

# Women’s Climate Adaptation in Rural Sub-Saharan Africa: Constraints and Research Priorities

## **Abstract**

Sub-Saharan Africa is highly vulnerable to climate change, with rural women disproportionately affected due to pre-existing gender inequalities that both increase adaptation needs and constrain response capacities. This paper systematically reviews empirical evidence on constraints to women’s climate adaptation in Sub-Saharan Africa, identifies key knowledge gaps, and outlines a gender-informed research and policy agenda. Focusing on three adaptation strategies—on-farm adaptation, income diversification, and migration—alongside weather insurance and adaptive social protection programs as enabling instruments, the review synthesizes 206 studies identified through a PRISMA-based search, distinguishes correlational patterns from causal evidence, and classifies interventions by the strength of their empirical support. Across strategies, women face greater adaptation barriers than men, driven by limited access to finance and assets, insecure land tenure, restrictive gender norms, gaps in human and social capital, and constrained access to climate information. The strongest causal evidence supports interventions that improve women’s access to agricultural information and extension, strengthen land tenure, relax capital and time constraints, and address multiple constraints through economic inclusion and social protection programs. Evidence remains more limited for many other approaches, including socio-emotional skills training, digital climate services, gender-responsive insurance, and norm-changing interventions. Important gaps persist regarding women’s migration as a climate adaptation strategy. By assessing the strength of evidence across interventions, this review clarifies which gender-sensitive adaptation policies are supported by causal evidence and where important knowledge gaps remain.

*Keywords:* Gender, climate change, adaptation, agricultural practices, migration

*JEL codes:* Q54, J16, O13, D63, Q15

# Introduction

Sub-Saharan Africa is experiencing increasing climate variability, with extreme weather events and shifting agricultural seasons disrupting rural livelihoods (Nicholson, 2018; Panthou et al., 2018). Women, who make up around 40 percent of the agricultural labor force in the region, are particularly affected by these changes (Palacios-Lopez et al., 2017). Pre-existing gender inequalities heighten their vulnerability while restricting their ability to adopt adaptive strategies, exacerbating poverty and widening disparities (see Box 1). Despite this reality, rigorous evidence on effective interventions to support women’s climate adaptation remains limited, particularly in low-income contexts (Feriga et al., 2025). Market failures and resource constraints can prevent individuals from making adaptation investments that would otherwise improve their livelihoods, justifying policy intervention (Carleton et al., 2024). Yet designing effective policies requires understanding which constraints matter for women’s adaptation, and which interventions can successfully address them.

Few studies rigorously evaluate interventions explicitly designed for climate adaptation, and even fewer assess their gendered impacts. This paper synthesizes empirical evidence on gender-specific constraints in climate adaptation, classifying interventions by strength of causal evidence, and identifying policy-relevant research priorities. It examines three key adaptation strategies: on-farm adaptation, income diversification, and migration. Additionally, it assesses the role of weather insurance and adaptive social protection as enabling instruments which improve access to these strategies for vulnerable women. Given the immediate and severe effects of climate change in low-income countries, this paper focuses on adaptation strategies rather than mitigation (see Box 2).

The review highlights three key findings. First, women face greater barriers than men in adopting all climate adaptation strategies, both on-farm and off-farm. While much of the literature is correlational, emerging experimental evidence suggests these barriers explain persistently lower adoption rates by women across all adaptation strategies.

Second, this paper identifies gender-specific constraints to climate adaptation that go be-

yond those faced by men. For on-farm adaptation, women’s constraints include land tenure insecurity, limited access to climate information and formal agricultural networks, and higher risk aversion due to economic vulnerability and structural factors. Household responsibilities further constrain their engagement in off-farm activities, reducing opportunities for income diversification and migration in response to climate shocks. These challenges are exacerbated by low expected returns, limited resources, and restricted bargaining power. Limited information contributes to women’s low uptake of weather insurance, compounded by their greater idiosyncratic risks such as health shocks linked to fertility and childcare, and their role as ‘shock absorbers’, which lead them to prioritize emergency savings. The effectiveness of adaptive social protection in supporting women’s climate resilience depends on how well programs address gendered constraints, including mobility restrictions, bargaining power imbalances, and domestic responsibilities. These constraints are multi-dimensional and intersecting, and may require interventions that address multiple barriers simultaneously rather than single constraints. Although constraints vary across household structures and regional contexts, we find in this evidence review that the evidence base is currently too thin to draw stylized facts that can robustly account for these variations. We propose some broad conclusions that will require more empirical work to fully represent the intersectional nature of the constraints that women face.

Third, we classify interventions promoting women’s adoption of strategies by the strength of the causal evidence in support of their effectiveness within a comprehensive evidence map. Interventions are categorized as credible (established causal evidence), emerging (limited causal evidence), or frontier (conceptually promising but empirically underexplored). Interventions with credible causal evidence of effectiveness include targeted delivery of information on climate-adaptive agricultural practices and technologies, formalized land tenure programs, cash transfers and public works, multi-faceted adaptive social protection programs, and childcare services. Socio-emotional skills training and joint spouse training are emerging as effective interventions but require further experimental research. Some interventions

are conceptually promising but remain empirically underexplored, such as digital climate information services, gender-responsive weather insurance, and norm-changing approaches. This evidence map identifies critical gaps between policy needs and rigorous evaluation, highlighting priority areas for future research.

Significant knowledge gaps remain for a comprehensive understanding of gender dynamics in climate change adaptation. The causal effects of climate information on women’s risk-taking behavior and adaptation decisions are still under-examined. Further research is also needed on how time constraints, household structure and intra-household dynamics influence women’s participation in off-farm employment, and on the role of gender norms and land tenure insecurity in shaping women’s migration decisions. Additionally, little is known about the adaptive capacity of women left behind when men migrate. Household-level agricultural data often obscure intra-household inequalities, limiting our understanding of the extent to which women are constrained in their adoption of climate-adaptive technologies on the plots they manage.<sup>1</sup>

This paper contributes to the literature by synthesizing the available evidence on gendered constraints to climate adaptation in Sub-Saharan Africa and proposing a research agenda for the field. Existing systematic reviews cover a single adaptation strategy, such as on-farm adaptation (Gupta et al., 2026) or adaptive social protection (Hidrobo et al., 2026), are global in scope (Ningombam et al., 2026) or focus on a single country (e.g., Zenda and Rudolph, 2024). In this paper, we extend the current literature on women’s adaptive choices and capacity in four main ways: i) we bring together in a single study the main adaptation strategies available to rural households, both on- and off-farm, along with the enabling instruments that support them, ii) we focus on Sub-Saharan Africa and systematically distinguish descriptive, quasi-experimental, and experimental evidence, allowing us to assess the strength of the causal evidence behind each constraint and intervention, iii) we map policy options into those proven effective, those requiring further research, and those at the knowledge frontier, iv) we compile the main knowledge gaps and propose a research

agenda for the field of development economics.

The remainder of the paper is organized as follows. We present our conceptual framework and literature review strategy in Section 1. We review the evidence on gender gaps in the adoption of three adaptive strategies: on-farm adaptation (Section 2), income diversification (Section 3) and migration (Section 4). We highlight the key challenges that must be overcome for weather insurance (Section 5) and adaptive social protection (Section 6) to be effective enabling instruments. For each strategy and instrument, we assess the evidence on gender disparities in adoption and constraints faced by women, and highlight causal studies when they are available, as well as interventions that shed light on gender-specific barriers. We present in Section 7 an evidence map reviewing experimental evidence on interventions seeking to address the key constraints previously identified for each adaptation strategy. We outline priority research questions in Section 8 before concluding.

### Box 1. Gender gaps in vulnerability to climate change

Climate change disproportionately affects women, exacerbating pre-existing gender inequalities in health, safety, livelihoods, and agricultural productivity. In Sub-Saharan Africa, women contribute significantly to agricultural labor yet face lower productivity due to limited access to inputs, land, and market opportunities (Kilic et al., 2015; Aguilar et al., 2015; Alik-Lagrange et al., 2025). Women smallholder farmers experience substantially larger productivity losses from extreme heat than men (Wu et al., 2026), experience higher food insecurity following climate shocks (Kakota et al., 2011; Zakari et al., 2014; Hübler et al., 2025) and increased maternal and infant health risks from rising temperatures (Grace et al., 2015; Abiona, 2023).<sup>2</sup>

Climate shocks also heighten gender-based violence risks (Brown, 2008). Droughts and floods increase intimate partner violence (Cools et al., 2020; Abiona and Koppensteiner, 2016), sexual exploitation (UNHCR, 2022), and feminicide (Miguel, 2005). Droughts can also increase transactional sex as a coping strategy among young unmarried women and raise HIV prevalence (Treibich et al., 2022). Drought-induced income shocks raise child marriage rates (Corno et al., 2020; Hotte and Marazyan, 2020; Andriano and Behrman, 2020), increasing fertility and adverse health outcomes and undermining women’s education, labor force participation and agency.

Economically, climate shocks increase women’s unpaid domestic and care work and restrict their education and labor market participation (Kakota et al., 2011; Moshoeshoe et al., 2021). Women’s responsibilities, such as fetching water, expand in response to climate stressors (Kamei, 2022) and they are more likely than men to exit employment and struggle to re-enter the workforce post-shock (Erman et al., 2021). Female-headed household income is more vulnerable to rainfall shocks than male-headed households, even after accounting for income differences (Flatø et al., 2017).

Furthermore, girls are more likely than boys to be withdrawn from school to contribute to domestic duties, exacerbating gender disparities in education (Björkman-Nyqvist, 2013; Babugura, 2008).

## 1 Methods

### 1.1 Conceptual framework

#### Scope of the review

Responses to climate change operate at two levels. Mitigation addresses the causes, reducing greenhouse gas emissions to slow global warming. Adaptation addresses the consequences, and is defined as “adjustment in natural or human systems in response to actual or expected

### **Box 2. Why focus on climate adaptation (rather than mitigation)?**

Climate change and poverty are deeply interconnected, as climate shocks threaten to push millions into extreme poverty, particularly in Sub-Saharan Africa, where agriculture remains highly climate-sensitive (Rozenberg and Hallegatte, 2015). Despite contributing minimally to global CO<sub>2</sub> emissions (IPCC, 2022), the region faces disproportionate vulnerability due to its reliance on rain-fed agriculture, limited economic diversification, and constrained adaptive capacity.

While global mitigation efforts are critical for limiting long-term climate change, adaptation is the more immediate and pressing priority for low-income countries that already experience severe climate shocks. Unlike mitigation, which focuses on reducing emissions, adaptation directly enhances resilience by enabling households and communities to adjust to climate change’s inevitable consequences. Strengthening adaptive capacity is particularly urgent for women who are disproportionately affected by climate shocks, not only as a matter of equity but also as a necessary condition for both poverty reduction and sustainable development in climate-vulnerable regions.<sup>3</sup>

climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC, 2007). This paper focuses on adaptation which is where rural households in Sub-Saharan Africa bear the most immediate costs. Broader macro policies, such as green jobs and sustainability initiatives, are excluded, as are responses of downstream consumers of agricultural products.

More specifically, we focus on rural Sub-Saharan Africa, where agriculture, which is highly vulnerable to climate variability, remains the main source of livelihoods (World Bank, 2019). This regional focus also allows us to examine gender differences in constraints to adaptation in a relatively coherent set of institutional and agricultural contexts. Climate change affects these households through both gradual changes such as rising temperatures and more erratic rainfall patterns, and more frequent climate shocks, including droughts and floods (Auffhammer et al., 2013). Even accounting for farmers’ adjustments, climate change is projected to impose substantial losses on staple crop production globally, with some of the largest damages in Sub-Saharan Africa (Hultgren et al., 2025). These changes require households to adjust how they produce, earn income, and manage risk.<sup>4</sup>

Adaptive responses can be placed along a continuum according to both their timing

and their purpose (Auffhammer, 2018; Rao et al., 2020; Call et al., 2019). At one end are *coping* strategies, which provide immediate responses to realized shocks. One example is forced migration due to an extreme flood that led to a destruction of housing and capital or last resort sale of livestock. In the middle are *risk-management* strategies, which reduce households’ exposure to future climatic risks and help them absorb shocks when they occur. Managing water use over time to cope with increasingly irregular rainfall is an example of a medium-term strategy: irrigation is a widespread adaptation strategy to drying conditions but it can also strain aquifers and increase soil salinity in the long run (Taylor, 2026). At the other end are *long-term adjustment* strategies, which help households adapt to changing climatic trends and reduce their vulnerability over time. These include sustainable agricultural practice switching or long-term, planned, migration to optimize one’s income. These categories overlap as an intervention may serve different purposes depending on the context, the timing of adoption, and the objectives of the households.

## Household strategies and enabling instruments

We focus on three strategies representing the main ways rural households respond to climate change in Sub-Saharan Africa, and two enabling instruments, which facilitate the adoption of adaptation strategies. The strategies are on-farm adaptation, income diversification and migration, the latter two being off-farm. These strategies encompass the main choices households make when climate risks increase: changing agricultural techniques and practices, diversifying sources of income, or shifting labor to other activities or locations. While classifications of strategies vary, these are commonly cited in the literature (Rao et al., 2020; Call et al., 2019; Rahut et al., 2021; Sani and Chalhisa, 2016). We chose to organize the paper along those three adaptation strategies to best structure the evidence around binding constraints to their adoption.

*On-farm adaptation* strategies are long-term changes in farming technologies and practices that make agricultural production more resilient to climate change and reduce farmers’

vulnerability to climate variability and change. It overlaps with the concept of Climate-Smart Agriculture (CSA) which was originally defined by the FAO around three pillars: sustainably increasing productivity, strengthening resilience and adaptation, and, where possible, reducing greenhouse gas emissions (Food and Organization, 2010). CSA is the most commonly used terminology in the empirical literature on agricultural adaptation in Sub-Saharan Africa reviewed in this paper but we adopt a broader approach and use the term on-farm adaptation which is inclusive of CSA and other frameworks such as agroecology or conservation agriculture.<sup>5</sup>

*Income diversification* lies between risk management and long-term adjustment. Diversifying income sources reduces dependence on climate-sensitive agriculture over time while also providing a buffer against the loss of agricultural income.

*Migration* is present on the whole continuum. Temporary and seasonal migration following climatic shocks often represents a coping response, while planned migration that permanently diversifies household livelihoods is closer to an adaptation strategy. Many forms of migration fall somewhere in between, serving both risk-management and long-term adjustment objectives. Migration can also be conceptualized as a form of income diversification, but the set of constraints affecting migratory choices is sufficiently distinct to warrant separate considerations.

These strategies are closely intertwined. Income diversification can relax liquidity constraints and in turn enable migration or agricultural investments. Migration may reduce dependence on agriculture while simultaneously allowing to invest more in new technologies or practices on the farm.

Two enabling instruments are also included in this review: weather insurance and adaptive social protection. Both of these instruments, one private, market-based, and the other offered through public policy, support households in adopting adaptation strategies.

*Weather insurance* is both a risk-management tool and a private market-based enabling instrument that enables adaptation. By protecting households against climatic shocks it

facilitates longer-term adaptation. For example, it can encourage farmers to adopt climate-adaptive technologies by reducing production risk (Mobarak and Rosenzweig, 2012; Karlan et al., 2014). It can also reduce the need for migrating following a shock by mitigating its negative effects on production.

*Adaptive social protection* also helps households adapt to climate change (Rao et al., 2020). It relies on public policy rather than individual household decisions. Cash transfers, public works programmes and economic inclusion programmes can relax financial constraints, reduce risk, help build productive assets and strengthen human capital, allowing households to invest in other adaptation strategies that may otherwise not be accessible to them. It is therefore an enabling policy instrument that can facilitate other forms of adaptation. We thus incorporate adaptive social protection in our review, focusing on the extent to which programme design helps women overcome the constraints that limit their adoption of other adaptation strategies.

Adoption is an essential pathway to household resilience and welfare: it helps stabilize incomes, smooth consumption, and protect food security when climatic shocks materialize (e.g., Okumu et al., 2025; Pan et al., 2018; Wegenast et al., 2026). Our review focuses on the constraints that limit women’s adoption, the necessary first step along this pathway.

For each strategy, we review the evidence on how adoption is challenged by constraints. The constraints were selected based on theory and scholarship, and are organized into three main groups: i) human, social, and financial capital, which covers resources and capacities, including skills, information, networks, finance and assets, ii) contextual factors, norms and institutions, including gender norms and intra-household dynamics, and iii) strategy-specific constraints, such as risk aversion for on-farm adaptation or basis and uninsured risk for insurance.

Figure A1 in Appendix A.1 summarizes this conceptual framework and the structure of the review: gender-specific constraints operate through women’s adaptive capacity to shape both the adoption of the three household strategies and access to the two enabling

instruments, which ultimately build household resilience and welfare.

## **Our gender lens**

This review asks whether women face different constraints than men in adopting climate adaptation strategies, and if so, what strategies and policies are effective at addressing them. Women are not assumed to be inherently more vulnerable than men, or to respond to climate change in fundamentally different ways. Women’s agency and role in agricultural food production is central (Malapit et al., 2020); they are adapting to climate change in many ways, and are neither victims nor heroes of the climate adaptation challenge of the times (Rao et al., 2020). Rather, we examine whether structural inequalities such as limited access to education and capital or legal and normative barriers affect women’s ability to adopt adaptation strategies.

Two additional points are worth noting. First, women are not a homogeneous group. The constraints they face vary with age, marital status, education, wealth, household composition and local social norms (Rao et al., 2020; Yimam and Holvoet, 2024). Although relatively few studies explicitly take an intersectional approach, we highlight these differences whenever the evidence allows. Second, the literature does not always approach gender in the same way. Some studies, mostly older, descriptive, work compare female- and male-headed households, while most recent studies, especially experimental, approach gender by taking individual women and men (sometimes within the same household) as the unit of analysis. Constraints to resource access and decision-making responsibilities may differ substantially between those two approaches, which may capture different mechanisms. Unless explicitly mentioned, the studies cited take individual women and men as the unit of analysis.

## **1.2 PRISMA**

This review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. The complete PRISMA flow diagram is reported in Appendix A.2

(Figure A2). The review synthesizes descriptive and causal evidence on gender differences in climate change adaptation, distinguishing between descriptive studies documenting gender gaps and studies providing causal evidence, further differentiating quasi-experimental and experimental designs.

*Search strategy* - We systematically searched the Web of Science and Scopus databases using the same Boolean search string, adapted to each database’s syntax, which combines three blocks of terms. The first block captures gender (e.g., *gender\**, *wom?n*, *female\**, *widow\**, *intra-household*, “bargaining power”); the second captures agriculture and the Sub-Saharan African context (e.g., *agricultur\**, *farm\**, *rural*, *smallholder\**, *pastoral\**, “sub-saharan”, *africa\**, together with the names of individual Sub-Saharan African countries and *sahel\**); the third captures climate change and adaptation, either directly (e.g., “climate change”, “climate variability”, *adaptat\**, *drought\**, “climate shock\*”, “climate information”) or through the adaptation strategies and enabling instruments reviewed in this paper (e.g., “weather insurance”, “index insurance”, “cash transfer\*”, “social protection”, “land tenure”, “technology adoption”, “livelihood diversif\*”, “savings group\*”, *microfinance*). A record had to match at least one term in each of the three blocks to be retrieved. The complete queries for both databases are reported in Appendix A.2. After removing duplicates, the search yielded 23,401 unique records.

*Screening process* - Title and abstract screening was performed using ASReview LAB, an active-learning systematic review tool that iteratively prioritizes the records most likely to be relevant based on reviewer feedback. Records were classified as either relevant or not relevant. Following current recommendations for active-learning screening, screening was stopped after 150 consecutively screened non-relevant records, indicating a negligible probability of identifying additional relevant studies. A total of 1,125 records were screened, of which 276 were classified as relevant and 849 as not relevant, while 22,276 records remained unscreened.

*Eligibility criteria* - Studies classified as relevant were subsequently assessed manually.

Eligible studies were required to focus on (i) gender, (ii) climate change, climate variability, or adaptation, (iii) Sub-Saharan Africa, and to have (iv) sufficiently credible empirical evidence. This process resulted in 76 eligible studies identified through the database search.

*Citation searching* - We complemented the database search through iterative backward and forward citation tracking (snowballing), starting from the studies deemed eligible after the manual assessment. Citation searching was conducted over four iterative rounds until no additional relevant studies were identified. Studies identified through citation searching were screened using the same AI-assisted procedure and subsequently reviewed manually. This process yielded 80 additional eligible studies. Finally, we supplemented the review with 50 additional studies identified through complementary search strategies, including gray literature, unpublished manuscripts, and studies outside the predefined search scope that provided relevant information on mechanisms or comparative evidence. Overall, the final review includes 206 studies. Table A1 summarizes the composition of the evidence reviewed in Sections 2 to 7, by adaptation strategy and study methods.

## 2 On-farm adaptation

On-farm adaptation is critical for reducing food insecurity among smallholder farmers facing unpredictable climate patterns. However, changing agricultural technologies and practices to adapt to climate change can be risky, and the potential consumption risks of failure can deter farmers from adoption. A study in Ethiopia shows that these high risks can perpetuate poverty by trapping farmers in a low technology, low risk cycle (Dercon and Christiaensen, 2011). In Malawi, climate-induced poverty traps confine poorer households to low-value maize cultivation, preventing adoption of improved inputs (Sesmero et al., 2018). Barriers to on-farm adaptation include resource constraints, small farm sizes, limited access to credit, markets and knowledge, as well as land tenure insecurity (Descheemaeker et al., 2016; Mersha and Duguma, 2019; Huyer et al., 2024). We begin by documenting the extent

of gender disparities in the adoption of on-farm adaptation before examining the constraints that produce these gaps.

