Ezenwa et al., 2018), and reductions in number (Silvestri et al., 2012; Kristjanson et al., 2015), as well as agroforestry-related strategies. However, the study by Bryan et al. (2013) highlighted that women are particularly less likely to take action in response to shocks compared to men, as adaptation responses are largely dependent on the level of access to resources, including climate information, income, land, and financial resources. As illustrated above, women tend to have far less access to these resources. Climate information is highly important in adoption of adaptation strategies, as it influences the perception of change. For example, significantly more women than men said they just do not know what the impacts are likely to be (Kristjanson et al., 2015). Of those who have observed climate changes and know what the impacts are likely to be, more than half of women and more than three-quarters of men in Wote, Makueni County, a semi-arid region in Eastern Kenya, have reported adapting their agricultural practices in response to the longer-term changes that they have experienced. In the meantime, in Nyando, an upland region in Western Kenya that gets much more rainfall than Wote, fewer farmers reported adapting to climate change—more than half of men, but only one third of women reported making changes (Kristjanson et al., 2015).

Differences in needs, preferences, access to assets and resources, risk profiles and attitudes, access and sources to information, as well as labor requirements, which depend on cultural norms, can all influence the adoption of specific land-management practices, including CSA practices. Women in Nyando are more likely than men to adopt more efficient use of fertilizer, stress-tolerant varieties, no till and improved feed management practices. In Wote, women are less likely to adopt crop residue management practices, but are more likely to take pasture management actions. In Nyando, households where women have access to credit are more likely to adopt CSA practices—such as use of fertilizers and switch to drought-tolerant livestock breeds—but are less likely to adopt terracing. In Wote, women accessing credit is associated with CSA practices—such as uptake of water harvesting, irrigation and livestock manure management—but negatively associated with composting and terracing (Bernier et al., 2015). However, women are overall less likely than men to be aware of CSA practices, but just as likely as men, if not more so, to adopt such practices if they are aware of them (Twyman et al., 2014).

Reflecting gendered differences in access to financial resources, female farmers preferred low-cost measures when dealing with the impacts of climate change and variability, such as planting tree crops, use of manure and mixed farming, as well as use of soil and water conservation measures, according to a study conducted in the semi-arid regions of Machakos Sub-County and Makueni sub-County in Eastern Kenya, as

well as in the sub-humid regions of Limuru sub-county and Kikuyu sub-County in Central Kenya (Kalungu, 2014). However, more capital intensive practices—such as pest and disease control measures, use of improved crop varieties, and crop diversification—were the most common adaptation measures used by the male farmers. For example, the "Sustainable Intensification of Maize-Legume Farming Systems for Food Security in Eastern and Southern Africa (SIMLESA)" project, conducted in two districts from the Western region (Bungoma and Siaya) and three districts from the Eastern region (Embu, Meru and Imenti South), showed that female-headed households are 15% more likely to sell assets than their male-headed counterparts in order to adapt to crop pests (Tongruksawattana, 2014). This shows that adaptation strategies chosen to adapt to shocks and stresses might be influenced by gender relations, both in terms of what activities are defined as appropriate for whom, as well as (re)producing gendered roles, identities and authority relations.

Non-agricultural strategies, such as charcoal production, table banking (Kichamu et al., 2018), and rural to urban migration can be either short-term or long-term adaptive strategies for farmers in order to diversify their income sources in the face of climate change (Ifejika Speranza, 2011; Ogalleh et al., 2012). These strategies are central to the resilience of the local population, yet are highly socially differentiated and often gendered. Ochieng et al. (2014) found for the case of Makueni, Eastern Kenya, that some "principal" strategies could at least in part substitute for farming as a main source of income and counteract the need to sell off productive assets during drought. These strategies, such as charcoal production or employment, often involve engagement with outside markets and tend to be dominated by men. For instance, the limited options to earn an income in the rural areas can result in the migration of many (young) men to urban areas, temporarily or permanently, in search for alternative or complementary sources of income, by working as driver, night watchmen, factory or domestic workers (Ifejika Speranza, 2011). At the same time, many households and women in particular engage in a multitude of "complementary" strategies including the collection of wild foods, and the sale of sisal ropes, baskets, fruits, forest products and other smallscale produce targeting the local market. While women often tended to have more diversified strategies than men, the strategies brought only marginal and temporary incomes (Ochieng et al., 2014). The potential of collecting plant gums and resins for livelihood diversification and for contributing to sustainable adaptation to climate change in Kenya's drylands has also been investigated, particularly in the districts of Isiolo, Garissa, Wajir, Mandera, Moyale, Marsabit and Samburu where gums- and resins-producing tree species were abundant and the collection and marketing of gums and resins was well-defined, and it has been found that many (mainly female-headed) households currently collect and sell plant gums and resins as alternative to livestock production (Gachathi and Eriksen, 2011).