## **Gender disparities in adoption rates**

Cross-sectional evidence from Sub-Saharan Africa documents persistent gender gaps in on-farm adaptation, with men consistently adopting at higher rates than women. These disparities arise both within households (between women and men farmers managing separate plots) and between households, with male-headed households more likely to invest in modern technologies. A comprehensive review confirms that women lag behind men in adopting high-yielding varieties and agricultural technologies (Doss, 2001), with high variability across contexts. Some descriptive research reports higher adoption rates of water conservation and crop diversification among female-headed households in South Africa, Zambia and Zimbabwe (Nhemachena and Hassan, 2007) and greater intercropping among households with more female members (Benin et al., 2005). However, many studies from Uganda, Ghana, Nigeria, Burundi, Malawi, or Ethiopia, show higher adoption of irrigation, modern inputs, soil conservation, improved crop varieties, or tree planting among male-headed households and men plot managers (Nabikolo et al., 2012; Adzawla et al., 2019; Arimi and Olajide, 2016; Nchanji et al., 2023; Magreta et al., 2026; Deressa et al., 2009; Gebrehiwot and Veen, 2013; Rufe et al., 2026; Tufa et al., 2022). Multi-country panel evidence from Kenya, Uganda, and Senegal shows that men adopt higher-return modern technologies (e.g., chemical fertilizers, improved varieties, drought-tolerant livestock) while women favor low-risk traditional practices like water harvesting and cover cropping (Hailemariam et al., 2024). The literature suggests that binding resource and information constraints limit women’s adoption of new technologies and practices to adapt to climate change, and that when these barriers are removed, women may be equally or more likely than men to adopt them (Huyer et al., 2024). These patterns appear to reflect structural barriers rather than differences in inherent preference, a point we return to in the discussion of risk aversion below. In addition, a study from

Kenya finds that the welfare returns to adoption of CSA may be higher for female-headed households, confirming the high potential of removing these barriers (Okumu et al., 2025).<sup>6</sup> The next section examines these constraints in detail.

### **Box 3. Gendered crop specialization**

Across Africa, agricultural labor is gendered, with men primarily cultivating cash and export crops while women grow subsistence crops (Croppenstedt et al., 2013). Women’s focus on lower-risk, lower-return crops supports household food security during climate shocks (Duflo, 2003; Lovo and Veronesi, 2019) but limits their market access, reinforcing poverty traps and constraining investments in adaptation strategies. In Uganda, Agamile et al. (2021) find that drought-induced labor shifts alter household crop allocation. As men seek off-farm work, women increase farm labor and reallocate land from subsistence to cash crops. However, restrictive gender norms continue to limit women’s engagement in income-generating agriculture, constraining long-term adaptation despite their potential preference for commercial crops.

## **Women’s constraints to on-farm adaptation**

### **Information on climate change and weather forecasts**

Limited access to information is a major barrier to women’s on-farm adaptation (Quisumbing and Pandolfelli, 2010). Reliable climate information can correct misperceptions (Box 4), update beliefs, and reduce uncertainty surrounding agricultural investments (Burlig et al., 2024), with experimental evidence from Benin showing that weather information provision causally improves agricultural outcomes (Yegbemey et al., 2023). However, systematic reviews note that rigorous causal evidence on Climate Information Services (CIS) impacts remains scarce (McKune et al., 2018).

Women face additional barriers to CIS, which provide timely weather updates, especially in rainfed agricultural systems (Roudier et al., 2014; Tall et al., 2018; Autio et al., 2021; Fikadu et al., 2024). In Kenya, intra-household survey data show gender gaps in access to climate information services: men more often receive early warning and advisory services

associated with greater on-farm adaptation, while women primarily access basic forecasts with no significant impact, resulting in unequal access to actionable information (Ngigi and Muange, 2022).<sup>7</sup> Gender gaps in digital access, costs, information interpretability, and trust further constrain women’s effective use of CIS (Partey et al., 2020; Henriksson et al., 2021; Antwi-Agyei et al., 2021). Household power dynamics also mediate impacts of CIS access: experimental evidence from Zambia shows that providing forecasts to both spouses shifts joint investment decisions toward greater preference alignment between spouses (Kramer et al., 2023a).

Overall, women’s limited adoption of climate-smart agriculture and other climate-resilient technologies and practices reflects constraints to accessing information, as well as compounding constraints that limit their acting upon received information, including digital exclusion, climate misperceptions, and intrahousehold decision-making. Yet little is known about interventions that effectively expand women’s access to CIS or enable action on received information.

#### **Box 4. Climate change perception and adaptation**

Climate change perception is often assumed to facilitate adaptation, as farmers who recognize climate risks may be more likely to seek information and adopt adaptive practices, though causal evidence for this mechanism remains limited. Observational studies document associations between education, farming experience, climate perception, and adaptation behavior (Maddison, 2007; Ishaya and Abaje, 2008; Tambo, 2013), though these correlations do not establish causality. Cross-sectional evidence from Ghana and Kenya suggests links between climate risk perception and use of climate information services (Partey et al., 2020; Ngigi and Muange, 2022). Few studies examine gender differences. In Senegal, qualitative evidence suggests that limited risk perception may contribute to low uptake of climate information among both women and men (Diouf et al., 2019). However, rigorous causal evidence on whether climate perception influences information-seeking behavior and adaptation—and whether these relationships differ by gender—is lacking.

## Information on agricultural technologies

Unequal access to information on agricultural technologies is a major barrier to women’s on-farm adaptation, particularly for costly innovations. While many studies examine the impact of information interventions on agricultural technology adoption (Hanna et al., 2014; Emerick and Dar, 2020; Glennerster and Suri, 2018; Barrett et al., 2022), few assess gender-specific effects. Experimental evidence from Niger shows that information is a more binding constraint than liquidity or credit (Aker and Jack, 2023): training on *demi-lunes*, a land restoration technique, significantly increased adoption; although women adopted at lower rates than men, they still achieved substantial gains despite land ownership and financial constraints. An experiment in Uganda confirms that providing women farmers with extension services and agricultural inputs significantly increases the adoption of a new biofortified crop, effects not replicated by credit or insurance alone (Buehren et al., 2025).

Agricultural extension and advisory services represent a critical mechanism for delivering climate-adaptive technologies to farmers, and therefore play a central role in women’s on-farm adaptation (Gupta et al., 2026).<sup>8</sup> Panel data across four sub-Saharan African countries show that women’s participation as extension recipients and farm co-managers substantially increases agricultural income and resilience to weather shocks (Azzarri and Nico, 2022). However, mobility constraints, time poverty, and gender biases in service delivery limit women’s access, with cross-sectional evidence documenting disproportionate support to men farmers by both public and private organizations across nine East and West African countries (Perez et al., 2015; Ifeanyi-obi and Tolumoyi, 2025). Regression discontinuity evidence from a large-scale extension program targeting women farmers in Uganda demonstrates that these information constraints have real consequences for women’s adoption of improved agricultural practices and adaptive capacity: women offered access to extension services adopted improved cultivation methods, achieved better food security, and modified their shock-coping strategies, with gains operating primarily through improved access to information and training (Pan et al., 2018).

Studies also highlight the importance of intra-household dynamics in benefiting from information: training both spouses together can enhance women’s participation and farm outcomes in some contexts, such as milk production in Mozambique (Johnson et al., 2015) and rubber farming in Côte d’Ivoire (Donald et al., 2022), while in others women benefit more when trained without their husbands (Lecoutere et al., 2023). However, an RCT in Ethiopia suggests that improving women’s access to information alone may not be sufficient to increase technology adoption in the presence of intra-household bargaining constraints. While jointly targeting both spouses through video-mediated extension significantly increased women’s access to extension services and technical knowledge, it generated no additional gains in household technology adoption relative to targeting the household head alone (Abate et al., 2023). While more work is needed on the interaction of intra-household dynamics, access to information, and on-farm adaptation, the evidence strongly supports lack of information on new adaptive technologies and practices as a constraint to women’s adoption.

## **Social networks**

Social networks play a critical role in the diffusion of agricultural technologies. Causal evidence demonstrates that social networks facilitate the diffusion of information and foster social learning, as farmers observe and learn from peers about the effectiveness and profitability of agricultural practices (Conley and Udry, 2010; Krishnan and Patnam, 2014; Emerick and Dar, 2020). Despite the established importance of social networks for technology diffusion, descriptive studies suggest that women face systematic barriers to accessing these networks. Cross-sectional evidence documents gender gaps in group membership and formal network participation across Sub-Saharan Africa, with men more likely to join agricultural cooperatives and hold leadership positions (World Bank, 2010; Katungi et al., 2008; Meinzen-Dick et al., 2014). These disparities in network access may limit women’s ability to obtain reliable climate information (Gumucio et al., 2020) and learn about climate-adaptive practices from peers. Existing evidence is largely descriptive and focuses primarily on women’s access to

climate information and CIS through these networks (Gumucio et al., 2020; Sprout, 2022).

Beyond network access, descriptive studies suggest that the quality of women’s participation—including the presence of other women in groups and supportive group dynamics—may influence their on-farm adaptation (Gotschi et al., 2008; Dikito-Wachtmeister, 2001). One RCT in Kenya demonstrates that women’s attendance at community meetings increases when organizations actively emphasize their participation and schedule meetings at convenient times (Leino, 2007), but this does not translate into downstream positive impacts on water source maintenance. There remains limited causal evidence on how to increase women’s participation in formal agricultural networks and on whether gender inequalities in access to agricultural social networks, both formal (e.g., cooperatives and water user associations) and informal farmer-to-farmer networks, constrain women’s on-farm adaptation in Sub-Saharan Africa.

## **Education**

Education is hypothesized to enhance farmers’ adaptive capacity by improving their ability to interpret climate data, assess risks, and implement appropriate strategies (Striessnig et al., 2013; Cinner et al., 2018). Both formal education and traditional ecological knowledge contribute to these capacities: formal education may enhance the timing of technology adoption (Weir and Knight, 2004), while traditional knowledge provides place-based understanding of ecological systems and adaptive practices (Aswani et al., 2018; McCarter, 2011).

Women in Sub-Saharan Africa generally have lower educational attainment than men (Shapiro, 2012; Shapiro and Tenikue, 2017), which may constrain their adaptive capacity, though rigorous causal evidence testing this mechanism is lacking. Descriptive evidence from Kenya suggests that formal education may influence how pastoral women assess climate risks. In a participatory simulation activity, women with formal education exhibited more risk-averse behavior when making livestock decisions during simulated drought conditions compared to women without formal education (Walker et al., 2022). However, this

observational study cannot establish whether education causally influences risk perception due to potential confounding factors. Rigorous causal evidence on how educational disparities affect women’s on-farm adaptation in Sub-Saharan Africa represents a critical research gap.

### **Access to financial services**

Women face systematic exclusion from formal financial services, limiting their access to credit, savings, and insurance (Morsy, 2020; Balana et al., 2022; Ebabu et al., 2026; Koudjom and Lokonon, 2023). These financial instruments are hypothesized to facilitate investment in costly climate-adaptive technologies. However, causal evidence on the role of credit constraints in limiting on-farm adaptation—particularly for women—remains mixed and limited. Recent experimental studies examining credit access and agricultural technology adoption find modest and heterogeneous effects (Karlan et al., 2014). Yet these studies are largely gender-blind, examining household-level effects without disaggregating by gender or examining intra-household dynamics. Aker and Jack (2023) find that in Niger, information constraints may be more binding than financial constraints in adopting the *demi-lunes* agricultural practice. In Zambia, a recent study finds that these constraints may be complementary rather than competing: participation in village savings and loan associations is associated with higher CSA adoption among women, with most of the association operating through improved access to agricultural information rather than through relaxed credit constraints (Mwalupaso et al., 2025). Whether women’s greater exclusion from financial services causally constrains their on-farm adaptation, and what is the optimal bundle of interventions to address complementary constraints remains an open question.

### **Land and asset ownership**

Women’s limited property and contractual rights over land, water, and natural resources restrict their ability to implement on-farm adaptations. Secure land tenure is theorized to

encourage long-term agricultural investments, including in climate-resilient technologies and practices, and systematic reviews find that tenure security influences farmers' adaptation decisions and increases agricultural investment and productivity (Holden and Ghebru, 2016; Lawry et al., 2017; Murken and Gornott, 2022). Yet in Sub-Saharan Africa, women have substantially weaker land ownership and formal tenure security than men. In cross-sectional data, only 13% of women report sole land ownership versus 36% of men, reflecting both discriminatory statutory laws and restrictive customary systems granting land access only through male relatives (Gaddis et al., 2018; Doss, 2018; Mutangadura, 2007).

Empirical work demonstrates that land tenure insecurity directly limits women's adoption of climate-adaptive investments. Within-household analyses in Ghana and Malawi show that women with weaker tenure shorten fallow periods to avoid displacement, reducing soil fertility (Goldstein and Udry, 2008; Lovo, 2016). Experimental and quasi-experimental evidence additionally indicates that interventions strengthening women's land rights increase climate-resilient investments, including through spousal co-titling in Uganda (Cherchi et al., 2019), land formalization in Rwanda (Ali et al., 2014) and land tenure security in Benin (Goldstein et al., 2015). Beyond adoption, matched difference-in-differences evidence from Tanzania links joint land ownership to improved household food security following extreme weather (Wegenast et al., 2026). Overall, there is strong evidence that strengthening women's land tenure security increases on-farm adaptation.

While most evidence concerns land tenure, similar mechanisms may operate for other productive agricultural assets. A randomized controlled trial in Kenya allocating irrigation pumps directly to women strengthened women's decision-making power and increased irrigation adoption, suggesting that direct ownership of productive assets can facilitate women's on-farm adaptation (Dyer and Shapiro, 2023).

## **Risk aversion**

While the economic literature has typically concluded that women are more risk averse than men, more recent studies have nuanced this finding, suggesting that observed differences in women’s decision-making may in large part be attributable to context, differences in risk assessment, and structural constraints rather than intrinsic risk preferences (Nelson, 2015; Sarin and Wieland, 2016; Hillesland, 2019; Crosetto and Filippin, 2023; Dilmaghani, 2021).

Risk preferences—whether intrinsic or shaped by structural constraints—influence land use decisions (Chavas et al., 2010), agricultural choices (Adger et al., 2008; Charness et al., 2013), and adaptation strategies (Tam and McDaniels, 2013). Farmers exhibiting more cautious decision-making tend to use fewer inputs, invest less in new technologies, and prioritize lower-risk, lower-return strategies (Molua, 2011). Risk aversion is associated with lower adoption of productivity-enhancing agricultural inputs among women, as observed in lower fertilizer use among women farmers in Ethiopia and Kenya and limited technology adoption by female-headed households in Cameroon (Kebede, 2022; Sheremenko and Magnan, 2015; Molua, 2011). However, disentangling the effects of risk preferences from structural constraints such as limited access to credit, information, and secure land tenure remains challenging, making it difficult to determine whether these patterns reflect intrinsic risk aversion or rational responses to binding constraints.

## **3 Income Diversification**

Why use income diversification as an adaptive strategy to weather shocks? Diversifying livelihoods helps rural households smooth income, manage risks (Macours, 2012; Macours et al., 2022; Banerjee et al., 2021; Ellis, 2005), and adapt to severe climatic changes, especially in low-income countries (Howden et al., 2008). While on-farm adaptation strategies focus on boosting agricultural output and minimizing crop losses (Di Falco and Chavas, 2008), non-farm diversification generates income through wage labor and self-employment. Farmers

frequently rely on non-farm wage jobs as an adaptive strategy to weather shocks and climate change (Chuang, 2019; Asfaw et al., 2014; Bertoni et al., 2016; Asravor, 2017).

Income diversification is a key lever for women’s economic empowerment in Africa and a critical tool for limiting the impact of climate change on their well-being. By increasing income, reducing risk, and enhancing autonomy, diversification may be particularly beneficial for rural women, who face lower agricultural productivity due to limited access to inputs (Croppenstedt et al., 2013; Quisumbing et al., 2014). In addition, transitioning to off-farm activities can strengthen married women’s bargaining power within the household, as suggested by evidence of a positive correlation between diversification, commercialization, and household decision-making in Ethiopia, Kenya, and Tanzania (Tavenner and Crane, 2019).

## **Gender disparities in adoption rates**

Both qualitative and experimental evidence reveals gender differences in income diversification strategies. Likely due to higher exposure to structural constraints, such as lower access to education, capital, and information, gender norms and legal and institutional factors, women tend to choose long-term, ex-ante risk management approaches. For example, in Ghana, experimental evidence shows women prefer long-term investment in non-farm activities over farming, a preference influenced by gender stereotypes around skills (Kramer and Lambrecht, 2019). Despite this preference, income diversification remains male-dominated, with participation of women and female-headed households varying greatly across contexts and sociodemographic characteristics (Van den Broeck and Kilic, 2019; Khan and Morrissey, 2020; Eriksen et al., 2005; Coulibaly et al., 2017; Kakota et al., 2011; Hesselberg and Yaro, 2006; Asravor, 2017). Marital status, for example, plays a role; a study from Tanzania finds that divorced women diversify income sources more than married or widowed women but still less than men (Van Aelst and Holvoet, 2016).

## **Women’s constraints to income diversification**

### **Education and skills**

Unequal access to education can limit women’s ability to adopt new income-generating strategies, particularly those requiring specialized skills or knowledge. In Sub-Saharan Africa, women are, on average, less educated than men (Shapiro and Tenikue, 2017), and constraints such as time and resource limitations prevent them from acquiring training necessary to engage in non-agricultural livelihoods.

Gaps in formal education restrict women’s opportunities to develop the managerial, entrepreneurial and technical skills needed to establish and run non-farm businesses (Duflo, 2012; Gannon et al., 2022), a critical constraint when climate shocks reduce agricultural returns and necessitate income diversification (Sen Chakraborty, 2026). A recent review of causal evidence confirms that addressing gaps in human capital through training can improve business outcomes for women-led businesses (Ubfal, 2026). Experimental evidence demonstrates the effectiveness of building business and socio-emotional skills to enhance women’s business performance (Campos et al., 2017; Alibhai et al., 2019; McKenzie and Puerto, 2021; Bossuroy and Vaillant, 2025) and shows combining cash grants, mentoring, and asset transfers with training programs can increase self-employment (Brudevold-Newman et al., 2024; Campos et al., 2025; Bossuroy et al., 2022; Dammert and Nansamba, 2023).

For skills training to effectively increase women’s participation in adaptive off-farm activities, barriers to accessing training must be addressed (Gannon et al., 2022). These include mobility restrictions (Perez et al., 2015; Singh and Belwal, 2008; Mersha and Sriram, 2019), time constraints due to household responsibilities (Arbache et al., 2010; Jost et al., 2015), lack of familial financial support (Cho et al., 2013), and spousal permission often required to attend training programs (Nyantakyi-Frimpong, 2019; World Bank, 2014). Overall, while research demonstrates that low skills constrains women’s capacity for non-farm income diversification, most studies don’t look at income diversification explicitly as a strategy to

adapt to climate change.

## **Capital**

Women face significant barriers to financial services, including credit and insurance, which are essential for initiating and sustaining diverse income activities. In Niger, Bossuroy et al. (2022) find that capital is a binding constraint, as a lump-sum cash grant, combined with other productive inclusion interventions, increased the number of income sources for women. Experimental evidence from Malawi and Zambia further supports this, showing that multifaceted economic inclusion programs that include a capital injection increase women’s likelihood of diversifying economic activities (Botea et al., 2023; Bedi et al., 2025). Taken together, these findings provide robust evidence that capital constraints significantly limit women’s ability to diversify income sources.

## **Land and asset ownership**

Ownership of and control over assets play a crucial role in shaping livelihood opportunities available to women. Gender inequalities in asset ownership (Doss, 2001; Meinzen et al., 2013), particularly in land access, significantly hinder women’s ability to use income diversification as a climate adaptation strategy. For example, formal land ownership, which enhances tenure security, allows women to retain land and livestock while pursuing off-farm income generating opportunities (Goldstein and Udry, 2008). Experimental and quasi-experimental evidence supports this link: a land title registration program in Ghana increased women’s engagement in non-farm activities (Agyei-Holmes et al., 2020), while an RCT in Burkina Faso showed that strengthening women’s control over assets expanded their income-generating opportunities (van den Bold et al., 2015).

## **Time use**

The heavy workload of women, who are primarily responsible for specific agricultural tasks such as subsistence farming, and most, if not all, domestic chores and caregiving, consistently limits their ability to engage in income diversification across diverse contexts (see also Box 3 on gendered crop specialization). In addition to subsistence farming, women are responsible for water and firewood collection, food preparation, childcare, and healthcare—tasks that often follow rigid schedules, unlike men’s more flexible routines (Kakota et al., 2011). Many of these responsibilities depend on natural resources, and climate change-induced resource depletion further increases women’s labor burden, reducing both the time and energy available for income-generating activities (Ribeiro and Chauque, 2010; Nelson et al., 2002; Eriksen et al., 2005). Experimental evidence highlights the impact of alleviating women’s time constraints on income diversification. In Burkina Faso, providing mobile childcare services through a public works program increases women’s ability to engage in alternative income-generating activities (Ajayi et al., 2022). Similarly, an RCT in the Democratic Republic of Congo found that community-based childcare centers significantly boost women’s engagement in commercial agriculture, processing, and wage work (Donald et al., 2023). While these two studies establish a causal link between alleviating women’s time constraints and engaging in income diversification, they do not directly address the question of diversification as climate adaptation strategy. In addition, little is known on how time constraints differentially affect women living in households with a husband, co-wives, or children, versus non-married women.

## **Intra-household dynamics, gender norms and occupational choice**

Underlying the time and labor constraints discussed in the previous section, gender norms shape acceptable economic activities for women and men (Jayachandran, 2015), restricting women’s income diversification opportunities. Experimental evidence demonstrates that these norms causally constrain women’s diversification and that interventions can relax these

constraints. In Niger, a large RCT testing psychosocial interventions (among others), including community discussions on gender norms and support for women’s economic participation, significantly increased women’s diversification (Bossuroy et al., 2022). The intervention increased household income by expanding women’s engagement in off-farm enterprises, both at the extensive and intensive margin, demonstrating that addressing restrictive gender norms can substantially expand women’s economic opportunities.

Marital status and prevailing household structures further influence women’s agency, decision-making and intra-household bargaining power (Duflo, 2012), and thus their ability to diversify income-generating activities. In Kenya, women need male household heads’ consent to undertake certain activities, such as tree felling (Eriksen, 1999). In Burkina Faso, polygamous women are more likely than monogamous women to engage in independent income-generating activities (Guirkinger et al., 2021). Household structure likely influences which constraints are most binding. Married women may have better access to information, while divorced, widowed, or women in polygamous households may have greater autonomy to diversify income, as observed in rural Tanzania and Burkina Faso (Guirkinger et al., 2021; Van Aelst and Holvoet, 2016). Causal evidence on the role of household structure and intra-household dynamics in women’s income diversification as a climate adaptive strategy remains scarce.

## 4 Migration

Climate-induced migration varies in distance and duration, from international and rural-urban migration (Marchiori et al., 2012; Cattaneo and Peri, 2016; Cattaneo et al., 2019; Missirian and Schlenker, 2017) to shorter-distance rural-rural movements (Dillon et al., 2011; Henderson et al., 2017; Defrance et al., 2022; Mueller et al., 2014; Gittard, 2024), and can be permanent, seasonal, voluntary, or imposed. It may serve as a planned household strategy, a last-resort survival mechanism, or a complement or substitute for on-farm and off-farm

adaptation.

Labor migration can be strategic or anticipatory, as remittances alleviate financial constraints, facilitating local adaptation and innovation adoption, and thus complement other on- and off-farm adaptation strategies. However, when local adaptation strategies fail, migration becomes a last-resort strategy and high migration costs may restrict resource-constrained households to short-distance movement or prevent migration entirely, trapping them in climate-affected areas.

## **Gender disparities in adoption rates**

Evidence from Sub-Saharan Africa suggests that rural-urban labor migration in response to weather extremes is predominantly male-driven. Men migrate strategically to diversify income and send back remittances, while women use migration as a short-term coping mechanism and are typically more vulnerable when doing so (Henry et al., 2004; Dillon et al., 2011; Djoudi and Brockhaus, 2011; Gray and Mueller, 2012; Thiede and Gray, 2017), a pattern also documented in South Asia (Mueller et al., 2014; Morten, 2019).

Migration patterns vary by context. For example, a study in Burkina Faso finds that women migrate mainly for family reasons (e.g., marriage, separation), whereas men undertake long-distance moves for economic opportunities, such as agricultural expansion (Henry et al., 2004). In Ethiopia, severe droughts increase men’s labor migration—particularly among land-poor households—while reducing women’s marriage-related mobility, suggesting that households postpone marriages during adverse climatic conditions (Gray and Mueller, 2012). In Mali, Findley (1994) observes that women and children relied on short-cycle circular migration to cope with the 1983–1985 drought, while long-distance, permanent migration was mainly undertaken by resource-connected young men. In Malawi, quasi-experimental evidence finds no increase in marriage-related migration among adolescent girls following drought, but does document higher work-related migration among children, consistent with child labor as a coping strategy (Becerra-Valbuena and Millock, 2021). In Nigeria, droughts

typically lead to male migration, but the presence of girls in the household or a male household head increases the likelihood of women migrating (Dillon et al., 2011), indicating that household structure also influences women’s migratory behavior.

## **Women’s constraints to migration**

### **Expected returns**

Women’s underrepresentation in climate-induced migration may stem from lower expected returns. Since remittances drive migration decisions (Marchiori et al., 2012; Henderson et al., 2017), households may be reluctant to send women if their returns are lower or more uncertain than men’s. Across Sub-Saharan Africa, women’s lower education and skills reduce their employability in destination areas, as supported by experimental evidence (Ashraf et al., 2020). Migration often requires adapting through skills acquisition, and education is a key driver of climate-induced migration (Defrance et al., 2022; Baez et al., 2017; Gittard, 2024). However, we know very little about whether improving women’s education and technical skills translates into greater participation in climate-induced, strategic migration, reflecting the broader lack of gender-specific evidence on climate-related migration (Irbik, 2022). In addition, women entrepreneurs often earn lower profits and returns to capital than men, making them less viable candidates for strategic labor migration as a household-level income diversification strategy (de Mel et al., 2008; Berge et al., 2015; Bernhardt et al., 2018; Carranza et al., 2018).

Evidence on the returns to rural-urban migration in response to climate change is mixed; while longitudinal evidence from Kenya suggests minimal gains (Hamory et al., 2020) significant benefits documented in other low-income contexts have yet to be rigorously established in Sub-Saharan Africa (Baysan et al., 2024; Pulido and Swiecki, 2019; Imbert and Papp, 2020; Lagakos et al., 2022). Migration can lead to uncertain outcomes, as migrants often face integration challenges due to skill mismatches and labor productivity gaps (Bryan and Morten, 2019; Harris and Todaro, 1970). Uncertainty in migration returns may be more

restrictive for women, who experience higher unemployment and lower earnings than men.

More research is needed to assess how lower returns to climate migration and higher uncertainty around those returns affect women’s ability and decision to migrate as an adaptation strategy.

## **Social networks**

Women typically engage in small, community-based, informal groups, while men tend to have stronger ties to formal networks beyond their local communities (Perez et al., 2015; Westermann et al., 2005; Huyer, 2016). Migrant networks at destination play a crucial role in shaping migration patterns by reducing migration costs, such as in the Mexico-US migration channel (McKenzie and Rapoport, 2010), facilitating economic and social integration, expanding job opportunities (Patel and Vella, 2007; Drever and Hoffmeister, 2008), and providing material support, information and assistance (Mazzucato, 2009; Chort et al., 2012). However, the extent to which women’s limited formal networks constrain climate-induced migration in Sub-Saharan Africa remains unexplored.

## **Liquidity and wealth**

Migration is costly, with fixed costs posing significant barriers, especially for low-income households (IOM, 2018). Women typically face greater liquidity constraints than men, limiting their ability to finance migration (Marchetta et al., 2021). Expenses include transportation, relocation, and higher urban living costs. One study outside of Sub-Saharan Africa found that subsidizing bus tickets increased rural-urban migration (Bryan et al., 2014), but there is no evidence for the region about how liquidity and wealth constraints affect women’s migration decisions or the impact of easing these constraints.

## **Land tenure insecurity and mobility**

Women’s greater land tenure insecurity may discourage their migration, as remote monitoring of plots increases the risk of expropriation. In Ghana, women shorten fallow periods to avoid losing uncultivated land (Goldstein and Udry, 2008), potentially limiting their ability to migrate. However, no causal link has been established between women’s fear of expropriation and restricted climate-induced migration (Goldstein and Udry, 2008). In Benin, a large-scale RCT found that land demarcation improved women’s mobility, enabling them to shift production from secure to less secure land outside the village (Goldstein et al., 2015). In addition, in Côte d’Ivoire, restrictive land tenure laws limit migrants’ land rights (Fenske, 2009; Colin and Ayouz, 2006), further constraining women’s mobility after climate shocks. These findings suggest that land tenure insecurity acts as a key barrier to women’s climate-induced migration, but more work is needed to establish a direct causal link.

## **Gender roles**

Gender norms defining the expected roles and suitable activities for men and women (Jayachandran, 2015) may limit women’s ability to take up migratory opportunities as an adaptation strategy, in particular for married women with children. As primary caregivers, women often cannot leave children behind or migrate with them. Following adverse climatic events, they typically take on the dual responsibilities of caregiver and shock absorber, managing subsistence crops (see Box 3), preparing meals and fetching water—tasks that become more time-intensive due to rainfall deficits and resource scarcity (Björkman-Nyqvist, 2013; Ribeiro and Chauque, 2010; Babugura, 2008). These responsibilities limit women’s mobility, confining them to the household. Male-dominated migration further increases women’s domestic workload when men leave, reinforcing their immobility (Djouidi and Brockhaus, 2011).

Women also have limited decision-making power in determining who migrates, when, and where, as seen in East Africa (Abebe, 2014). By contrast, men’s migration can, in some cases, empower women by increasing their control over household resources and decision-making,

enabling them to engage in traditionally male-dominated activities (Agamile et al., 2021). However, few studies causally examine the relative importance of mechanisms through which gender norms may limit women’s ability to migrate as a climate adaptation strategy.

While the previous discussion focuses on women left behind, evidence on female migrants points to a related but distinct dynamics: climate shocks may reshape gender gaps in labor market outcomes among migrant households after settlement. Evidence from West African migrants in Côte d’Ivoire shows that climate shocks at destination increase migrant women’s labor force participation relative to men’s, primarily through low-quality informal employment, suggesting a coping response rather than a durable improvement in women’s economic position (Elmallakh and Wodon, 2025).

## **Risks of violence**

Climate-induced migrants face numerous risks during their journey and at destination, particularly in irregular migration, including physical and sexual violence, forced labor, financial exploitation, trafficking, and even death (Reuveny and Moore, 2009; Tacoli, 2009; Black et al., 2013; McKenzie and Yang, 2015; IOM, 2018; Bah et al., 2023), and can be exposed to conflict due to tensions with host populations (Reuveny and Moore, 2009; Fröhlich and Brzoska, 2015; McGuirk and Nunn, 2024; Thoenig et al., 2020). Women migrants face heightened risks of sexual and gender-based violence, often citing lack of safe shelter as a major concern following climatic events (Brown, 2008; Mitchell et al., 2007). Climate-induced mass migration frequently leads to resettlement in urban slums or camps, where women and children are particularly vulnerable to violence and trafficking (Verma et al., 2011). Despite these risks, the extent to which migration dangers influence women’s decision to migrate as an adaptation strategy remains understudied.

Information campaigns have expanded to raise awareness about the risks of irregular migration, particularly from Africa to Europe, where smuggling networks often misinform migrants (Geiger and Pécoud, 2019) but evidence on their effectiveness is limited. Peer-to-

peer information has been shown to increase risk awareness and reduce irregular migration intentions in Senegal (Tjaden and Dunsch, 2021). However, the role of (mis)information in shaping women’s migration decisions remains largely unexplored.

## 5 Weather Insurance

Weather insurance is a risk management tool that can help rural households manage the economic consequences of climate extremes by providing payouts based on measurable weather indices. In Sub-Saharan Africa, various types—such as rainfall, index-based, livestock, crop, parametric, and catastrophic insurance—address specific risks, including agricultural losses, extreme weather events and livestock mortality, thereby enhancing resilience and adaptation (Platteau et al., 2017; Koloma, 2014). These products offer financial protection, encourage agricultural investment (Sundar and Ramakrishnan, 2013; Hill and Robles, 2011), promote risk-taking (Mobarak and Rosenzweig, 2012; Dercon et al., 2014; Karlan et al., 2014), and improve welfare (de Nicola, 2015a). Farmers benefit from reduced contract disputes through exogenous weather station data (Devereux and Guenther, 2009) and faster payouts (Greatrex et al., 2015). Experimental evidence shows that weather insurance increases yields and improves food security management during climate shocks (Delavallade et al., 2026; Dercon et al., 2014; Barnett, 2014; Karlan et al., 2014).

Despite its benefits, adoption of weather insurance products remains extremely low in Africa (Cole et al., 2013; Hill and Viceisza, 2012). Key barriers include basis risk—the imperfect correlation between payouts and actual losses due to rainfall variability (de Nicola, 2015b; Dicko et al., 2014)—as well as cost-protection trade-offs (Berg et al., 2009; Koloma, 2014), poor understanding of insurance concepts (Tadesse et al., 2015), financial constraints (Belissa et al., 2019), risk preferences (Mude and Barrett, 2012), subjective expectations (Mude et al., 2010), trust issues, and liquidity limitations (Cole et al., 2013). Demand increases with payout experience, adverse conditions, and training (Dercon et al., 2014; Karlan

et al., 2014; Mobarak and Rosenzweig, 2012), while insufficient stakeholder cooperation and farmer involvement in product design further hinder uptake (Muller, 2012; William et al., 2018).

## **Gender disparities in adoption rates**

A limited experimental literature points to women in Sub-Saharan Africa adopting weather insurance at lower rates than men (Delavallade et al., 2026). Most studies focus on willingness to pay (WTP) rather than actual adoption. In Burkina Faso, male-headed households have higher WTP amounts than female-headed households (William et al., 2018). Choice experiments in Bangladesh show significant aversion to insurance among women farmers (Akter et al., 2016), while randomized trials in Senegal and Burkina Faso reveal lower adoption rates among women, who prioritize emergency savings due to higher exposure to life cycle risks (Delavallade et al., 2026). A literature review by Timu and Kramer (2023) shows that agricultural insurance products are rarely designed with gender-specific needs in mind, limiting their accessibility and benefits for women. There is also very little evidence on the heterogeneous impacts of weather insurance on women and men; one study in Ethiopia finds agricultural insurance to be an effective strategy in helping poor women farmers cope with climate-related shocks (Timu et al., 2023). We next review the evidence on binding constraints to adoption of agricultural insurance.

## **Women’s constraints to adoption of insurance**

### **Information and financial literacy**

Limited financial literacy and information gaps—driven by lower education, restricted networks, and limited agency—may significantly constrain women’s adoption of weather insurance in Africa. In Ethiopia, Tadesse et al. (2015) find that most rural households misunderstand crop insurance, with 64% viewing it as a financial tool primarily designed for wealthier

individuals, akin to motor insurance. In Burkina Faso, a study based on a participatory design shows that information and income are key determinants of weather insurance demand, with male-headed households exhibiting higher WTP than female-headed households (William et al., 2018). An experiment by Arteaga et al. (2026) in Kenya finds that reframing insurance benefits in more relatable terms increases women’s uptake, further supporting the information constraint. On the other hand, a randomized comparison of extension delivery formats for a bundled rainfall-indexed credit-insurance product in Kenya providing animated brochures alongside standard face-to-face training significantly increased product comprehension, with larger gains for women than men. However, these improvements in women’s understanding did not translate into a narrowing of the gender gap in WTP, which remained significantly lower for women across all extension formats (Timu et al., 2024). More work is needed on the extent to which addressing the information constraint is sufficient to increase women’s take-up of weather insurance or needs to be combined with other interventions.

## **Control over land and assets**

Women’s land tenure insecurity is multidimensional, encompassing ownership, control, and management rights (Doss and Meinzen-Dick, 2020). Systematic reviews suggest associations between land tenure and agricultural investment behavior (Murken and Gornott, 2022), which may have implications for adoption of risk management tools like weather insurance. Secure land rights may enhance the perceived value of insurance by reducing uncertainties related to land loss relative to climate-related risks. In places where formal land titles may be required for insurance access -such as Ghana for instance (Otsuki and Jasaw, 2017)- this constraint could be particularly binding for women.

A WTP experiment in Kenya found higher demand when payouts were deposited directly into beneficiaries’ mobile money accounts, suggesting that lack of direct financial control may hinder women’s adoption of agricultural insurance (Kramer et al., 2023b). Married women in

households with unequal control over assets may be particularly affected by this constraint. However, there is limited causal evidence on how restricted asset and land ownership directly and indirectly affects women’s uptake of weather insurance.

### **Trust in financial institutions**

Women’s lower trust in financial institutions may pose substantial constraints for their adoption of weather insurance in Sub-Saharan Africa.<sup>9</sup> This constraint is supported by quantitative evidence from a study by Akter et al. (2016) conducted in Bangladesh, which used a choice experiment to assess WTP for hypothetical insurance products. The research found that women farmers displayed significant aversion towards insurance products, and this aversion was primarily attributed to gender disparities in the level of trust in insurance institutions. Importantly, this reluctance was not explained by differences in risk and time preferences, decision-making power, or specific attributes of the insurance product. Suggestive evidence from Kenya indicates that women may be more likely to take up insurance when insurance agents are also women, potentially overcoming the lack of trust constraint (Cecchi et al., 2021). However, there is a lack of both descriptive and causal evidence on how women’s distrust in financial institutions hinders their uptake of weather insurance in Sub-Saharan Africa.

### **Uninsured and basis risk**

Delavallade et al. (2026) find lower adoption of index-based agricultural insurance among women farmers in Senegal and Burkina Faso. In standard weather index insurance, basis risk arises when the weather index does not accurately capture plot-level crop losses, so farmers may experience losses without receiving a payout. Women may face additional uninsured risks related to pregnancy, childbirth, and caregiving responsibilities. In their randomized experiment, women invested 30% less than men in index-based insurance, a gap not explained by differences in land size, crop type, shock history, or remittance income. The authors argue

that the limited coverage of risks disproportionately borne by women may help explain this gap.

Alternative insurance designs can reduce conventional basis risk. For example, picture-based insurance uses plot-level images to assess crop damage, reducing reliance on spatially coarse weather indices. Experimental evidence from Kenya shows that replacing weather index-based insurance with picture-based insurance substantially increases take-up, particularly among women and farmers in drought-prone areas (Kramer et al., 2025). Experimental evidence on insurance contracts explicitly designed to address women’s uninsured life cycle risks or combining insurance with complementary services however remains scarce (Timu and Kramer, 2023).

## 6 Adaptive Social Protection

Adaptive social protection programs, such as cash transfers, public works, and economic inclusion programs, are a key policy lever to help vulnerable households cope with climate shocks in the short term and facilitate individuals’ access to longer-term private adaptation strategies by alleviating financial constraints (Hidrobo et al., 2026). Without these programs, extreme poverty and market failures often prevent households from investing in market-based interventions, such as improved farming techniques or weather insurance, or adopting individual strategies such as investing in off-farm businesses.

While women are often the primary beneficiaries of adaptive social protection programs in Sub-Saharan Africa—72% of all Social Safety Nets included in a systematic review for low- and middle-income countries targeted women (Peterman et al., 2024)—they still face specific barriers that limit their ability to fully access and benefit from these programs, thereby constraining their uptake of adaptation strategies.

## **Gender norms and domestic responsibilities**

Gender norms around caregiving responsibilities intensify in the face of climate shocks, further restricting women and female-headed households' ability to benefit from adaptive social protection (Kakota et al., 2011; Sorenson et al., 2011; Moshoeshoe et al., 2021). Accommodating maternal and caregiving needs is crucial to ensure program accessibility. In Ghana, providing on-site childcare and sanitation facilities, along with flexible employment conditions, increased women's participation in public works programs (Dadzie and Ofei-Aboagye, 2021). Similarly, in Burkina Faso, providing affordable childcare for public works beneficiaries significantly improved women's well-being and resilience (Ajayi et al., 2022).

## **Safety and mobility**

Gender norms around mobility and safety concerns further hinder women's participation in adaptive social protection programs. For instance, while the Central African Republic's Londo public works program improved shock resilience for both men and women, its asset transfer component—a bicycle given to beneficiaries—only increased men's mobility, failing to address gender norms restricting women's movement (Alik-Lagrange et al., 2023). Innovations such as mobile money transfers offer potential solutions. A program in Niger demonstrated that mobile transfers reduced travel distances and increased women's bargaining power within households compared to traditional cash transfers (Aker et al., 2016).

## **Bargaining power and financial autonomy**

While the gender of cash transfer recipients does not significantly impact household well-being and resilience (Akresh et al., 2016; Benhassine et al., 2015), gender-targeted transfers have been effective in increasing women's income and strengthening their intra-household bargaining power (Bastagli et al., 2016). However, recent empirical evidence from a lab-in-the-field in Nigeria suggests that cash transfers to women increase their demand for agency

but do not change the intra-household balance of power enough to allow them to express it publicly (Bakhtiar et al., 2024). Gains in women’s agency, if not in their bargaining power, have led to increased investments in traditionally female-dominated areas such as human capital, children’s nutrition, and clothing (Fafchamps et al., 2014). However, these programs have not consistently translated into productive capital accumulation or investments in women’s entrepreneurial activities (Duflo, 2012; Duflo and Udry, 2004; Bernhardt et al., 2019; Friedson-Ridenour and Pierotti, 2019).<sup>10</sup> In the context of climate adaptation, women may lack financial autonomy to invest in resilience-enhancing activities, such as on-farm adaptation or diversified livelihoods, due to intra-household pressures and gendered financial obligations (e.g. the kin tax) that prioritize their partner’s or family’s needs over their own income-generating opportunities (Andrews et al., 2011; Peterman and Gilligan, 2019). For example, Liberia’s Cash for Work Temporary Employment Project showed that while women allocated a higher proportion of their public works income to farm investments, men diversified their investments more broadly, suggesting a limited impact on income diversification for women (Andrews et al., 2011).