The case of illicit strategies, that is, socially unacceptable or formally illegal activities, illustrates particularly well the gendered nature of the relations between discourses of livelihoods, mobilization of identities, and tools of coercion. Illicit strategies such as brewing alcohol, engaging in prostitution or accessing forest products in protected areas, can be important survival mechanisms for some marginalized women (Mosberg and Eriksen, 2015). While social (and in practice, legal) norms regarding what are appropriate activities sometimes shift during drought, those dependent on these activities also carry the risk of social stigma and long term loss of social status. At the same time, the relatively wealthy and influential (mainly men) may be able to evade any sanctions from exploiting forest products, accessing prostitutes or buying illicit brew. Formal law and social codes are malleable yet effective tools of coercion that drive important adaptation strategies underground, at times reinforcing marginalization processes (Ochieng et al., 2014; Mosberg and Eriksen, 2015).

This section shows how climate change adaptive strategies interact with the mobilization of gendered identities in which men are construed as being primarily responsible for the material wellbeing of their households. Men are more likely to engage in capital intensive practices in relatively higher value commodities. Navigating the uncertain environment and economy of this context also ensures that men's income and contributions are significantly greater than those of their wives. Failure to meet the subsistence needs of the household in this specific manner produces challenges not only to men's identities as providers and respected members of the community, but also to the material wellbeing of the entire household (Carr, 2019). This shows that livelihood decision-making tends to prioritize social goals, especially the desire to retain their privileges, over material goals, such as the secure access to subsistence, providing structure to the panarchy of livelihoods that results in resilience which benefits particular activities and people more than others (Carr, 2019).

Gendered Forms of Governing Agricultural Support (Women's Group-Based Approach)

While climate change adaptation in agriculture is often technical in nature, innovations in social organization also constitute an important element of risk management and access to adaptation resources. Group-based approaches, including women's groups, have for decades formed an important way that local development efforts have been governed in Kenya, intended to address poverty and gender inequities (Ringler et al., 2014; Aberman et al., 2015; Ngigi et al., 2017). These approaches are not specific to Kenya, with CSA often governed through group type mechanisms also elsewhere in Africa (Eriksen et al., 2019). As such, group governance and processes represent an important moment when socio-political dynamics embedded within adaptation come into view (Caretta, 2014). Using a participatory rural appraisal approach, a series of qualitative studies conducted by Aberman et al. (2015) in four countries facing negative impacts of climate change, including Kenya, show that group-based approaches are recognized as a key strategy for adapting to climate change, mostly as a tool that can facilitate asset development through group purchase of inputs, group loans, and capacity development, and thus foster risk management capabilities in the context of climate change. Group-based approaches can be particularly crucial for women's recognition because even if women are in the poorest income segments, group membership is likely to have a positive effect on female-controlled income share (Fischer and Qaim, 2012). For

example, women members of a banana farmer groups in Kenya have a higher likelihood of retaining control over banana outputs and revenues, leading to a higher female-controlled share in total income (Fischer and Qaim, 2012). The group-based approach is a particular way that "inclusion" of women into development projects takes place.

Group-based micro-credit facilities can also enhance women's ability to build asset portfolios, besides enhancing their welfare through enabling them to pay school tuitions for their children and gain autonomy over their earnings. Additionally, women's groups often assist women to diversify their livelihoods, manage climate and non-climate risks, and gain access to productive resources. These group-based micro-credit facilities and women's groups can enable and increase the women's uptake on CSA practices, as CSA requires smallholder farmers to acquire new knowledge, change behaviors and invest significant quantities of time, labor and cash (Bernier et al., 2015). Furthermore, by enabling access to renting land, women's groups increase women's decision-making authority over the use of land. Apart from group-based food production, women's groups also collectively purchase food stock in bulk and sub-divide it among themselves. This kind of arrangement can have a far-reaching effect on women's adaptive capacity with respect to improving their position within their household (i.e., their recognition and inclusion in decision-making), their nutritional security, and their diversification of sources of income (Ngigi et al., 2017). Group-based approaches can benefit husbands and wives differently, and policy interventions that rely on group-based approaches should reflect this gender reality on the ground to amplify men's and women's specific abilities to manage risks and improve wellbeing outcomes in the face of accelerating climate change (Ringler et al., 2014; Ngigi et al., 2017). Yet, in Uganda, it was found that group-based approaches can also serve as a mean for state and development actors to govern farming livelihood decisions and promote particular development strategies, such as commercialisation, reinforcing asymmetric gender and expert-farmer relations (Eriksen et al., 2019).