## **Structural and institutional barriers**

Even when women access adaptive social protection, their benefits are often constrained by structural inefficiencies such as decision-making dynamics at the local level. Local authorities, where women often have limited voice and influence, may prioritize projects that predominantly benefit men, reducing the overall impact of adaptive social protection on women (Jordan et al., 2021).

Addressing these multifaceted challenges requires gender-sensitive program design, including adjustments in operational features to directly address the constraints faced by women in both economic and complementary programming components. Reviews suggest that targeting women and incorporating gender-sensitive operational features, such as literacy support, flexible program requirements, proximity-based service delivery, and childcare

facilities, and further adopting gender-transformative approaches are essential for ensuring that adaptive social protection programs effectively strengthen women’s agency, decision-making power, and control over resources (Bastagli et al., 2016; Gavrilovic et al., 2022; Peterman et al., 2024). These dimensions of women’s empowerment may in turn strengthen women’s capacity to adapt to climate change (Kihoro et al., 2026).

## 7 Intervention Evidence Map

Despite the critical role that women can play in adapting to climate change and the significant opportunities that their inclusion in adaptation strategies presents, this paper highlights numerous constraints that still hinder women’s ability to implement adaptation strategies both on and off the farm. This section presents an evidence map (Table 1) of interventions that may increase the adoption of each of the three strategies identified in the paper as well as enhance the reach and impact of the two enabling instruments that are weather insurance and adaptive social protection. For each strategy, policy options are proposed or identified along with the current strength of the evidence in support of that intervention. The categories used to grade the evidence are defined as follows: *credible* indicates that more than one impact evaluation from Sub-Saharan Africa demonstrates consistent, positive impacts of an intervention; *emerging* indicates that just one impact evaluation (from Sub-Saharan Africa) shows positive impacts or multiple impact evaluations show mixed or not exclusively positive results; *frontier* indicates that there are no impact evaluations showing strong positive impacts, but other nonexperimental evidence suggests that the intervention could address the given constraint. Papers cited in the map are exclusively those with experimental or quasi-experimental evidence for Sub-Saharan Africa.

The evidence map is organized by policy objective. Figure A3 in Appendix B additionally summarizes it by the constraint each option targets, mirroring the structure of our conceptual framework (Figure A1). First, credible evidence is concentrated in a small set

of interventions: agricultural information delivered by female extension agents, cash transfers and economic inclusion packages, childcare provision, and land titling. Second, entire areas remain almost untested: no intervention directly promoting women’s climate-induced migration has been rigorously evaluated in Sub-Saharan Africa, and interventions explicitly designed to shift gender norms such as community norm-changing programs, female mentorship, or quotas in welfare decision-making, remain entirely at the frontier. Table 1 below details each option, the underlying studies and the direction of their estimated effects.

Table 1: Evidence Map

| Policy Objective                                             | Policy Options                                                              | Main Conclusion                                                                                                                                                                                | State of Evidence |
|--------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>On-farm adaptation</b>                                    |                                                                             |                                                                                                                                                                                                |                   |
| Promoting women’s access to information on climate change    | Providing digital devices to women <sup>11</sup>                            | Digital devices facilitate access to information, especially for women whose access to Climate Information Services (CIS) is restricted due to reliance on traditional media such as radio.    | Frontier          |
| Increasing women’s access to information on new technologies | Formal and informal training on climate-adaptive technologies and practices | Training sessions, by providing technical advice and filling knowledge gaps and skills, increase women’s adoption of new agricultural technologies ((Aker and Jack, 2023) <a href="#">↑</a> ). | Emerging          |
|                                                              | Information and Communication Technology-based extension programs           | Phone-based extension improved agricultural outcomes more than traditional extension alone in Niger (Aker and Ksoll, 2016 <a href="#">↑</a> ). <sup>12</sup>                                   | Emerging          |

| Policy Objective                                                 | Policy Options                                                                            | Main Conclusion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | State of Evidence |
|------------------------------------------------------------------|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|                                                                  | Providing women with agricultural inputs along with information and extension support     | Strengthening women's access to extension services increases their use of modern inputs in Ethiopia (Buehren et al., 2019 <a href="#">↑</a> ). In Uganda, providing extension together with inputs increased women's adoption of a new climate-resilient crop, while credit or insurance alone did not (Buehren et al., 2025: extension and inputs <a href="#">↑</a> , credit or insurance alone <a href="#">−</a> ). In Mali, providing free fertilizer to women rice farmers increased output but not profits (Beaman et al., 2013: production <a href="#">↑</a> , profits <a href="#">−</a> ). | Emerging          |
|                                                                  | Training programs led by female extension agents                                          | Women farmers are more likely to adopt new practices and make decisions in the household when trainings are delivered by female extension agents (Kondylis et al., 2016 <a href="#">↑</a> ; Lecoutere et al., 2023 <a href="#">↑</a> ; BenYishay and Mobarak, 2019 <a href="#">↑</a> ).                                                                                                                                                                                                                                                                                                           | Credible          |
| Increasing women's participation in agricultural social networks | Structuring social groups to fit women's time constraints, e.g. women-friendly scheduling | Women's attendance at community meetings increases when organizations actively prioritize women's participation and schedule meetings at times convenient for them (Leino, 2007: participation <a href="#">↑</a> ), although these gains did not translate into downstream improvements in water source maintenance ( <a href="#">−</a> ).                                                                                                                                                                                                                                                        | Emerging          |
|                                                                  | Gender quotas in leadership within agricultural social groups                             | Building on evidence from climate governance (Cook et al., 2019 <a href="#">↑</a> ), gender quotas in leadership positions within agricultural social groups can address the barriers created by male dominance, strengthen women's voices and increase their active participation in these groups.                                                                                                                                                                                                                                                                                               | Emerging          |
|                                                                  | All-women social groups                                                                   | All-women social groups, such as micro-credit groups, savings groups, self-help groups, health groups or innovation platforms, could significantly boost women's on-farm adaptation by offering a space for peer learning and collective action.                                                                                                                                                                                                                                                                                                                                                  | Frontier          |

| Policy Objective                                             | Policy Options                                     | Main Conclusion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | State of Evidence |
|--------------------------------------------------------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Increasing long term investment incentives                   | Land titling formalization                         | The formalization and strengthening of women's land tenure leads to increased investments in conservation agricultural practices (Ali et al., 2014 <a href="#">↑</a> ; Goldstein et al., 2015 <a href="#">↑</a> ; Cherchi et al., 2019 <a href="#">↑</a> ).                                                                                                                                                                                                                                                                                                         | Credible          |
|                                                              | Direct provision of productive assets to women     | A randomized trial in Kenya allocating irrigation pumps directly to women strengthened their decision-making power and increased irrigation adoption (Dyer and Shapiro, 2023 <a href="#">↑</a> ).                                                                                                                                                                                                                                                                                                                                                                   | Emerging          |
| Addressing intra-household constraints to on-farm adaptation | Delivering CIS to both spouses together            | Providing forecast information to the couple helps them agree on investment decisions (Kramer et al., 2023a <a href="#">↑</a> ) and increases women's voice in agricultural decision-making within the household (Kramer and Timu, 2023 <a href="#">↑</a> ).                                                                                                                                                                                                                                                                                                        | Emerging          |
|                                                              | Training programs targeting both spouses           | Including both spouses in agricultural extension training increases women's participation in decision-making and improves planning by reducing frictions (Lecoutere et al., 2023 <a href="#">↑</a> ; Donald et al., 2022 <a href="#">↑</a> ). However, jointly targeting both spouses through video-mediated extension in Ethiopia increased women's access to information and technical knowledge (Abate et al., 2023 <a href="#">↑</a> ) without generating additional gains in household technology adoption relative to targeting the household head alone (–). | Emerging          |
| <b>Income Diversification</b>                                |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                   |
| Unlocking women's access to capital and ownership of assets  | Cash transfers and public work programs            | Consumption support increases income diversification, especially among women (Alik-Lagrange et al., 2023 <a href="#">↑</a> ; Natali et al., 2016 <a href="#">↑</a> ).                                                                                                                                                                                                                                                                                                                                                                                               | Credible          |
|                                                              | Economic inclusion packages with capital injection | Multifaceted packages with capital injection increase women's income diversification (Bossuroy et al., 2022 <a href="#">↑</a> ; Botea et al., 2023 <a href="#">↑</a> ; Bedi et al., 2025 <a href="#">↑</a> ).                                                                                                                                                                                                                                                                                                                                                       | Credible          |

| Policy Objective                                        | Policy Options                                                | Main Conclusion                                                                                                                                                                                                                               | State of Evidence |
|---------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|                                                         | Land titling formalization                                    | Strengthening women’s control over assets such as land can expand their income-generating opportunities by increasing women’s decision-making power (van den Bold et al., 2015 <a href="#">↑</a> ).                                           | Emerging          |
| Alleviating women’s skills and social norms constraints | Socio-emotional skills training                               | Socio-emotional skills trainings increase women farmers’ participation in non-farm activities (Bossuroy et al., 2022 <a href="#">↑</a> ; Boxho et al., 2025 <a href="#">↑</a> ).                                                              | Emerging          |
|                                                         | Information and Communication Technology provision            | The provision of mobile phones, and learning how to use them, increases women’s crop diversification (Aker and Ksoll, 2016 <a href="#">↑</a> ).                                                                                               | Emerging          |
|                                                         | Community norm-changing interventions                         | Community level norm-changing interventions, such as edutainment interventions and facilitated community discussions, could promote women’s involvement in off-farm and non-farm activities.                                                  | Frontier          |
|                                                         | Trainings and interventions led by female mentors             | Female role models and mentors can challenge gender norms regarding sectoral choices, while also expanding women’s networks and boosting their confidence to enter higher-return, male-dominated sectors.                                     | Frontier          |
| Relaxing women’s time constraints                       | Engaging men to increase participation in house and care work | Gender-transformative trainings that engage men to participate more in domestic chores can help alleviate women’s time constraints and increase their ability to diversify income sources.                                                    | Frontier          |
|                                                         | Childcare services                                            | Childcare access can allow mothers to move from lower-wage jobs with flexible schedules to higher-paying jobs, and facilitate greater income diversification (Ajayi et al., 2022 <a href="#">↑</a> ; Donald et al., 2023 <a href="#">↑</a> ). | Credible          |
| <b>Migration</b>                                        |                                                               |                                                                                                                                                                                                                                               |                   |

| Policy Objective                                                     | Policy Options                                                     | Main Conclusion                                                                                                                                                                                                                                                                                                                        | State of Evidence |
|----------------------------------------------------------------------|--------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Promoting women's labor relocation                                   | Information session on women's integration in migrant networks     | Migrants' networks lower migration costs and ease integration. Information sessions on migrant networks for women could facilitate both social and economic integration.                                                                                                                                                               | Frontier          |
|                                                                      | Land titling formalization                                         | Insecurity in women's land tenure can discourage migration due to the heightened expropriation risks. Strengthening women's land tenure security encourages them to shift production from secure land to less secure areas outside the village (Goldstein et al., 2015 <a href="#">↑</a> ) and could enhance their ability to migrate. | Emerging          |
| Relaxing women's financial constraints                               | Subsidized transportation for seasonal migration or cash transfers | Subsidizing transportation costs for women could lower their financial barriers to migration by reducing expenses.                                                                                                                                                                                                                     | Frontier          |
| Reducing women's risk of violence                                    | Information campaigns                                              | Information campaigns that outline the dangers of climate-induced migration, compare risky versus safer pathways, and specifically address the risks faced by women could reduce their insecurity and reluctance to migrate.                                                                                                           | Frontier          |
|                                                                      | Peer-to-peer transmission and role models                          | A peer-to-peer information campaign in Senegal increased awareness of migration risks and reduced intentions to migrate irregularly (Tjaden and Dunsch, 2021 <a href="#">↑</a> ). Whether such campaigns can support women's safe climate-induced migration remains untested.                                                          | Emerging          |
| <b>Weather Insurance</b>                                             |                                                                    |                                                                                                                                                                                                                                                                                                                                        |                   |
| Increasing women's knowledge and understanding of insurance products | Training sessions on weather insurance and financial literacy      | A gender-inclusive extension brochure significantly improved women's comprehension of a bundled insurance-credit product (Timu et al., 2024: comprehension <a href="#">↑</a> ), although these gains did not translate into a narrowing of the gender gap in willingness to pay ( <a href="#">−</a> ).                                 | Emerging          |

| Policy Objective                                        | Policy Options                                                                     | Main Conclusion                                                                                                                                                                                                                                       | State of Evidence |
|---------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|                                                         | Women insurance agents                                                             | Involving women as actors of the insurance value chain, for example by having female extension workers enroll farmers in insurance schemes, could increase women's take-up of the products by improving trust and accessibility.                      | Frontier          |
|                                                         | Framing insurance products in terms of benefits to women                           | Changing the way insurance products are framed to emphasize the benefits for women, for example by changing units of insurance sold in terms of number of household members at risk, can boost demand for insurance (Arteaga et al., 2026).           | Emerging          |
| Tailoring products to women's needs                     | Reducing basis risk through picture-based insurance                                | Replacing weather index-based insurance with picture-based insurance increases take-up, particularly among women (Kramer et al., 2025).                                                                                                               | Emerging          |
|                                                         | Designing insurance products that cover women's life cycle risks                   | Designing insurance products that address risks disproportionately borne by women, such as vulnerabilities related to their life cycle risks, could increase their adoption of weather insurance.                                                     | Frontier          |
|                                                         | Designing insurance products that account for women's lack of land tenure security | Developing insurance products that take into account women's land tenure insecurity could increase their uptake of weather insurance as land tenure is often a prerequisite for insurance enrollment.                                                 | Frontier          |
|                                                         | Combining insurance with mobile money                                              | Paying insurance payouts directly on women's personal mobile money accounts increases their willingness to pay for agricultural insurance (Kramer et al., 2023b ↑).                                                                                   | Emerging          |
| <b>Adaptive Social Protection</b>                       |                                                                                    |                                                                                                                                                                                                                                                       |                   |
| Making adaptive social protection work better for women | Gender-sensitive provisions in public works programs                               | Accompanying public works programs with gender-sensitive provisions, such as flexible hours, childcare support, and safe transportation, could improve women's participation and adoption of on- and off-farm diversification (Ajayi et al., 2022 ↑). | Emerging          |

| Policy Objective                                                     | Policy Options                                                                      | Main Conclusion                                                                                                                                                                                                                        | State of Evidence |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|                                                                      | Mobile delivery of cash transfers                                                   | Delivering cash transfers via mobile money in Niger reduced travel and waiting costs for women recipients and increased their intra-household bargaining power relative to physical cash distribution (Aker et al., 2016 $\uparrow$ ). | Emerging          |
|                                                                      | Quotas for women in public welfare decision-making                                  | Strengthening women’s voice and leadership in designing and allocating public welfare programs, such as implementing quotas for women in decision-making bodies, could enhance gender-inclusive policymaking.                          | Frontier          |
| Leveraging adaptive social protection for women’s climate adaptation | Climate adaptive interventions in economic inclusion packages and/or cash transfers | Adding climate-adaptive interventions to economic inclusion packages and cash transfers could enhance women’s climate resilience.                                                                                                      | Frontier          |
|                                                                      | Cash transfers framed for climate adaptation                                        | Framing cash transfers as part of climate adaptation strategies could enhance their effectiveness in building resilience for women.                                                                                                    | Frontier          |

*Notes:* Policy objectives group options by policy goal. Arrows report the direction of each study’s estimated impact on the row’s policy objective:  $\uparrow$  statistically significant positive impact,  $-$  no significant effect,  $\downarrow$  significant adverse effect. Arrows are reported only for experimental and quasi-experimental studies from Sub-Saharan Africa; *frontier* rows have no such studies, and their conclusions are hypotheses formulated from theory and the descriptive evidence reviewed in the text.

## 8 Priority Research Questions

This section identifies key under-researched areas critical to understanding and addressing barriers to women’s climate adaptation. These questions are derived from the preceding analysis and are organized in Table 2 by adaptation strategy and enabling instrument; colour markers identify the constraint group each question addresses, echoing the conceptual framework (Figure A1) and the gaps identified in the evidence map (Figure A3). An extended discussion of these questions, organized by adaptation strategy, is provided in Appendix C.

Three cross-cutting priorities emerge. First, the interaction between climate information, perceptions, and risk preferences in shaping women’s on-farm adaptation remains largely unexplored: women’s more cautious decision-making could prove an opportunity rather than a barrier if accurate information can channel it toward protective, long-term practices. Second, migration stands out as the least understood strategy: interventions addressing women’s constraints to climate-induced migration remain almost entirely unevaluated in Sub-Saharan Africa. Third, across the two enabling instruments, the open question is no longer whether gender-sensitive design matters, but which design features translate into women’s adoption of adaptation strategies, and at what cost.

Table 2: Priority research questions, by adaptation strategy, enabling instrument, and constraint

| Constraint                    | Priority research question                                                                                                                                                                                                                |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>On-farm adaptation</b>     |                                                                                                                                                                                                                                           |
| ■ Climate information         | Do gender differences in climate-change perceptions shape adaptation decisions, and does improving women’s access to climate information services translate into greater adoption of climate-adaptive practices?                          |
| ■ Social networks             | Do gender gaps in access to formal and informal agricultural networks constrain women’s on-farm adaptation, and which forms of group organization overcome these barriers and women’s time constraints?                                   |
| ■ Land & productive assets    | To what extent does land tenure insecurity shape women’s willingness to undertake long-term on-farm investments, such as fallowing or conservation agriculture?                                                                           |
| ■ Risk preferences            | Is women’s more cautious decision-making, often attributed to risk aversion, a barrier or an opportunity for the adoption of protective long-term practices, and can accurate information on climate change and technologies leverage it? |
| <b>Income diversification</b> |                                                                                                                                                                                                                                           |

| Constraint                     | Priority research question                                                                                                                                                                                                   |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ■ Time & care responsibilities | To what extent do time and care constraints limit women's engagement in off-farm activities, and can interventions that relax them, including engaging men in domestic and care work, expand women's income diversification? |
| ■ Gender norms & bargaining    | How do intra-household dynamics across household structures (monogamous, polygamous, female-headed) shape women's agency and ability to diversify income in response to climate change?                                      |
| <b>Migration</b>               |                                                                                                                                                                                                                              |
| ■ Education & skills           | Can skills training and economic inclusion programs raise women's expected returns to migration, and thereby their participation in strategic labor migration?                                                               |
| ■ Social networks              | Does women's limited access to migrant networks deter climate-induced migration, and can facilitating their social and economic integration at destination improve their migration outcomes?                                 |
| ■ Financial capital            | Does easing women's liquidity constraints, through for instance transport subsidies or cash transfers, increase their ability to migrate in response to climate shocks?                                                      |
| ■ Land & productive assets     | Does the fear of expropriation reduce women's climate-induced migration, and does strengthening land tenure security relax this constraint?                                                                                  |
| ■ Gender norms & bargaining    | How do norms around caregiving and intra-household decision-making restrict women's migration, and does male out-migration ultimately burden or empower the women left behind?                                               |
| ■ Safety & trust               | Do safety risks and (mis)information about migration dangers deter women's migration, and can targeted information campaigns make migration a safer and viable adaptation strategy for women?                                |
| <b>Weather insurance</b>       |                                                                                                                                                                                                                              |

| Constraint                         | Priority research question                                                                                                                                                                     |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ■ Information & financial literacy | Is relaxing women's information and financial-literacy constraints sufficient to raise their take-up of weather insurance, or must information be bundled with complementary interventions?    |
| ■ Product design & trust           | Do insurance products designed around women's risk profiles — covering life-cycle risks, accommodating land tenure insecurity, or delivered by women agents — close the gender gap in take-up? |

---

### Adaptive social protection

---

|                                |                                                                                                                                                                                                                                                                   |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ■ Financial capital            | Which complements to cash transfers and economic inclusion packages (eg. savings instruments, financial training, or bundled climate-adaptive components) are most cost-effective in supporting women's adaptation investments and preventing maladaptive coping? |
| ■ Time & care responsibilities | Which gender-sensitive design features such as flexible hours, childcare provision, or safe transportation, most increase women's participation in, and benefits from, adaptive social protection?                                                                |
| ■ Gender norms & bargaining    | Does strengthening women's voice in program governance, for example through quotas in welfare decision-making bodies, make adaptive social protection more responsive to women's constraints?                                                                     |

---

Constraint groups: ■ Human, social & financial capital   ■ Contextual factors, norms & institutions  
 ■ Strategy-specific constraints

*Notes:* Colour markers identify the three constraint groups of the conceptual framework (Figure A1).

Beyond these headline questions, several design-level questions merit attention: whether joint spousal training can improve household decision-making around who migrates; whether insurance products can cover crops grown on leased land or deliver payouts through mobile money; whether linking cash transfers to early warning systems and anticipatory action strengthens women's resilience; and how the timing and digital delivery of transfers shape women's allocation toward adaptation investments rather than short-term consumption.

## 9 Summary and Discussion

This paper reviews the evidence on gender-specific constraints to climate adaptation across three key strategies and two enabling instruments in Sub-Saharan Africa, identifies interventions that effectively address these barriers, and proposes a research agenda. Women face greater barriers than men when adapting to climate change, both on-farm and off-farm. While some constraints are strategy-specific, others are common across adaptation strategies. The latter include women’s financial limitations and restricted control over assets, gender norms that position them as primary caregivers and shock absorbers, and constraints on women’s accumulation of human and social capital.

Five key constraints emerge. Limited access to credit, savings, and insurance products prevents women from investing in adaptation measures, safeguarding assets, and using savings or remittances to smooth consumption and reduce food insecurity. Insecure land tenure and limited control over productive assets reduce women’s ability to invest in agriculture, diversify livelihoods, and migrate. While strong causal evidence links tenure insecurity to lower adoption of climate-resilient technologies and practices, its role in shaping women’s uptake of insurance and other long-term adaptation strategies remains underexplored. Gender norms that designate women as primary caregivers, shock absorbers, and subsistence crop providers limit their time and flexibility for adaptation strategies including on-farm adaptation, crop selection, migration, and income diversification. Addressing these norms requires engaging men, improving childcare access, and promoting norm-changing interventions. Limited access to accurate climate and technology information increases uncertainty about the returns to on-farm adaptive investments and weather insurance, constraining adoption. Further research is needed on how information provision shapes women’s climate perception and adoption of long-term adaptation strategies. Women’s limited access to education and skills training reduces their ability to adapt on and off the farm. Gender gaps in social capital further restrict women’s access to information, which impedes their ability to migrate or engage in more sustainable on-farm and off-farm activities. There is a significant gap in

the literature on how social networks and gendered barriers to information diffusion impact women’s access to agricultural and climate adaptation knowledge.

The empirical evidence on interventions that address women’s constraints to climate adaptation is still scant, especially in Sub-Saharan Africa. Based on the available literature, we classify interventions into three categories: *credible*, *emerging*, and *frontier*, reflecting the strength of causal evidence supporting their effectiveness to guide policy and research prioritization. Across adaptation strategies, most interventions with *credible* evidence are not necessarily gender-specific, such as strengthened land tenure for on-farm investments, cash transfers and public works programs, or multi-faceted economic inclusion interventions, which jointly alleviate financial, skills, time and network constraints. Agricultural information delivery through female extension agents and childcare services also have been credibly shown to consistently improve women’s adoption of adaptation strategies. *Emerging* interventions in support of off-farm adaptation, such as socio-emotional skills training, joint spousal training, and land titling, show promise but remain supported by more limited or mixed causal evidence, and require further rigorous evaluation before scaling. These interventions address constraints related to agency and asset security, which are central to women’s adaptation decisions, particularly their ability to engage in non-farm activities. *Frontier* interventions, including digital climate information services, gender-responsive weather insurance, social network strengthening, and norm-changing initiatives, remain poorly documented despite strong conceptual relevance. Future research should rigorously evaluate these interventions, especially examining gender-responsive designs, with careful attention to context, household structure, and gendered power dynamics. Interventions that address restrictive gender norms and strengthen women’s intra-household bargaining power represent a critical priority, including community-level norm change and strategies that engage men in shifting norms around decision-making, housework, and caregiving. Evaluations of adaptation interventions should systematically adopt an intersectional lens, accounting not only for the structural barriers women face, but also for heterogeneity across household

arrangements and context-specific vulnerabilities. Across all adaptation strategies and enabling instruments, evidence remains highly context-specific, with intrahousehold dynamics, social norms, and institutional settings playing critical roles in shaping adaptation outcomes.

By its multifaceted nature, adaptive social protection plays a crucial role in alleviating simultaneous constraints that hinder the most vulnerable women's ability to access sustainable adaptation strategies. However, despite being the primary recipients of many social protection programs, women face persistent barriers, including limited financial autonomy, mobility constraints, and caregiving responsibilities, that restrict their ability to fully leverage these programs for climate adaptation. Addressing these gender-specific constraints through targeted program design, such as mobile transfers, childcare support, and gender-sensitive operational adjustments, is essential to enhancing women's adaptive capacity. Further research is needed to establish which operational features are the most cost-effective in making adaptive social protection work for women, and causal links between social protection and women's adoption of adaptive strategies, particularly in the African context.

Migration remains the least understood and most gender-differentiated climate adaptation strategy for women in Sub-Saharan Africa. While male migration is often framed as a strategic response to climate change, women's migration frequently reflects short-term coping rather than long-term adaptation and is more constrained by liquidity, expected returns, land tenure insecurity, safety risks, and limited social networks. Yet rigorous causal evidence is scarce. Priority research areas include identifying interventions that relax women's liquidity and mobility constraints, assessing how land tenure security and social networks shape migration decisions, and evaluating whether migration can serve as a viable and safe long-term adaptation strategy for women rather than merely a distress response.

Overall, the evidence reviewed here shows the need for both climate adaptation policies and future research to pay closer attention to the intersecting financial, informational, and normative constraints shaping women's adaptation choices.

# Endnotes

<sup>1</sup>The LSMS-ISA surveys are a notable exception. They collect plot-level data which provide gender-disaggregated indicators at the plot-manager level, critical for identifying barriers to women’s agricultural productivity.

<sup>2</sup>Gender-sensitive adaptation strengthens household resilience, as constraints faced by women in rural couples can weaken the entire family’s ability to cope with climate shocks. Since household decisions are often joint endeavors, addressing women’s adaptation barriers not only empowers them but also promotes inclusive decision-making and efficient resource allocation across the household.

<sup>3</sup>Estimates indicate that Sub-Saharan Africa will require \$15 billion annually for agriculture and food system adaptation, while the cost of inaction could be more than 10 times higher, surpassing \$200 billion annually (Ijjasz-Vasquez et al., 2021).

<sup>4</sup>While the review focuses on evidence from Sub-Saharan Africa, we occasionally draw on studies from other regions when the regional literature is too limited to draw conclusions. We clearly indicate when a study is set outside the region, and use such evidence to motivate future research questions rather than to draw conclusions about Sub-Saharan Africa.

<sup>5</sup>Various frameworks exist and are relevant, such as CSA, conservation agriculture, regenerative agriculture or sustainable intensification (Arakelyan et al., 2017; Zenda and Rudolph, 2024). These approaches are sometimes presented as competing policy frameworks, and the boundaries between them are not always clear. We do not propose to compare or oppose them here, and instead adopt the broader terminology of “on-farm adaptation” which includes all of the above.

<sup>6</sup>See also Box 3.

<sup>7</sup>Early warning systems provide alerts on extreme climate events such as droughts and floods, whereas weather forecasts consist of short-term predictions.

<sup>8</sup>Agricultural extension and advisory services range from agent-based recommendations on crop management and harvesting technologies to labor-saving practices and climate adaptation strategies.

<sup>9</sup>Lower trust is not an intrinsic gender trait but rather the result of structural inequalities and weak rule-of-law which favors men (on this topic, see for example, Ashraf et al. (2019)).

<sup>10</sup>The effectiveness of such support mechanisms may also depend on regional cultural and household norms, which shape women’s roles in decision-making, mobility, and control over resources. For example, practices common in West Africa’s polygamous households may influence intrahousehold bargaining dynamics differently than in monogamous Southern African settings.

<sup>11</sup>Digital devices include smartphones and tablets.

<sup>12</sup>For reviews of ICT-based extension and mobile phone-enabled services for smallholder farmers, see Aker (2011) and Baumüller (2018).

## **Declaration of generative AI and AI-assisted technologies in the manuscript preparation process**

During the preparation of this work, the authors used Claude (Anthropic) and ChatGPT (OpenAI) for English language editing, manuscript refinement, and figure preparation. The authors also used ASReview Lab during the literature screening process. After using these tools, the authors reviewed and edited all content as needed and take full responsibility for the content of the published article.

## **References**

- Abate, G. T., Bernard, T., Makhija, S., and Spielman, D. J. (2023). Accelerating technical change through ict: Evidence from a video-mediated extension experiment in ethiopia. *World Development*, 161:106089.
- Abebe, M. A. (2014). Climate Change, Gender Inequality And Migration in East Africa.
- Abiona, O. (2023). Weather shocks, birth and early life health: Evidence of different gender impacts. *Journal of African Economies*, pages 46–66.
- Abiona, O. and Koppensteiner, M. F. (2016). The Impact of Household Shocks on Domestic Violence: Evidence from Tanzania. Discussion Papers in Economics 16/14, Division of Economics, School of Business, University of Leicester.
- Adger, W., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D., Naess, L., Wolf, J., and Wreford, A. (2008). Are There Social Limits to Adaptation to Climate Change? *Climatic Change*, 93:335–354.

- Adzawla, W., Azumah, S. B., Anani, P. Y., and Donkoh, S. A. (2019). Gender perspectives of climate change adaptation in two selected districts of Ghana. *Heliyon*, 5(11):e02854.
- Agamile, P., Dimova, R., and Golan, J. (2021). Crop Choice, Drought and Gender: New Insights from Smallholders’ Response to Weather Shocks in Rural Uganda. *Journal of Agricultural Economics*, 72(3):829–856.
- Aguilar, A., Carranza, E., Goldstein, M., Kilic, T., and Oseni, G. (2015). Decomposition of gender differentials in agricultural productivity in Ethiopia. *Agricultural Economics*, 46(3):311–334.
- Agyei-Holmes, A., Buehren, N., Goldstein, M. P., Osei, R. D., Osei-Akoto, I., and Udry, C. R. (2020). The Effects of Land Title Registration on Tenure Security, Investment and the Allocation of Productive Resources: Evidence from Ghana. Policy Research Working Paper Series 9376, The World Bank.
- Ajayi, K. F., Dao, A., and Koussoube, M. E. J. (2022). The Effects of Childcare on Women and Children : Evidence from a Randomized Evaluation in Burkina Faso. Policy Research working paper WPS 10239, Impact Evaluation series Washington, D.C. : World Bank Group.
- Aker, J. C. (2011). Dial “A” for Agriculture: A Review of Information and Communication Technologies for Agricultural Extension in Developing Countries. *Agricultural Economics*, 42:631 – 647.
- Aker, J. C., Boumnijel, R., McClelland, A., and Tierney, N. (2016). Payment Mechanisms and Antipoverty Programs: Evidence from a Mobile Money Cash Transfer Experiment in Niger. *Economic Development and Cultural Change*, 65(1):1 – 37.
- Aker, J. C. and Jack, B. K. (2023). Harvesting the Rain: The Adoption of Environmental Technologies in the Sahel. *The Review of Economics and Statistics*, pages 1–52.

- Aker, J. C. and Ksoll, C. (2016). Can mobile phones improve agricultural outcomes? Evidence from a randomized experiment in Niger. *Food Policy*, 60:44–51.
- Akresh, R., De Walque, D., and Kazianga, H. (2016). Evidence from a randomized evaluation of the household welfare impacts of conditional and unconditional cash transfers given to mothers or fathers. Policy Research Working Paper Series 7730, The World Bank.
- Akter, S., Krupnik, T. J., Rossi, F., and Khanam, F. (2016). The influence of gender and product design on farmers’ preferences for weather-indexed crop insurance. *Global Environmental Change*, 38:217–229.
- Ali, D. A., Deininger, K., and Goldstein, M. (2014). Environmental and gender impacts of land tenure regularization in Africa: Pilot evidence from Rwanda. *Journal of Development Economics*, 110:262–275.
- Alibhai, S., Buehren, N., Frese, M., Goldstein, M., Papineni, S., and Wolf, K. (2019). Full esteem ahead? mindset-oriented business training in ethiopia. *Mindset-Oriented Business Training in Ethiopia (June 17, 2019)*. World Bank Policy Research Working Paper, (8892).
- Alik-Lagrange, A., Buehren, N., Goldstein, M., and Hoogeveen, J. (2023). Welfare impacts of public works in fragile and conflict affected economies: The Londö public works in the Central African Republic. *Labour Economics*, 81:102293.
- Alik-Lagrange, A., Delavallade, C., Goldstein, M., and Gonzalez, P. (2025). Unveiling the Gender Divide in Nigerian Smallholder Farming: High-Frequency Data Insights on Labor Composition and Time Allocation. Technical report.
- Andrews, C., Backiny-Yetna, P., Garin, E., Weedon, E., Wodon, Q., and Zampaglione, G. (2011). *Liberia’s Cash for Work Temporary Employment Project*. World Bank.
- Andriano, L. and Behrman, J. (2020). The effects of growing-season drought on young

- women's life course transitions in a sub-saharan context. *Population Studies*, 74(3):331–350.
- Antwi-Agyei, P., Amanor, N., and Dougill, A. J. (2021). Predictors of access to and willingness to pay for climate information services in north-eastern ghana: A gendered perspective. *Environmental Development*, 37:100580.
- Arakelyan, I., Wreford, A., Moran, D., Ninan, K., and Inoue, M. (2017). *Building a Climate Resilient Economy and Society: Challenges and Opportunities*, chapter Can agriculture be climate smart? Edward Elgar Publishing Ltd.: Cheltenham, UK.
- Arbache, J., Kolev, A., and Filipiak, E. (2010). *Gender Disparities in Africa's Labor Market*. The World Bank Group.
- Arimi, K. and Olajide, B. R. (2016). Comparative analysis of male and female adopters of improved rice production technology in Ogun and Ekiti states, Nigeria. *International Journal of Agricultural Resources, Governance and Ecology*, 12(3):246–261.
- Arteaga, J., Carter, M. R., and Hobbs, A. (2026). Insuring those who bear the risk: The impact of gender-inclusive framing on insurance uptake in kenya. *World Development*, 201:107330.
- Asfaw, S., Davis, B., Dewbre, Handa, S., and Winters, P. (2014). Cash Transfer Programme, Productive Activities and Labour Supply: Evidence from a Randomised Experiment in Kenya. *Journal of Development Studies*, 50.
- Ashraf, N., Bau, N., Low, C., and McGinn, K. (2020). Negotiating a Better Future: How Interpersonal Skills Facilitate Intergenerational Investment. *The Quarterly Journal of Economics*, 135(2):1095–1151.
- Ashraf, N., Delfino, A., and Glaeser, E. L. (2019). Rule of law and female entrepreneurship. Technical report, National Bureau of Economic Research.

- Asravor, R. (2017). Livelihood Diversification Strategies to Climate Change among Smallholder Farmers in Northern Ghana: Diversification Strategies to Climate Change. *Journal of International Development*, 30.
- Aswani, S., Lemahieu, A., and Sauer, W. H. (2018). Global trends of local ecological knowledge and future implications. *PLoS ONE*, 13.
- Auffhammer, M. (2018). Quantifying economic damages from climate change. *Journal of Economic Perspectives*, 32(4):33–52.
- Auffhammer, M., Hsiang, S. M., Schlenker, W., and Sobel, A. (2013). Using Weather Data and Climate Model Output in Economic Analyses of Climate Change. *Review of Environmental Economics and Policy*, 7(2):181–198.
- Autio, A., Johansson, T., Motaroki, L., Minoia, P., and Pellikka, P. (2021). Constraints for adopting climate-smart agricultural practices among smallholder farmers in Southeast Kenya. *Agricultural Systems*, 194:103284.
- Azzarri, C. and Nico, G. (2022). Sex-disaggregated agricultural extension and weather variability in africa south of the sahara. *World Development*, 155:105897.
- Babugura, A. (2008). Vulnerability of Children and Youth in Drought Disasters: A Case Study of Botswana. *Children, Youth and Environments*, 18:126–157.
- Baez, J., Caruso, G., Mueller, V., and Niu, C. (2017). Heat Exposure and Youth Migration in Central America and the Caribbean. *American Economic Review*, 107(5):446–50.
- Bah, T. L., Batista, C., Gubert, F., and McKenzie, D. (2023). Can information and alternatives to irregular migration reduce “backway” migration from The Gambia? *Journal of Development Economics*, 165(C).
- Bakhtiar, M. M., Fafchamps, M., Goldstein, M., Leonard, K. L., and Papineni, S. (2024). To

- defer or to differ: Experimental evidence on the role of cash transfers in Nigerian couples' decision-making. *The Economic Journal*, page ueae117.
- Balana, B. B., Mekonnen, D., Haile, B., Hagos, F., Yimam, S., and Ringler, C. (2022). Demand and supply constraints of credit in smallholder farming: Evidence from ethiopia and tanzania. *World Development*, 159:106033.
- Banerjee, A., Duflo, E., and Sharma, G. (2021). Long-Term Effects of the Targeting the Ultra Poor Program. *American Economic Review: Insights*, 3(4):471–86.
- Barnett, B. (2014). Multiple-peril crop insurance: successes and challenges. *Agricultural Finance Review*.
- Barrett, C. B., Islam, A., Mohammad Malek, A., Pakrashi, D., and Ruthbah, U. (2022). Experimental Evidence on Adoption and Impact of the System of Rice Intensification. *American Journal of Agricultural Economics*, 104(1):4–32.
- Bastagli, F., Hagen-Zanker, J., Harman, L., Barca, V., Sturge, G., Schmidt, T., and Pellerano, L. (2016). Cash transfers: What does the evidence say? A rigorous review of programme impact and of the role of design and implementation features.
- Baumüller, H. (2018). The Little We Know: An Exploratory Literature Review on the Utility of Mobile Phone-Enabled Services for Smallholder Farmers. *Journal of International Development*, 30:134–154.
- Baysan, C., Dar, M. H., Emerick, K., Li, Z., and Sadoulet, E. (2024). The agricultural wage gap within rural villages. *Journal of Development Economics*, 168(C).
- Beaman, L., Karlan, D., Thuysbaert, B., and Udry, C. (2013). Profitability of Fertilizer: Experimental Evidence from Female Rice Farmers in Mali. *American Economic Review*, 103(3):381–386.

- Becerra-Valbuena, L. G. and Millock, K. (2021). Gendered migration responses to drought in malawi. *Journal of Demographic Economics*, 87(3):437–477.
- Bedi, T., King, M., and Vaillant, J. (2025). Gender targeting and household cooperation: Experimental evidence from a multifaceted anti-poverty program in Malawi. Technical report.
- Belissa, T., Bulte, E., Cecchi, F., Gangopadhyay, S., and Lensink, R. (2019). Liquidity constraints, informal institutions, and the adoption of weather insurance: A randomized controlled Trial in Ethiopia. *Journal of Development Economics*, 140:269–278.
- Benhassine, N., Devoto, F., Duflo, E., Dupas, P., and Pouliquen, V. (2015). Turning a Shove into a Nudge? A "Labeled Cash Transfer" for Education. *American Economic Journal: Economic Policy*, 7(3):86–125.
- Benin, S., Smale, M., and Pender, J. (2005). Explaining the diversity of cereal crops and varieties grown on household farms in the highlands of Northern Ethiopia. *Valuing Crop Biodiversity: On-Farm Genetic Resources and Economic Change*, pages 78–96.
- BenYishay, A. and Mobarak, A. (2019). Social Learning and Incentives for Experimentation and Communication. *The Review of Economic Studies*, 86(3):976–1009.
- Berg, A., Quirion, P., and Sultan, B. (2009). Weather-Index Drought Insurance in Burkina-Faso: Assessment of Its Potential Interest to Farmers. *Weather, Climate, and Society*, 1(1):71 – 84.
- Berge, L. I. O., Bjorvatn, K., and Tungodden, B. (2015). Human and Financial Capital for Microenterprise Development: Evidence from a Field and Lab Experiment. *Management Science*, 61(4):707–722.
- Bernhardt, A., Field, E., Pande, R., and Rigol, N. (2019). Household matters: Revisiting

- the returns to capital among female microentrepreneurs. *American Economic Review: Insights*, 1(2):141–160.
- Bernhardt, A., Rigol, N., Pande, and Field, E. (2018). What Happens when Investments Targeting Women’s Microbusinesses Go to Men? Technical report.
- Bertoni, E., Corral, P., Molini, V., and Oseni, G. (2016). *Heterogeneous Returns to Income Diversification: Evidence from Nigeria*. The World Bank.
- Björkman-Nyqvist, M. (2013). Income shocks and gender gaps in education: Evidence from Uganda. *Journal of Development Economics*, 105(C):237–253.
- Black, R., Kniveton, D., and Schmidt-Verkerk, K. (2013). *Migration and Climate Change: Toward an Integrated Assessment of Sensitivity*, pages 29–53. Springer Netherlands, Dordrecht.
- Bossuroy, T., Goldstein, M., Karimou, B., Karlan, D., Kazianga, H., Pariente, W., Premand, P., Thomas, C., Udry, C., Vaillant, J., and Wright, K. (2022). Tackling psychosocial and capital constraints to alleviate poverty. *Nature*, 605:1–7.
- Bossuroy, T. and Vaillant, J. (2025). When training works but cash doesn’t: evidence from a youth employment program in Benin. Working Paper.
- Botea, I., Brudevold-Newman, A., Goldstein, M., Low, C., and Roberts, G. (2023). Supporting Women’s Livelihoods at Scale: Evidence from a Nationwide Multi-Faceted Program. Technical report, National Bureau of Economic Research.
- Boxho, C., Campos, F., Carneiro, P., Frese, M., Gielnik, M., Goldstein, M., Montalvao, J., and Scharweit, B. (2025). Overcoming the Knowing-Doing Gap in Farming by Personal Initiative: Experimental Evidence from Mozambique. Technical report.
- Brown, O. (2008). Climate change and forced migration: Observations, projections and implications. Technical report, Human Development Report.