Our findings show how group-based approaches to adaptation can be effective in improving women's recognition at a community level, as well as their access to and authority over productive resources, enhancing the space for livelihood decision-making that promote their resilience. Group approaches to adaptation do not necessarily pose overt or immediate challenges to prevalent livelihood discourses and cultural gender norms. However, while women's groups can push gendered boundaries, both in terms of social roles and appropriate livelihood activities, we expect that experiences will differ according to the degree to which they engage in traditionally masculine or feminine activities. In either case, women in groups are more likely to have their needs and rights fulfilled because groups-based approaches can provide an alternative source of access to resources. Associating in social groups can also offer alternative sources of livelihood and can act as a risk management tool through innovative systems to adapt to climate change, and thus increase resilience, safety and stability of those associating in such groups.

However, group-based approaches to adaptation are often focused on practical measures and may inadvertently reinforce development approaches and gendered division of labour, as men retain control over commercial type activities and incomes derived from them (Eriksen et al., 2019). Group-based approach and participation in social groups are more likely to represent a transformative capacity, if they involve governance mechanisms, policies/regulations, infrastructure, community networks, and formal and informal social protection mechanisms that constitute the enabling environment for systemic change. This capacity can be evaluated by metrics such as availability of/access to formal safety nets; availability of/access to communal natural resources; availability of/access to basic services; and the availability of/access to agricultural extension services. In this sense, resilience is linked to transformation when resilience provides "the enabling environment for systemic change" that can provide safety and stability to the widest number of people (Carr, 2019).

DISCUSSION AND CONCLUSIONS

Climate-smart agriculture faces multiple critiques relating to its tendency to focus on narrow technical measurements while ignoring the broader social, political and cultural dynamics that perpetuate uneven power relations and reinforce privileges. This includes, but is not limited to, reproduction of inequitable gendered relations that can produce vulnerability and further exacerbate social inequalities, even while succeeding by CSA's standard technical measures.

Using the combined analytical frameworks from Nightingale (2017) and Carr (2019) to identify gendered dimensions of authority, recognition, discourses of livelihoods, mobilization of identity and tools of coercion, our review highlights the variety of mechanisms through which climate change adaptation interacts with gendered cultural norms. This analysis thus suggests ways of responding to critiques (Arora-Jonsson, 2011; Karlsson et al., 2017; Eriksen et al., 2019) such that climate change adaptation interventions and strategies can better anticipate and engage with gendered power and knowledges, and contribute to adaptation pathways that are technically effective and socially equitable.

Our findings demonstrate how gender inequalities still persist today in Kenya over rights to resources and economic opportunities, with substantial implications for women's ability to adapt to climate change. Resource governance and rights struggles are about more than the resources themselves, as they are embedded in very specific socio-ecological contexts and power relations. Social norms relating to masculine power, persistent structural inequalities, and gendered gaps in development and adaptation projects contribute to many women's relatively low access to skills, information, labour, capital, and decision-making. For example, land tenure in the context of CSA projects is effectively used as a tool of coercion to ensure that men distribute future landholding in a manner compliant with existing dominant power relations and structures. Rather than reshaping gender relations, this explains the persistence of agricultural strategies that preserve existing gendered relations of power and privilege unequally by actually limiting the material returns on agricultural assets at the household level. Also, even if new marketing, or technological and innovative opportunities emerge through

CSA, farm production is often centralized under men's control, increasing gender disparities. The implication is that promoting "climate-smart" technical practices and development processes without attending how they structure and affect social relations—especially gender roles and norms—will generally serve to entrench gendered power disparities. This being said, CSA need not continue to depoliticize its technical interventions. Instead, the technical focus of the classic CSA framework can be broadened to account for and address social change as inherently intertwined with technical change.