- Brudevold-Newman, A., Honorati, M., Ipapa, G., Jakiela, P., and Ozier, O. (2024). A firm of one’s own: experimental evidence on credit constraints and occupational choice. *Review of Economics and Statistics*, pages 1–25.
- Bryan, G., Chowdhury, S., and Mobarak, A. (2014). Underinvestment in a Profitable Technology: The Case of Seasonal Migration in Bangladesh. *Econometrica*, 82:1671–1748.
- Bryan, G. and Morten, M. (2019). The Aggregate Productivity Effects of Internal Migration: Evidence from Indonesia. *Journal of Political Economy*, 127(5):2229 – 2268.
- Buehren, N., Chowdhury, S., Papineni, S., and Sulaiman, M. (2025). Impact of inputs, information, and financial services on the adoption of a biofortified crop by women farmers in uganda. *American Journal of Agricultural Economics*, 107(4):1117–1151.
- Buehren, N., Goldstein, M., Molina, E., and Vaillant, J. (2019). The impact of strengthening agricultural extension services on women farmers: Evidence from Ethiopia. *Agricultural Economics*, 50(4):407–419.
- Burlig, F., Jina, A., Kelley, E. M., Lane, G. V., and Sahai, H. (2024). Long-range forecasts as climate adaptation: Experimental evidence from developing-country agriculture. Technical report, National Bureau of Economic Research.
- Call, M., Gray, C., and Jagger, P. (2019). Smallholder responses to climate anomalies in rural uganda. *World Development*, 115:132–144.
- Campos, F., Frese, M., Goldstein, M., Iacovone, L., Johnson, H. C., McKenzie, D., and Mensmann, M. (2017). Teaching personal initiative beats traditional training in boosting small business in west africa. *Science*, 357(6357):1287–1290.
- Campos, F., Hernandez-de Benito, M., Jamison, J. C., Safir, A., and Zia, B. (2025). Persistent yet ameliorable shocks to female entrepreneurship: Experimental evidence from kenya. *Journal of Development Economics*, page 103546.

- Carleton, T., Duflo, E., Jack, B. K., and Zappalà, G. (2024). Adaptation to climate change. In *Handbook of the Economics of Climate Change*, volume 1, pages 143–248. Elsevier.
- Carranza, E., Dhakal, C., and Love, I. (2018). Female Entrepreneurs: How and Why Are They Different? Technical report, World Bank.
- Cattaneo, C., Beine, M., Frohlich, C. J., Kniveton, D., Martinez-Zarzoso, I., Mastrorillo, M., Millock, K., Piguet, E., and Schraven, B. (2019). Human Migration in the Era of Climate Change. *Review of Environmental Economics and Policy*, 13(2):189–206.
- Cattaneo, C. and Peri, G. (2016). The migration response to increasing temperatures. *Journal of Development Economics*, 122(Supplement C):127 – 146.
- Cecchi, F., Chegeh, J., Aredo, S. D., Kivuva, B., Kramer, B., Waithaka, L., and Waweru, C. (2021). Climate-smart crop insurance to promote adoption of stress-tolerant seeds: midterm findings from a cluster randomized trial.
- Charness, G., Gneezy, U., and Imas, A. (2013). Experimental methods: Eliciting risk preferences. *Journal of Economic Behavior and Organization*, 87:43–51.
- Chavas, J.-P., Chambers, R. G., and Pope, R. D. (2010). Production Economics and Farm Management: a Century of Contributions. *American Journal of Agricultural Economics*, 92(2):356–375.
- Cherchi, L., Goldstein, M., Habyarimana, J., Montalvao, J., O’Sullivan, M., and Udry, C. (2019). Incentives for Joint Land Titling: Experimental Evidence from Uganda. *Working Paper*.
- Cho, Y., Kalomba, D., Mobarak, A. M., and Orozco, V. (2013). *Gender Differences in the Effects of Vocational Training: Constraints on Women and Drop-Out Behavior*. The World Bank.

- Chort, I., Gubert, F., and Senne, J.-N. (2012). Migrant Networks as a Basis for Social Control : Remittance Incentives among Senegalese in France and Italy. *Regional Science and Urban Economics*, 42.
- Chuang, Y. (2019). Climate variability, rainfall shocks, and farmers' income diversification in India. *Economics Letters*, 174:55–61.
- Cinner, J., Adger, W., Allison, E., Barnes, M., Brown, K., Cohen, P., Gelcich, S., Hicks, C., Hughes, T., Lau, J., Marshall, N., and Morrison, T. (2018). Building adaptive capacity to climate change in tropical coastal communities. *Nature Climate Change*, 8.
- Cole, S., Giné, X., Tobacman, J., Topalova, P., Townsend, R., and Vickery, J. (2013). Barriers to Household Risk Management: Evidence from India. *American Economic Journal: Applied Economics*, 5(1):104–35.
- Colin, J.-P. and Ayouz, M. (2006). The Development of a Land Market? Insights from Côte d'Ivoire. *Land Economics*, 82:404–423.
- Conley, T. G. and Udry, C. R. (2010). Learning about a New Technology: Pineapple in Ghana. *American Economic Review*, 100(1):35–69.
- Cook, N. J., Grillos, T., and Andersson, K. P. (2019). Gender quotas increase the equality and effectiveness of climate policy interventions. *Nature Climate Change*, 9(4):330–334.
- Cools, S., Flatø, M., and Kotsadam, A. (2020). Rainfall shocks and intimate partner violence in sub-Saharan Africa. *Journal of Peace Research*, 57:002234331988025.
- Corno, L., Hildebrandt, N., and Voena, A. (2020). Age of Marriage, Weather Shocks, and the Direction of Marriage Payments. *Econometrica*, 88:879–915.
- Coulibaly, J., Birachi, E., Kagabo, D., and Mutua, M. (2017). Climate services for agriculture in Rwanda: Baseline survey report. CCAFS Working Paper 202, CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

- Croppenstedt, A., Goldstein, M., and Rosas, N. (2013). Gender and Agriculture: Inefficiencies, Segregation, and Low Productivity Traps. *The World Bank Research Observer*, 28.
- Crosetto, P. and Filippin, A. (2023). Safe options and gender differences in risk attitudes. *Journal of Risk and Uncertainty*, 66(1):19–46.
- Dadzie, C. E. and Ofei-Aboagye, E. (2021). *Opportunities for Youth and Women’s Participation in Ghana’s Labour-intensive Public Works Program*. World Bank.
- Dammert, A. C. and Nansamba, A. (2023). Skills training and business outcomes: Experimental evidence from liberia. *World Development*, 162:106120.
- de Mel, S., McKenzie, D., and Woodruff, C. (2008). Returns to Capital in Microenterprises: Evidence from a Field Experiment. *The Quarterly Journal of Economics*, 123(4):1329–1372.
- de Nicola, F. (2015a). Handling the Weather: Insurance, Savings, and Credit in West Africa. *Poverty and Equity Global Practice Working Paper Series*.
- de Nicola, F. (2015b). The impact of weather insurance on consumption, investment, and welfare. *Quantitative Economics*, 6(3):637–661.
- Defrance, D., Delesalle, E., and Gubert, F. (2022). Migration response to drought in Mali. An analysis using panel data on Malian localities over the 1987-2009 period. *Environment and Development Economics*, page 1–20.
- Delavallade, C., Dizon, F., Hill, R. V., and Petraud, J.-P. (2026). Financial inclusion for agricultural investments: experimental evidence on male and female farm managers in the sahel. *Oxford Development Studies*, pages 1–24.
- Dercon, S. and Christiaensen, L. (2011). Consumption risk, technology adoption and poverty traps: Evidence from Ethiopia. *Journal of Development Economics*, 96(2):159–173.

- Dercon, S., Hill, R. V., Clarke, D., Outes-Leon, I., and Seyoum Taffesse, A. (2014). Offering rainfall insurance to informal insurance groups: Evidence from a field experiment in Ethiopia. *Journal of Development Economics*, 106:132–143.
- Deressa, T., Hassan, R., Ringler, C., Alemu, T., and Yesuf, M. (2009). Determinants of farmers’ choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global Environmental Change*, 19:248–255.
- Descheemaeker, K., Oosting, S., Homann-Kee Tui, S., Masikati, P., Gatien, F., and Giller, K. (2016). Climate change adaptation and mitigation in smallholder crop–livestock systems in sub-Saharan Africa: a call for integrated impact assessments. *Regional Environmental Change*, 16.
- Devereux, S. and Guenther, B. (2009). Agriculture and Social Protection in Ethiopia.
- Di Falco, S. and Chavas, J.-P. (2008). On Crop Biodiversity, Risk Exposure, and Food Security in the Highlands of Ethiopia. *American Journal of Agricultural Economics*, 91:599–611.
- Dicko, A. H., William, F., Mueller, M., and Bouyer, J. (2014). Index-based insurance: a new tool to control vector-borne diseases under climate change in West Africa ?
- Dikito-Wachtmeister, M. (2001). Social capital: The ‘missing link’ in water resources management. *Waterlines*, 20:29–31.
- Dillon, A., Mueller, V., and Salau, S. (2011). Migratory Responses to Agricultural Risk in Northern Nigeria. *American Journal of Agricultural Economics*, 93(4):1048–1061.
- Dilmaghani, M. (2021). A matter of time: Gender, time constraint, and risk taking among the chess elite. *Economics Letters*, 208:110085.
- Diouf, N. S., Ouedraogo, I., Zougmore, R. B., Ouedraogo, M., Partey, S. T., and Gumucio,

- T. (2019). Factors influencing gendered access to climate information services for farming in Senegal. *Gender, Technology and Development*, 23(2):93–110.
- Djouidi, H. and Brockhaus, M. (2011). Is Adaptation to Climate Change Gender Neutral? Lessons from Communities Dependent on Livestock and Forests in Northern Mali. *International Forestry Review*, 13.
- Donald, A., Lowes, S., and Vaillant, J. (2023). Experimental evidence on rural childcare provision.
- Donald, A. A., Goldstein, M. P., and Rouanet, L. M. (2022). Two Heads Are Better Than One : Agricultural Production and Investment in Côte d’Ivoire. Policy Research Working Paper Series 10047, The World Bank.
- Doss, C. and Meinzen-Dick, R. (2020). Land tenure security for women: A conceptual framework. *Land Use Policy*, 99:105080.
- Doss, C. R. (2001). Designing Agricultural Technology for African Women Farmers: Lessons from 25 Years of Experience. *World Development*, 29(12):2075–2092.
- Doss, C. R. (2018). Women and agricultural productivity: Reframing the Issues. *Development Policy Review*, 36(1):35–50.
- Drever, A. and Hoffmeister, O. (2008). Immigrants and Social Networks in a Job-Scarce Environment: The Case of Germany. *International Migration Review*, 42:425 – 448.
- Duflo, E. (2003). Grandmothers and Granddaughters: Old-Age Pensions and Intrahousehold Allocation in South Africa. *The World Bank Economic Review*, 17(1):1–25.
- Duflo, E. (2012). Women empowerment and economic development. *Journal of Economic literature*, 50(4):1051–1079.

- Duflo, E. and Udry, C. (2004). Intrahousehold Resource Allocation in Cote d'Ivoire: Social Norms, Separate Accounts and Consumption Choices. Working Paper 10498, National Bureau of Economic Research.
- Dyer, J. and Shapiro, J. (2023). Pumps, prosperity and household power: Experimental evidence on irrigation pumps and smallholder farmers in kenya. *Journal of Development Economics*, 163:103034.
- Ebabu, M., Ayalew, Z., Jemal, K., and Sileshi, M. (2026). Microfinance credit and household food security in north wollo, ethiopia: an endogenous switching regression analysis. *Agricultural Finance Review*.
- Ellis, F. (2005). Small-Farms, Livelihood Diversification and Rural-Urban Transitions: Strategic Issues in Sub-Saharan Africa.
- Elmallakh, N. and Wodon, Q. (2025). Climate shocks, migration, and labor markets: a gender analysis from west africa. *The Journal of Development Studies*, 61(9):1443–1477.
- Emerick, K. and Dar, M. (2020). Farmer Field Days and Demonstrator Selection for Increasing Technology Adoption. *The Review of Economics and Statistics*, pages 1–41.
- Eriksen, S. H., Brown, K., and Kelly, P. M. (2005). The dynamics of vulnerability: locating coping strategies in Kenya and Tanzania. *The Geographical Journal*, 171(4):287–305.
- Eriksen, T. H. (1999). *A Non-ethnic State for Africa? A Life-world Approach to the Imagining of Communities*, pages 45–64. Palgrave Macmillan UK, London.
- Erman, A., De Vries Robbe, S. A., Thies, S. F., Kabir, K., and Maruo, M. (2021). Gender Dimensions of Disaster Risk and Resilience : Existing Evidence. Technical report, Washington, D.C. : World Bank Group.
- Fafchamps, M., McKenzie, D., Quinn, S., and Woodruff, C. (2014). Microenterprise growth

- and the flypaper effect: Evidence from a randomized experiment in Ghana. *Journal of development Economics*, 106:211–226.
- Fenske, J. (2009). L’Etranger: Status, Property Rights and Investment Incentives in Cote d’Ivoire. *Land Economics*, 86.
- Feriga, M., Gracia, N. L., and Serneels, P. (2025). The impact of climate change on work: Lessons for developing countries. *The World Bank Research Observer*, 40(1):104–146.
- Fikadu, T., Damene, S., and Teklu, A. (2024). Determinants of climate information service access and use among smallholder farmers in bereh woreda, ethiopia. *Integrated Environmental Assessment and Management*, 20(3):794–804.
- Findley, S. (1994). Does drought increase migration? A study of migration from rural Mali during the 1983-1985 drought. *International Migration Review*, 28(3):539–553.
- Flatø, M., Muttarak, R., and Pelsler, A. (2017). Women, weather, and woes: The triangular dynamics of female-headed households, economic vulnerability, and climate variability in south africa. *World development*, 90:41–62.
- Food and Organization, A. (2010). *”Climate-Smart” Agriculture: Policies, Practices and Financing for Food Security, Adaption and Mitigation*. Food and Agriculture Organization of the United Nations.
- Friedson-Ridenour, S. and Pierotti, R. S. (2019). Competing priorities: Women’s microenterprises and household relationships. *World Development*, 121:53–62.
- Fröhlich, C. and Brzoska, M. (2015). Climate Change, Migration and Violent Conflict: Vulnerabilities, Pathways and Adaptation Strategies. *Migration Development*, 5.
- Gaddis, I., Lahoti, R. S., and Li, W. (2018). Gender Gaps in Property Ownership in Sub-Saharan Africa. Policy Research Working Paper Series 8573, The World Bank.

- Gannon, K., Castellano, E., Eskander, S., Agol, D., Diop, M., Conway, D., and Sprout, E. (2022). The triple differential vulnerability of female entrepreneurs to climate risk in sub-Saharan Africa: Gendered barriers and enablers to private sector adaptation. *Wiley Interdisciplinary Reviews: Climate Change*, 13.
- Gavrilovic, M., Rubio, M., Bastagli, F., Hinton, R., Staab, S., Goulder, R. G., Bilo, C., Khan, R., Peterman, A., Diallo, B., Alfars, L., Santiago, A., Rizvi, Z., Holmes, R., Mejia, J. G. J., and Tabbush, C. (2022). Gender-responsive social protection post-COVID-19. *Science*, 375(6585):1111–1113.
- Gebrehiwot, T. and Veen, A. (2013). Farm Level Adaptation to Climate Change: The Case of Farmer’s in the Ethiopian Highlands. *Environmental management*, 52.
- Geiger, M. and Pécoud, A. (2019). *The Politics of International Migration Management*.
- Gittard, M. (2024). Droughts, Migration and Population in Kenya. *PSE Working Paper*.
- Glennerster, R. and Suri, T. (2018). Agricultural Technology and Nutrition: The Impacts of NERICA Rice in Sierra Leone. *Working Paper*.
- Goldstein, M., Hounghedji, K., Kondylis, F., O’Sullivan, M., and Selod, H. (2015). *Formalizing Rural Land Rights in West Africa: Early Evidence from a Randomized Impact Evaluation in Benin*. The World Bank.
- Goldstein, M. and Udry, C. (2008). The Profits of Power: Land Rights and Agricultural Investment in Ghana. *Journal of Political Economy*, 116(6):981–1022.
- Gotschi, E., Njuki, J., and Delve, R. (2008). Gender equity and social capital in smallholder farmer groups in central Mozambique. *Development in Practice*, 18(4-5):650–657.
- Grace, K., Davenport, F., Hanson, H., Funk, C., and Shukla, S. (2015). Linking climate change and health outcomes: Examining the relationship between temperature, precipitation and birth weight in Africa. *Global Environmental Change*, 35:125–137.

- Gray, C. and Mueller, V. (2012). Drought and population mobility in rural ethiopia. *World development*, 40(1):134–145.
- Greatrex, H., Hansen, J., Garvin, S., Diro, R., Blakeley, S., Le Guen, M., Rao, K., and Osgood, D. (2015). Scaling up index insurance for smallholder farmers: Recent evidence and insights. CCAFS Report 14, CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).
- Guirkingier, C., Gross, J., and Platteau, J.-P. (2021). Are women emancipating? Evidence from marriage, divorce and remarriage in Rural Northern Burkina Faso. *World Development*, 146:105512.
- Gumucio, T., Hansen, J., Huyer, S., and van Huysen, T. (2020). Gender-responsive rural climate services: a review of the literature. *Climate and Development*, 12(3):241–254.
- Gupta, R., Bora, K., Gangopadhyay, P. K., and Aggarwal, P. K. (2026). Who adopts what? a systematic global review of gender dynamics in climate-smart agriculture. *Agricultural Systems*, 234:104688.
- Haddaway, N. R., Page, M. J., Pritchard, C. C., and McGuinness, L. A. (2022). Prisma2020: An r package and shiny app for producing prisma 2020-compliant flow diagrams, with interactivity for optimised digital transparency and open synthesis. *Campbell systematic reviews*, 18(2):e1230.
- Hailemariam, A., Kalsi, J., and Mavisakalyan, A. (2024). Gender gaps in the adoption of climate-smart agricultural practices: Evidence from sub-saharan africa. *Journal of Agricultural Economics*, 75(2):764–793.
- Hamory, J., Kleemans, M., Li, N., and Miguel, E. (2020). Reevaluating Agricultural Productivity Gaps with Longitudinal Microdata. *Journal of the European Economic Association*, 19.

- Hanna, R., Mullainathan, S., and Schwartzstein, J. (2014). Learning Through Noticing: Theory and Evidence from a Field Experiment. *The Quarterly Journal of Economics*, 129(3):1311–1353.
- Harris, J. R. and Todaro, M. P. (1970). Migration, Unemployment Development: A Two-Sector Analysis. *American Economic Review*, 60(1):126–42.
- Henderson, J. V., Storeygard, A., and Deichmann, U. (2017). Has climate change driven urbanization in Africa? *Journal of Development Economics*, 124(C):60–82.
- Henriksson, R., Vincent, K., Archer, E., and Jewitt, G. (2021). Understanding gender differences in availability, accessibility and use of climate information among smallholder farmers in malawi. *Climate and Development*, 13(6):503–514.
- Henry, S., Schoumaker, B., and Beauchemin, C. (2004). The Impact of Rainfall on the First Out-Migration: A Multilevel Event-History Analysis in Burkina Faso. *Population and Environment*, 25:423–460.
- Hesselberg, J. and Yaro, J. (2006). An assessment of the extent and causes of food insecurity in Northern Ghana using a livelihood vulnerability framework. *GeoJournal*, 67:41–55.
- Hidrobo, M., Mueller, V., Roy, S., Bryan, E., Nesbitt-Ahmed, Z., and Läderach, P. (2026). Leveraging social protection to strengthen women’s and girls’ climate-resilience in agrifood systems. *Food Policy*, 140:103066.
- Hill, R. V. and Robles, M. (2011). Flexible insurance for heterogeneous farmers: Results from a small-scale pilot in Ethiopia. IFPRI discussion papers 1092, International Food Policy Research Institute (IFPRI).
- Hill, R. V. and Viceisza, A. (2012). A field experiment on the impact of weather shocks and insurance on risky investment. Ifpri discussion papers, International Food Policy Research Institute (IFPRI).

- Hillesland, M. (2019). Gender differences in risk behavior: An analysis of asset allocation decisions in ghana. *World Development*, 117:127–137.
- Holden, S. T. and Ghebru, H. (2016). Land tenure reforms, tenure security and food security in poor agrarian economies: Causal linkages and research gaps. *Global Food Security*, 10:21–28.
- Hotte, R. and Marazyan, K. (2020). Demand for insurance and within-kin-group marriages: Evidence from a West-African country. *Journal of Development Economics*, 146:102489.
- Howden, S., Soussana, J.-F., Tubiello, F., Chhetri, N., Dunlop, M., and Meinke, H. (2008). Adapting Agriculture to Climate Change. *Proceedings of the National Academy of Sciences of the United States of America*, 104:19691–6.
- Hübler, M., Ogenrwoth, B., Walusimbi, R., Ssali, P., Bonabana, J., and Kyamanywa, S. (2025). The impact of weather shocks on food security in uganda: a panel regression analysis. *Food Security*, 17(4):957–978.
- Hultgren, A., Carleton, T., Delgado, M., Gergel, D. R., Greenstone, M., Houser, T., Hsiang, S., Jina, A., Kopp, R. E., Malevich, S. B., et al. (2025). Impacts of climate change on global agriculture accounting for adaptation. *Nature*, 642(8068):644–652.
- Huyer, S. (2016). Closing the Gender Gap in Agriculture. *Gender, Technology and Development*, 20(2):105–116.
- Huyer, S., Loboguerrero, A. M., Chanana, N., and Spellman, O. (2024). From gender gaps to gender-transformative climate-smart agriculture. *Current Opinion in Environmental Sustainability*, 67:101415.
- Ifeanyi-obi, C. C. and Tolumoyi, Y. E. (2025). Utilisation of extension serviceation by male and female arable cropfarmers in bayelsa state, nigeria. *Journal of Agricultural Extension*, 29(3):118–133.

- Ijjasz-Vasquez, E. J., Saghir, J., and Noble, I. (2021). State and Trends in Adaptation Report 2021: Africa.
- Imbert, C. and Papp, J. (2020). Costs and benefits of rural-urban migration: Evidence from India. *Journal of Development Economics*, 146(C):S0304387820300481.
- IOM (2018). Migration, Climate change and the Environment. Technical report.
- IPCC (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Cambridge Univ Press, Cambridge, UK.
- IPCC (2022). Climate Change 2022: Mitigation of Climate Change. Technical report, Cambridge University Press.
- Irbik, D. E. (2022). A systematic literature review of water–migration–gender nexus toward integrated governance strategies for (non) migrants. *Frontiers in Water*, 4:921459.
- Ishaya, s. and Abaje, I. (2008). Indigenous People’s Perception on Climate Change and Adaptation Strategies in Jema’a Local Government Area of Kaduna State, Nigeria. *Journal of Geography and Regional Planning.*, 1:138–143.
- Jayachandran, S. (2015). The roots of gender inequality in developing countries. *Annual review of economics*, 7(1):63–88.
- Johnson, N., Njuki, J., Waithanji, E., Nhambeto, M., Rogers, M., and Kruger, E. (2015). The Gendered Impacts of Agricultural Asset Transfer Projects. *Gender, Technology and Development*, 19:145–180.
- Jordan, J., Abhilashi, R., and Shaheen, A. (2021). Gender-sensitive social protection in the face of climate risk: A study in Uttar Pradesh, Rajasthan and Madhya Pradesh, India.
- Jost, C., Kyazze, F., Naab, J., Neelormi, S., Kinyangi, J., Zougmore, R., Aggarwal, P., Gopal, B., Ah, M., Chaudhury, Tapio-Bistrom, M.-L., Nelson, S., Kristjanson, P., Bhatta,

- G., and Chaudhury, M. (2015). Understanding gender dimensions of agriculture and climate change in smallholder farming communities. *Climate and Development*, 8.
- Kakota, T., Nyariki, D., Mkwambisi, D., and Wambui, K.-M. (2011). Gender vulnerability to climate variability and household food insecurity. *Climate and Development*, 3:1–12.
- Kamei, A. (2022). Who walks for water? water consumption and labor supply response to rainfall scarcity in uganda. *SSRN Electronic Journal*.
- Karlan, D., Osei, R., Osei-Akoto, I., and Udry, C. (2014). Agricultural decisions after relaxing credit and risk constraints. *The Quarterly Journal of Economics*, 129(2):597–652.
- Katungi, E., Smale, M., and Edmeades, S. (2008). Gender, social capital and information exchange in rural Uganda. *Journal of International Development*, 20:35–52.
- Kebede, H. A. (2022). Risk Aversion and Gender Gaps in Technology Adoption by Smallholder Farmers: Evidence from Ethiopia. *Journal of Development Studies*, 58(9):1668–1692.
- Khan, R. and Morrissey, O. (2020). Income diversification and household welfare in Tanzania 2008-2013. Technical report.
- Kihoro, E., Lecoutere, E., and Mishra, A. (2026). Uncovering the intersections of women’s empowerment and gender equality in climate adaptive capacities in climate hotspots for women in zambia. *Journal of Asian and African Studies*, 61(2):917–947.
- Kilic, T., Palacios-López, A., and Goldstein, M. (2015). Caught in a Productivity Trap: A Distributional Perspective on Gender Differences in Malawian Agriculture. *World Development*, 70:416–463.
- Koloma, Y. (2014). Crop Microinsurance for Maize Farmers in Burkina Faso: Access and Agriculture Performance in the Dandé Village. *Strategic Change*, 24:115–129.

- Kondylis, F., Mueller, V., Sheriff, G., and Zhu, S. (2016). Do Female Instructors Reduce Gender Bias in Diffusion of Sustainable Land Management Techniques? Experimental Evidence From Mozambique. *World Development*, 78:436–449.
- Koudjom, E. and Lokonon, B. O. K. (2023). Gender analysis of access to fortivity: evidence from togo. *Canadian Journal of Development Studies*, 44(4):533–553.
- Kramer, B., Cecchi, F., Levine, M., and Waithaka, L. (2025). See it grow: A randomized evaluation of a digital innovation to improve crop insurance contract design. IFPRI Discussion Paper 2396, International Food Policy Research Institute (IFPRI).
- Kramer, B. and Lambrecht, I. (2019). Gender and preferences for non-farm income diversification: A framed field experiment in Ghana:. IFPRI discussion papers 1855, International Food Policy Research Institute (IFPRI).
- Kramer, B. and Timu, A. G. (2023). Estimating the intrahousehold costs and benefits of innovations to enhance smallholder farmers’ resilience. *Frontiers in Sustainable Food Systems*, 7:1129419.
- Kramer, B., Trachtman, C., and Zuze, L. (2023a). Information as a Source of Empowerment: The Role of Climate Information Services. *AICCRA Workin Paper no.17*.
- Kramer, B., Waweru, C., and Malacarne, J. G. (2023b). Control over future payouts and willingness-to-pay for insurance: Experimental evidence from Kenyan farmers. Technical report, Conference paper presented at Agricultural Applied Economics Association Annual Meeting, Washington DC on July 23-25, 2023.
- Krishnan, P. and Patnam, M. (2014). Neighbors and Extension Agents in Ethiopia: Who Matters More for Technology Adoption? *American Journal of Agricultural Economics*, 96(1):308–327.

- Lagakos, D., Mobarak, M., and Waugh, M. (2022). The Welfare Effects of Encouraging Rural-Urban Migration.
- Lawry, S., Samii, C., Hall, R., Leopold, A., Hornby, D., and Mtero, F. (2017). The impact of land property rights interventions on investment and agricultural productivity in developing countries: a systematic review. *Journal of Development Effectiveness*, 9(1):61–81.
- Lecoutere, E., Spielman, D. J., and Van Campenhout, B. (2023). Empowering women through targeting information or role models: Evidence from an experiment in agricultural extension in Uganda. *World Development*, 167:106240.
- Leino, J. (2007). Gender and Community Management of Water Infrastructure: Evidence from a Randomized Evaluation in Kenya.
- Lovo, S. (2016). Tenure insecurity and investment in soil conservation. evidence from malawi. *World Development*, 78:219–229.
- Lovo, S. and Veronesi, M. (2019). Crop Diversification and Child Health: Empirical Evidence From Tanzania. *Ecological Economics*, 158:168–179.
- Macours, K. (2012). Volatility, Risk and Household Poverty: Micro-evidence from Randomized Control Trials. *Agricultural Economics*, 44.
- Macours, K., Premand, P., and Vakis, R. (2022). Transfers, Diversification and Household Risk Strategies: Can Productive Safety Nets Help Households Manage Climatic Variability? *The Economic Journal*, 132(647):2438–2470.
- Maddison, D. (2007). *The Perception Of And Adaptation To Climate Change In Africa*. The World Bank.
- Magreta, R., Botha, R., Marchetta, F., Mgomezulu, W., Mwale, M. L., and Tione, G. (2026). Exploring gender gaps in technology adoption and agricultural productivity: insights from male and female plot managers in malawi. *Journal of Development Studies*, pages 1–24.

- Malapit, H. J., Meinzen-Dick, R. S., Quisumbing, A. R., and Zselezky, L. (2020). Women: Transforming food systems for empowerment and equity. *IFPRI book chapters*, pages 36–45.
- Marchetta, F., Sahn, D., Tiberti, L., and Dufour, J. (2021). Heterogeneity in migration responses to climate shocks: evidence from madagascar.
- Marchiori, L., Maystadt, J., and Schumacher, I. (2012). The impact of weather anomalies on migration in sub-Saharan Africa. *Journal of Environmental Economics and Management*, 63(3):355 – 374.
- Mazzucato, V. (2009). Informal Insurance Arrangements in Ghanaian Migrants’ Transnational Networks: The Role of Reverse Remittances and Geographic Proximity. *World Development*, 37:1105–1115.
- McCarter, J., G. M. (2011). Perceptions of the value of traditional ecological knowledge to formal school curricula: opportunities and challenges from Malekula Island. *Ethnobiology Ethnomedicine* 7.
- McGuirk, E. F. and Nunn, N. (2024). Transhumant Pastoralism, Climate Change, and Conflict in Africa. *The Review of Economic Studies*, page rdae027.
- McKenzie, D. and Puerto, S. (2021). Growing markets through business training for female entrepreneurs: A market-level randomized experiment in kenya. *American Economic Journal: Applied Economics*, 13(2):297–332.
- McKenzie, D. and Rapoport, H. (2010). Self-Selection Patterns in Mexico-U.S. Migration: The Role of Migration Networks. *The Review of Economics and Statistics*, 92(4):811–821.
- McKenzie, D. and Yang, D. (2015). Evidence on Policies to Increase the Development Impacts of International Migration. *World Bank Research Observer*, 30(2):155–192.

- McKune, S., Poulsen, L., Russo, S., Devereux, T., Faas, S., McOmber, C., and Ryley, T. (2018). Reaching the end goal: Do interventions to improve climate information services lead to greater food security? *Climate Risk Management*, 22:22–41. Scaling Up Climate Services for Smallholder Farmers: Learning from Practice.
- Meinzen, D., Ruth, S., Johnson, N., Quisumbing, A. R., Njuki, J., Behrman, Julia A. and Rubin, D., and Peterman, A. (2013). Gender, assets, and agricultural development programs: A conceptual framework. Technical report, International Food Policy Research Institute (IFPRI).
- Meinzen-Dick, R., Behrman, J. A., Pandolfelli, L., Peterman, A., and Quisumbing, A. R. (2014). Gender and social capital for agricultural development. In *Gender in agriculture: Closing the knowledge gap*. Springer.
- Mersha, F. and Duguma, A. (2019). Climate Change and Its Impact on Agricultural Production in Ethiopia: An Empirical Review from Sub-Saharan Perspective. *Journal of Agricultural Economics and Rural Development*, 5:627–633.
- Mersha, T. and Sriram, V. (2019). Gender, entrepreneurial characteristics, and success: Evidence from Ethiopia. *Thunderbird International Business Review*, 61(2):157–167.
- Miguel, E. (2005). Poverty and Witch Killing. *The Review of Economic Studies*, 72(4):1153–1172.
- Missirian, A. and Schlenker, W. (2017). Asylum applications respond to temperature fluctuations. *Science*, 358(6370).
- Mitchell, T., Tanner, T., and Lussier, K. (2007). We Know What We Need: South Asian Women Speak Out on Climate Change Adaptation. Technical report, Institute of Development Studies (IDS), Sussex.

- Mobarak, A. M. and Rosenzweig, M. (2012). Selling Formal Insurance to the Informally Insured. Working Papers 1007, Economic Growth Center, Yale University.
- Molua, E. (2011). Farm income, gender differentials and climate risk in Cameroon: Typology of male and female adaptation options across agroecologies. *Sustainability Science*, 6:21–35.
- Morsy, H. (2020). Access to finance – Mind the gender gap. *The Quarterly Review of Economics and Finance*, 78:12–21.
- Morten, M. (2019). Temporary Migration and Endogenous Risk Sharing in Village India. *Journal of Political Economy*, 127(1):1 – 46.
- Moshoeshoe, R., Nchake, M. A., and Tiberti, L. (2021). The Effect of Weather Shocks on Women’s Labor Supply and the Income of Women-Headed Households in Lesotho. *Working Paper*.
- Mude, A. and Barrett, C. (2012). Index-Based Livestock Insurance in northern Kenya: An analysis of the patterns and determinants of purchase. Technical report, Kenya: ILRI.
- Mude, A., Chantarat, S., Barrett, C., Carter, M., Ikegami, M., and Mcpeak, J. (2010). Insuring Against Drought-Related Livestock Mortality: Piloting Index Based Livestock Insurance in Northern Kenya. *SSRN Electronic Journal*.
- Mueller, V., Gray, C., and Kosec, K. (2014). Heat Stress Increases Long-term Human Migration in Rural Pakistan. *Nature climate change*, 4.
- Muller, B. (2012). Index based crop insurance in Senegal and West Africa: some concerns based on on-going experiments. Technical report, CIRAD, Agricultural Research for Development.
- Murken, L. and Gornott, C. (2022). The importance of different land tenure systems for

- farmers' response to climate change: A systematic review. *Climate Risk Management*, 35:100419.
- Mutangadura, G. (2007). The incidence of land tenure insecurity in Southern Africa: Policy implications for sustainable development. *Natural Resources Forum*, 31:176 – 187.
- Mwalupaso, G. E., Geng, X., and Yasin, S. I. (2025). Financial inclusion for sustainable agriculture: Pathways among smallholder women farmers in rural zambia. *Plos one*, 20(7):e0326980.
- Nabikolo, D., Bashaasha, B., Mangheni, M., and Mwanjalolo, M. (2012). Determinants of climate change adaptation among male and female headed farm households in eastern Uganda. *African Crop Science Journal*, 20:203–212.
- Natali, L., Handa, S., Peterman, A., Seidenfeld, D., Tembo, G., and of Research Innocenti, U. O. (2016). Making Money Work: Unconditional cash transfers allow women to save and re-invest in rural Zambia. Papers inwopa827, Innocenti Working Papers.
- Nchanji, E., Nduwarugira, E., Ndabashinze, B., Bararyenya, A., Hakizimana, M. B., Nyamolo, V., and Lutomia, C. (2023). Gender norms and differences in access and use of climate-smart agricultural technology in burundi. *Frontiers in Sustainable Food Systems*, 7:1040977.
- Nelson, J. A. (2015). Are women really more risk-averse than men? A re-analysis of the literature using expanded methods. *Journal of Economic Surveys*, 29(3):566–585.
- Nelson, V., Meadows, K., Cannon, T., Morton, J., and Martin, A. (2002). Uncertain predictions, invisible impacts, and the need to mainstream gender in climate change adaptations. *Gender & Development*, 10(2):51–59.
- Ngigi, M. and Muange, E. (2022). Access to climate information services and climate-smart agriculture in Kenya: a gender-based analysis. *Climatic Change*, 174.

- Nhemachena, C. and Hassan, R. (2007). Micro-Level Analysis of Farmers' Adaptation to Climate Change in Southern Africa.
- Nicholson, S. E. (2018). The ITCZ and the Seasonal Cycle over Equatorial Africa. *Bulletin of the American Meteorological Society*, 99(2):337 – 348.
- Ningombam, S., Das, A., Puskur, R., and Kumar, S. (2026). Unveiling gendered perspectives on farmers' climate risk perception and adaptation strategies. *Regional Environmental Change*, 26(1):33.
- Nyantakyi-Frimpong, H. (2019). Combining feminist political ecology and participatory diagramming to study climate information service delivery and knowledge flows among smallholder farmers in northern Ghana. *Applied Geography*, 112.
- Okumu, B., Radeny, M., and Cramer, L. (2025). Welfare effects and gender dimensions of adoption of climate smart agriculture practices: Evidence from kenyan small-scale farmers. *World Development Sustainability*, 6:100204.
- Otsuki, K. and Jasaw, G. S. (2017). *Redistribution of property rights in response to climate change in Ghana, West Africa, In Property Rights and Climate Change: Land Use under Changing Environmental Conditions.*
- Palacios-Lopez, A., Christiaensen, L., and Kilic, T. (2017). How much of the labor in African agriculture is provided by women? *Food policy*, 67:52–63.
- Pan, Y., Smith, S. C., and Sulaiman, M. (2018). Agricultural extension and technology adoption for food security: Evidence from uganda. *American Journal of Agricultural Economics*, 100(4):1012–1031.
- Panthou, G., Lebel, T., Viscel, T., Quantin, G., Sane, Y., Ba, A., Ndiaye, O., Diongue Niang, A., and Diopkane, M. (2018). Rainfall intensification in tropical semi-arid regions : the Sahelian case. *Environmental Research Letters*, 13:p. art. 064013 [10 p.].

- Partey, S., Dakorah, A., Zougmore, R., Ouedraogo, M., Nyasimi, M., Nikoi, G., and Huyer, S. (2020). Gender and climate risk management: evidence of climate information use in Ghana. *Climatic Change*, 158.
- Patel, K. and Vella, F. (2007). Immigrant Networks and Their Implications for Occupational Choice and Wages. *Institute for the Study of Labor (IZA), IZA Discussion Papers*, 95.
- Perez, C., Jones, E., Kristjanson, P., Cramer, L., Thornton, P., Förch, W., and Barahona, C. (2015). How resilient are farming households and communities to a changing climate in Africa? A gender-based perspective. *Global Environmental Change*, 34:95–107.
- Peterman, A., Wang, J., Sonke, K. K., and Steinert, J. (2024). Social Safety Nets, Women’s Economic Achievements and Agency: A Systematic Review and Meta-Analysis. *Center for Global Development Working Papers*, (684).
- Peterman, Amber; Kumar, N. P. A. and Gilligan, D. O. (2019). Towards gender equality: A review of evidence on social safety nets in Africa. Technical report, IFPRI International Food Policy Research Institute (IFPRI).
- Platteau, J.-P., De Bock, O., and Gelade, W. (2017). The Demand for Microinsurance: A Literature Review. *World Development*, 94(C):139–156.
- Pulido, J. and Swiecki, T. (2019). Barriers to Mobility or Sorting? Sources and Aggregate Implications of Income Gaps across Sectors and Locations in Indonesia. Technical report.
- Quisumbing, A. R., Meinzen-Dick, R., Terri L. Raney, A. C., Behrman, J. A., and Peterman, A. (2014). *Gender in Agriculture Closing the Knowledge Gap*. Springer, IFPRI.
- Quisumbing, A. R. and Pandolfelli, L. (2010). Promising Approaches to Address the Needs of Poor Female Farmers: Resources, Constraints, and Interventions. *World Development*, 38(4):581–592.

- Rahut, D., Aryal, J., and Marenya, P. (2021). Ex-ante adaptation strategies for climate challenges in sub-saharan africa: Macro and micro perspectives. *Environmental Challenges*, 3:100035.
- Rao, N., Singh, C., Solomon, D., Camfield, L., Sidiki, R., Angula, M., Poonacha, P., Sidibé, A., and Lawson, E. T. (2020). Managing risk, changing aspirations and household dynamics: Implications for wellbeing and adaptation in semi-arid africa and india. *World Development*, 125:104667.
- Reuveny, R. and Moore, W. H. (2009). Does environmental degradation influence migration? Emigration to developed countries in the late 1980s and 1990s. *Social Science Quarterly*, 90(3):461–479.
- Ribeiro, N. and Chauque, A. (2010). Gender and Climate change: Mozambique Case Study. Technical report, Heinrich Boll Stiftung, Southern Africa.
- Roudier, P., Muller, B., d’Aquino, P., Roncoli, C., Soumaré, M., Batté, L., and Sultan, B. (2014). The role of climate forecasts in smallholder agriculture: Lessons from participatory research in two communities in Senegal. *Climate Risk Management*, 2:42–55.
- Rozenberg, J. and Hallegatte, S. (2015). *The Impacts of Climate Change on Poverty in 2030 and the Potential from Rapid, Inclusive, and Climate-Informed Development*. The World Bank.
- Rufe, H., Regasa, A., and Edao, A. (2026). Assessing wheat irrigation practices among smallholder farmers in kellem wallaga zone, oromia, ethiopia. *Scientific Reports*, 16(1):16222.
- Sani, S. and Chalchisa, T. (2016). Farmers’ perception, impact and adaptation strategies to climate change among smallholder farmers in sub-saharan africa: A systematic review. *Journal of Resources Development and Management*, 26(1):32–39.