Such shift in the governance of adaptation from technical change to social change is particularly important in light of the findings in the recent IPCC Report from Working Group II—that explicitly inserts social justice and development into climate action: "Climate resilient development is enabled when governments, civil society and the private sector make inclusive development choices that prioritise risk reduction, equity and justice, and when decision-making processes, finance and actions are integrated across governance levels, sectors and timeframes (*very high confidence*)." (IPCC, 2022). Specifically, the quality of interactions between multiple actors—such as degree of inclusion, knowledge diversity, social equity and justice, and ecosystem stewardship—determine whether societal choices and associated actions shift development towards or away from climate resilient development. The window of opportunity is rapidly narrowing for enabling development trajectories that support sustainability outcomes like wellbeing, poverty reduction, ecosystem health and low risk. Therefore, climate action—exemplified by CSA in this investigation—needs to urgently shift toward combining core technical measures with distributional equity and social justice objectives.

As such, CSA projects and other adaptation programs should start with the assumption that they are part of shaping gendered power relations and politics. Based on this premise, they can make deliberate choices about who is included in which roles and whose knowledge and authority are recognized in interventions. Adaptation programs produce realignments and/or entrenchment of existing and unequal power and knowledge. If the dynamics that produce vulnerability and marginalization are not addressed within project planning and implementation, CSA initiatives risk perpetuating women's marginalization relating to access over resources, knowledge sharing, and decision-making. However, the complexity of these issues may also explain why adaptation projects often do not address root causes of vulnerability among marginalized groups (Eriksen et al., 2021). Group-based approaches can, to some degree, support changes in gendered roles, responsibilities and activities because they represent a transformative capacity that can enable women to push gendered boundaries of authority, recognition and livelihood discourses outside of household spaces at the institutional and community levels. However, such groups inevitably operate within broader gender landscapes—and women generally return to household relationships—which can obstruct transformation of gender roles if they are seen as pushing boundaries too far or too hard.

Our findings underscore the numerous connections between agricultural climate change adaptation and gendered social institutions. We have focused on Kenya in the interest of making the topic more tractable, but we are confident that the overarching principles outlined here about the links between gender and climate adaptation interventions apply broadly, though specific aspects will vary. A better understanding of the social factors that lead to gender inequality over resources and adaptation strategies should help to better target the gendered needs for improved climate adaptation. As such, our findings also stress the importance of mainstreaming gender transformative approaches (e.g., Galiè and Kantor, 2016; Ampaire et al., 2020) into CSA initiatives to promote more equitable agricultural adaptation pathways. To advance gender transformative approaches, funders and implementers of CSA initiatives first need to acknowledge that successful climate change adaptation is often a process that transforms socio-political relations beyond just gender, meaning that gender should be embedded in broader pathways for social change that are based in social equity outcomes as well as adaptive technical changes.

AUTHOR CONTRIBUTIONS

AB: writing—original draft (main), writing—review and editing (main), conceptualization (supporting), methodology (main), and analysis (main). SE: writing—original draft (supporting), writing—review and editing (main), conceptualization (main), methodology (main), analysis (supporting), project administration (main), and funding acquisition (main). TC: writing—original draft (supporting), writing—review and editing (main), conceptualization (main), methodology (main), and analysis (supporting). All authors contributed to the article and approved the submitted version.

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APPENDIX

Annex 1 | List of databases.

Name of database	Online access
African Journals Online	https://www.ajol.info/index.php/ajol
Agris (FAO)	http://agris.fao.org/agris-search/index.do
Dart	http://www.dart-europe.eu/basic-search.php
Database on agricultural Research	https://cgspace.cgiar.org/
Eldis Data base	https://www.eldis.org/
Emerald Insight	https://www.emerald.com/insight/
Ethos	https://ethos.bl.uk/Home.do?new\protect$\relax=$1
Frontiers journal	https://www.frontiersin.org/
Google Scholar	https://scholar.google.com/
Oria	https://oria.no/
Proquest	Recherche simple—ProQuest
Science Direct	https://www.sciencedirect.com/
Scopus	Scopus preview—Scopus—Welcome to Scopus
Springer	https://www.springer.com/gp
Taylor and Francis Online	https://www.tandfonline.com/
Web of Science	Document search—Web of Science Core Collection