- Sarin, R. and Wieland, A. (2016). Risk aversion for decisions under uncertainty: Are there gender differences? *Journal of Behavioral and Experimental Economics*, 60:1–8.
- Sen Chakraborty, K. (2026). Drought shocks and rural labor informality: Exploring gender differences and the role of human capital. *The Journal of Development Studies*, pages 1–22.
- Sesmero, J., Ricker-Gilbert, J., and Cook, A. (2018). How Do African Farm Households Respond to Changes in Current and Past Weather Patterns? A Structural Panel Data Analysis from Malawi. *American Journal of Agricultural Economics*, 100(1):115–144.
- Shapiro, D. (2012). Women’s education and fertility transition in sub-Saharan Africa. *Vienna Yearbook of Population Research*, 10(1):9–30.
- Shapiro, D. and Tenikue, M. (2017). Women’s education, infant and child mortality, and fertility decline in urban and rural sub-Saharan Africa. *Demographic Research*, 37(21):669–708.
- Sheremenko, G. and Magnan, N. (2015). Gender-specific Risk Preferences and Fertilizer Use in Kenyan Farming Households. 2015 AAEE & WAEA Joint Annual Meeting, July 26-28, San Francisco, California 205766, Agricultural and Applied Economics Association.
- Singh, G. and Belwal, R. (2008). Entrepreneurship and SMEs in Ethiopia: Evaluating the role, prospects and problems faced by women in this emergent sector. *Gender in Management: An International Journal*, 23:120–136.
- Sorenson, S., Morssink, C., and Campos, P. (2011). Safe Access to Safe Water in Low Income Countries: Water Fetching in Current Times. *Social science medicine (1982)*, 72:1522–6.
- Sprout, E. (2022). Assessing the role of social networks in women’s access and use of climate services in sub-saharan africa: Evidence from literature. *Current Opinion in Environmental Sustainability*, 57:101206.

- Striessnig, E., Lutz, W., and Patt, A. G. (2013). Effects of Educational Attainment on Climate Risk Vulnerability. *Ecology and Society*, 18(1).
- Sundar, J. and Ramakrishnan, D. L. (2013). A Study on Farmers' Awareness, Perception and Willing To Join and Pay for Crop Insurance.
- Tacoli, C. (2009). Crisis or adaptation? Migration and climate change in a context of high mobility. *Environment and Urbanization*, 21(2):513–525.
- Tadesse, M. A., Shiferaw, B. A., and Erenstein, O. (2015). Weather index insurance for managing drought risk in smallholder agriculture: lessons and policy implications for sub-Saharan Africa. *Agricultural and Food Economics*, 3:1–21.
- Tall, A., Coulibaly, J., and Diop, M. (2018). Do climate services make a difference? A review of evaluation methodologies and practices to assess the value of climate information services for farmers: Implications for Africa. *Climate Services*, 11.
- Tam, J. and McDaniels, T. L. (2013). Understanding individual risk perceptions and preferences for climate change adaptations in biological conservation. *Environmental Science Policy*, 27:114–123.
- Tambo, J.A. Abdoulaye, T. (2013). Smallholder farmers' perceptions of and adaptations to climate change in the Nigerian savanna. *Reg Environ Chang*, 13(375).
- Tavener, K. and Crane, T. (2019). Beyond women and youth: Applying intersectionality in agricultural research for development. *Outlook on Agriculture*, 48:316–325.
- Taylor, C. A. (2026). Irrigation and climate change: Long-run adaptation and its externalities. *Journal of the Association of Environmental and Resource Economists*, 13(4):935–973.
- Thiede, B. and Gray, C. (2017). Erratum to: Heterogeneous climate effects on human migration in Indonesia. *Population and Environment*, 39:1–23.

- Thoenig, M., Eberle, U. J., and Rohner, D. (2020). Heat and Hate: Climate Security and Farmer-Herder Conflicts in Africa. CEPR Discussion Papers 15542, C.E.P.R. Discussion Papers.
- Timu, A. G., Gustafson, C. R., and Mieno, T. (2023). The gendered impacts of index-insurance on food-consumption: Evidence from southern ethiopia. *Climate Services*, 30:100355.
- Timu, A. G. and Kramer, B. (2023). Gender-inclusive,-responsive, and-transformative agricultural insurance: A literature review. *Global Food Security*, 36:100672.
- Timu, A. G., Manoti, D., Shee, A., and You, L. (2024). Impacts of gender-inclusive extension approaches on farmer understanding and willingness to pay for bundled financial services. *Current Research in Environmental Sustainability*, 8:100268.
- Tjaden, J. and Dunsch, F. A. (2021). The effect of peer-to-peer risk information on potential migrants—Evidence from a randomized controlled trial in Senegal. *World Development*, 145:105488.
- Treibich, C., Bell, E., Blanc, E., and Lépine, A. (2022). From a drought to hiv: An analysis of the effect of droughts on transactional sex and sexually transmitted infections in malawi. *SSM-Population Health*, 19:101221.
- Tufa, A. H., Alene, A. D., Cole, S. M., Manda, J., Feleke, S., Abdoulaye, T., Chikoye, D., and Manyong, V. (2022). Gender differences in technology adoption and agricultural productivity: Evidence from malawi. *World Development*, 159:106027.
- Ubfal, D. (2026). Supporting women-led businesses: Narrative review of recent causal evidence. *The World Bank Research Observer*, 41(1):118–156.
- UNHCR (2022). Sexual Violence Exploitation: The Experience of Refugee Children in Guinea, Liberia and Sierra Leone. Technical report, UNHCR and Save the Children-UK.

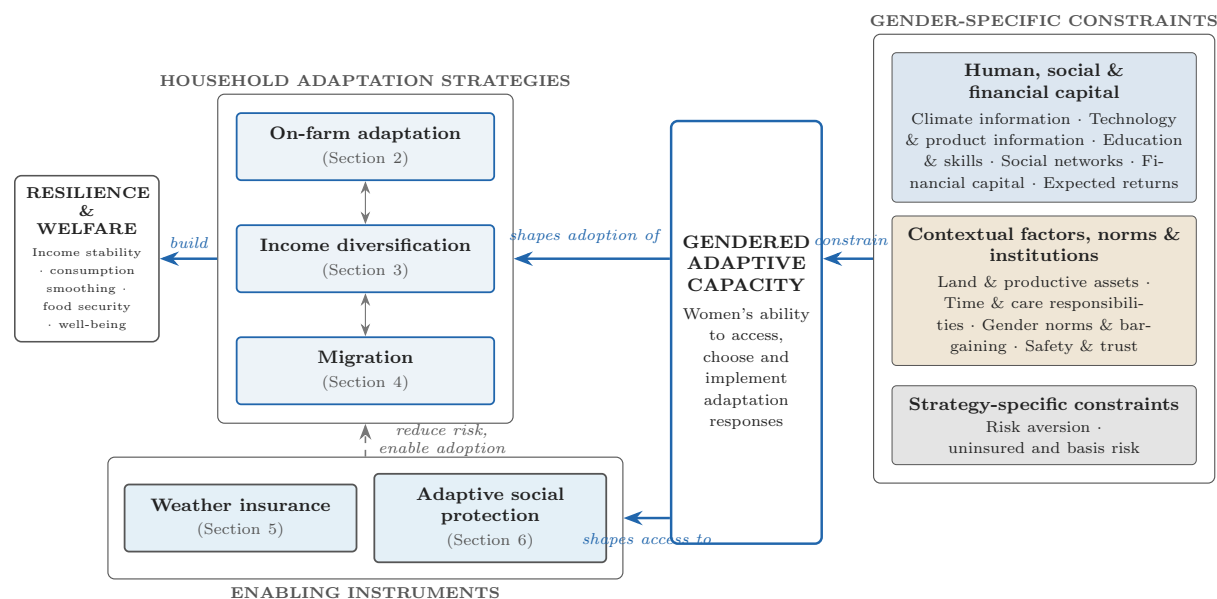
- Van Aelst, K. and Holvoet, N. (2016). Intersections of Gender and Marital Status in Accessing Climate Change Adaptation: Evidence from Rural Tanzania. *World Development*, 79(C):40–50.
- van den Bold, M., Dillon, A., Olney, D., Ouedraogo, M., Pedehombga, A., and Quisumbing, A. (2015). Can Integrated Agriculture-Nutrition Programmes Change Gender Norms on Land and Asset Ownership? Evidence from Burkina Faso. *Journal of Development Studies*, 51(9):1155–1174.
- Van den Broeck, G. and Kilic, T. (2019). Dynamics of off-farm employment in Sub-Saharan Africa: A gender perspective. *World Development*, 119:81–99.
- Verma, R., Nellemann, C., and Hislop, L. (2011). *Women at the Frontline of Climate Change: Gender Risks and Hopes*.
- Walker, S. E., Bruyere, B. L., Zarestky, J., Yasin, A., Lenaiyasa, E., Lolemu, A., and Pickering, T. (2022). Education and adaptive capacity: the influence of formal education on climate change adaptation of pastoral women. *Climate and Development*, 14(5):409–418.
- Wegenast, T., Hänze, N., and Haer, R. (2026). Women’s empowerment and climate adaptation: Does joint land ownership promote food security of households facing extreme weather events in tanzania? *Africa Spectrum*, page 00020397261450226.
- Weir, S. and Knight, J. (2004). Externality Effects of Education: Dynamics of the Adoption and Diffusion of an Innovation in Rural Ethiopia. *Economic Development and Cultural Change*, 53(1):93–113.
- Westermann, O., Ashby, J., and Pretty, J. (2005). Gender and Social Capital: the Importance of Gender Differences for the Maturity and Effectiveness of Natural Resource Management Groups. *World Development*, 33:1783–1799.

- William, F., Sanfo, S., Kedir, A., and Thiam, D. (2018). Estimating farmers’ willingness to pay for weather index-based crop insurance uptake in West Africa: Insight from a pilot initiative in Southwestern Burkina Faso. *Agricultural and Food Economics*, 6.
- World Bank (2010). Gender and governance in rural services : insights from India, Ghana, and Ethiopia. Technical report, Washington, DC: World Bank.
- World Bank (2014). Levelling the field: Improving opportunities for women farmers in Africa. Technical report, World Bank Group/One Campaign.
- World Bank (2019). World development indicators. World Development Indicators Database.
- Wu, L., Zhang, Y., Long, H., Bao, W., Xiao, W., Gong, B., Chigbu, U. E., Ma, L., Peng, L., Li, W., Gao, X., Zhu, Y., and Rao, F. (2026). Greater losses from heat exposure experienced by female smallholders in sub-saharan africa. *Nature Sustainability*.
- Yegbemey, R. N., Bensch, G., and Vance, C. (2023). Weather information and agricultural outcomes: Evidence from a pilot field experiment in Benin. *World Development*, 167:106178.
- Yimam, D. A. and Holvoet, N. (2024). Unpacking the invisible complex realities: intersections of gender and marital status in determining the intrinsic vulnerability of smallholder farmers to climate change in northwestern ethiopia. *Climate and Development*, 16(6):502–513.
- Zakari, S., Ying, L., and Song, B. (2014). Factors Influencing Household Food Security in West Africa: The Case of Southern Niger. *Sustainability*, 6(3):1–12.
- Zenda, M. and Rudolph, M. (2024). A systematic review of agroecology strategies for adapting to climate change impacts on smallholder crop farmers’ livelihoods in south africa. *Climate*, 12(3):33.

# A Methods

## A.1 Conceptual Framework

Figure A1: Conceptual Framework: Gendered Constraints to Climate Adaptation in Rural Sub-Saharan Africa

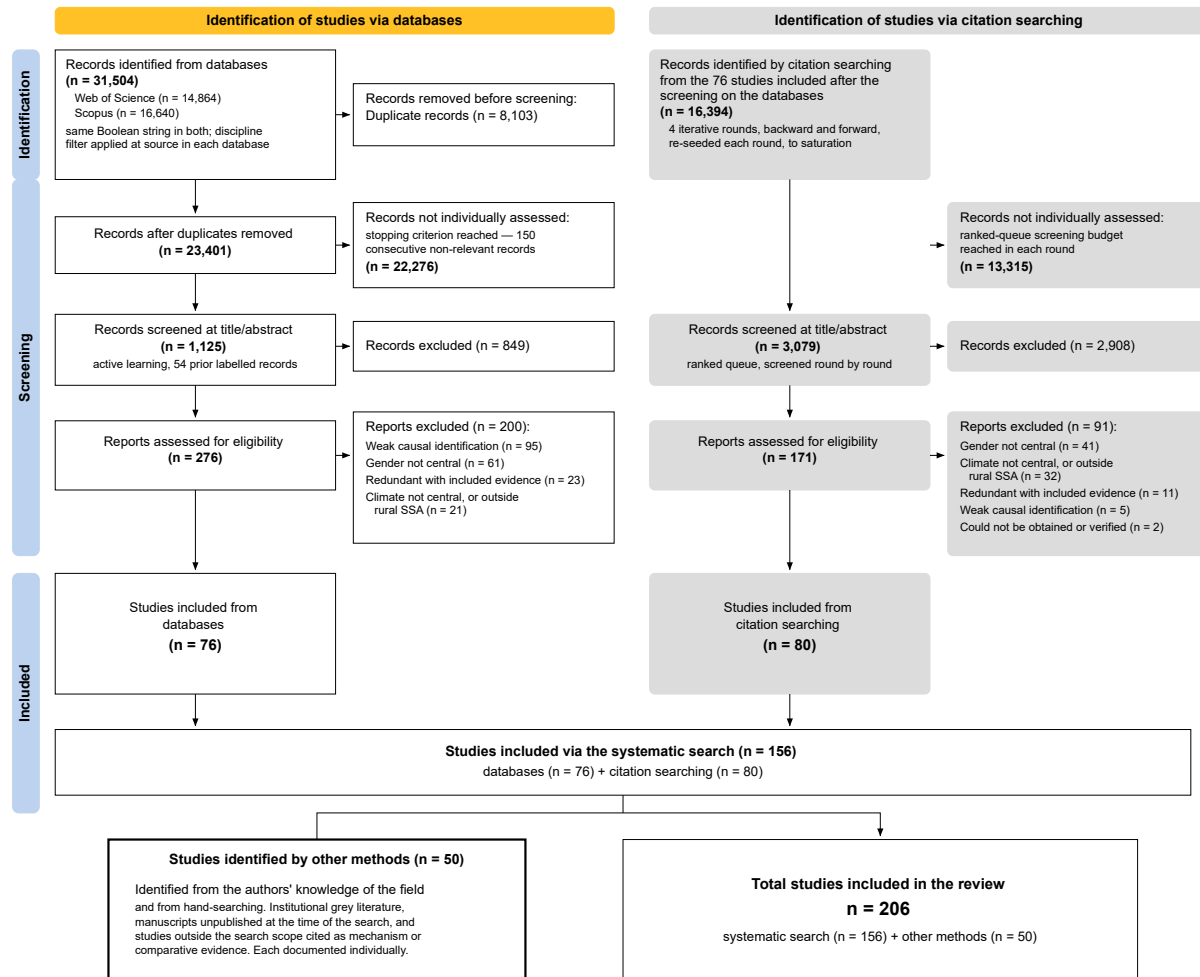


*Notes:* The figure summarizes the conceptual framework and the structure of the review. Gender-specific constraints (right), organized into the three groups used throughout the paper, erode women's adaptive capacity—their ability to access, choose, and implement adaptation responses—which in turn shapes both the adoption of the three household adaptation strategies (Sections 2 to 4) and access to the two enabling instruments (Sections 5 and 6). Vertical double arrows indicate that strategies are interlinked and can complement or substitute for one another. Adoption of strategies ultimately builds household resilience and welfare. Constraints are reviewed within each strategy and instrument section; the same three constraint groups organize the evidence gap map (Figure A3) and the research questions (Table 2).

## A.2 Database search strategy

### A.2.1 PRISMA flow diagram

Figure A2: PRISMA Flow Diagram of the Literature Search and Study Selection Process



*Notes:* The diagram follows the visual conventions of the PRISMA 2020 R package (Haddaway et al., 2022). Records not screened after the active-learning stopping criterion was reached are reported separately rather than classified as exclusions, in accordance with reporting recommendations for active-learning systematic reviews.

### A.2.2 Technical details of the screening procedure

**Screening model.** Web of Science and Scopus were searched using the same Boolean search string (below), with discipline-specific filters applied within each database using their native classification systems. Title and abstract screening in ASReview LAB used the ELAS

u4 model (TF-IDF feature extraction with a linear support vector machine), initialized with 54 previously labelled records. Reasons for exclusion at the eligibility stage are mutually exclusive, with each report assigned a single primary reason for exclusion.

**Citation searching.** At each of the four rounds, newly included studies were used as seeds for the next iteration until no additional eligible studies were identified. Records already screened in previous stages or rounds were removed before screening, and candidate records were ranked using the same active-learning model and assessed against the same mutually exclusive exclusion criteria.

**Counting rule.** Studies were counted only once at the study level and attributed to the first search strategy through which they were identified (databases, then citation searching, then other methods). Working-paper and published versions of the same study were merged and counted as a single study. Studies identified through complementary strategies were documented individually.

### A.3 Search string

The review was based on systematic searches conducted in the Web of Science and Scopus databases. The search string combined three blocks of terms—(i) gender, (ii) agriculture and the Sub-Saharan African context, and (iii) climate change and adaptation-related interventions. The complete Web of Science query was:

```
TS=( ( gender* OR wom?n OR femal* OR wife OR wives OR widow* OR intra-household
OR intrahousehold OR ‘‘bargaining power’’ )

AND

( agricultur* OR farm* OR rural OR crop* OR livestock* OR smallholder* OR harvest*
OR irrigat* OR village* OR pastoral* OR ‘‘sub-saharan’’ OR africa* OR angola OR
benin OR botswana OR ‘‘burkina faso’’ OR burundi OR cameroon OR ‘‘cape verde’’ OR
‘‘central african republic’’ OR chad OR comoros OR congo OR ivoire OR ‘‘ivory coast’’
```

OR djibouti OR eritrea OR eswatini OR ethiopia OR gabon OR gambia OR ghana OR guinea  
OR kenya OR lesotho OR liberia OR madagascar OR malawi OR mali OR mauritania OR  
mauritius OR mozambique OR namibia OR niger OR nigeria OR rwanda OR senegal OR ‘‘sierra  
leone’’ OR somalia OR ‘‘south africa’’ OR ‘‘south sudan’’ OR sudan OR tanzania OR  
togo OR uganda OR zambia OR zimbabwe OR sahel\* )

AND

( ( ‘‘climate change’’ OR ‘‘climate variability’’ OR ‘‘climate change adaptation’’  
OR adaptat\* OR ‘‘weather shock\*’’ OR ‘‘climate shock\*’’ OR ‘‘climate risk’’ OR ‘‘climate  
information’’ OR ‘‘climate service\*’’ OR drought\* OR ‘‘rainfall shock\*’’ OR ‘‘environmental  
shock\*’’ OR ‘‘global warming’’ )

OR

( ‘‘agricultural extension’’ OR ‘‘extension service\*’’ OR ‘‘extension agent\*’’ OR  
‘‘climate information’’ OR ‘‘climate service\*’’ OR ‘‘weather forecast\*’’ OR ‘‘weather  
insurance’’ OR ‘‘weather index insurance’’ OR ‘‘index insurance’’ OR ‘‘crop insurance’’  
OR ‘‘basis risk’’ OR ‘‘cash transfer\*’’ OR ‘‘social protection’’ OR ‘‘safety net\*’’  
OR ‘‘public works’’ OR ‘‘graduation program\*’’ OR ‘‘anti-poverty program\*’’ OR ‘‘asset  
transfer\*’’ OR ‘‘input subsid\*’’ OR ‘‘land tenure’’ OR ‘‘land right\*’’ OR ‘‘property  
right\*’’ OR ‘‘tenure security’’ OR ‘‘land titling’’ OR ‘‘technology adoption’’ OR  
‘‘improved seed\*’’ OR ‘‘improved variet\*’’ OR ‘‘crop diversif\*’’ OR ‘‘livelihood  
diversif\*’’ OR ‘‘off-farm’’ OR ‘‘non-farm income’’ OR ‘‘business training’’ OR ‘‘personal  
initiative’’ OR ‘‘savings group\*’’ OR ‘‘financial inclusion’’ OR ‘‘credit constraint\*’’  
OR ‘‘risk preference\*’’ OR ‘‘risk avers\*’’ OR microfinance OR microcredit OR microenterprise\*  
) ) )

An equivalent query, adapted to the Scopus syntax, was used for the Scopus database;  
both queries are provided verbatim in the replication package.

## A.4 Composition of the reviewed evidence

Table A1 summarizes the composition of the gender-focused evidence reviewed in Sections 2  
to 7, by adaptation strategy and study design. The table counts only studies providing evi-  
dence on gender differences, gender-specific constraints, or gendered impacts in the context

of climate change, climate variability, or adaptation; the broader gender-blind literature—for instance on the demand for and impacts of weather insurance—is discussed as background in the text but not counted here. The small number of studies for weather insurance and adaptive social protection thus reflects a substantive finding of this review: these literatures are sizable but remain largely gender-blind. Study designs are classified according to their characterization in the manuscript: experimental (randomized controlled trials and field or lab-in-the-field experiments), quasi-experimental (instrumental variables, regression discontinuity, difference-in-differences, matching), descriptive and correlational (cross-sectional, panel, and qualitative studies without causal identification), and reviews and syntheses.

Table A1: Composition of the reviewed gender-focused evidence, by adaptation strategy and study design

|                            | Causal       |                    | Descriptive & correlational | Reviews & syntheses | Total |
|----------------------------|--------------|--------------------|-----------------------------|---------------------|-------|
|                            | Experimental | Quasi-experimental |                             |                     |       |
| On-farm adaptation         | 16           | 9                  | 41                          | 9                   | 75    |
| Income diversification     | 16           | 2                  | 19                          | 7                   | 44    |
| Migration                  | 6            | 9                  | 9                           | 6                   | 30    |
| Weather insurance          | 6            | 0                  | 3                           | 1                   | 10    |
| Adaptive social protection | 8            | 0                  | 6                           | 3                   | 17    |
| Distinct studies           | 50           | 17                 | 74                          | 24                  | 165   |

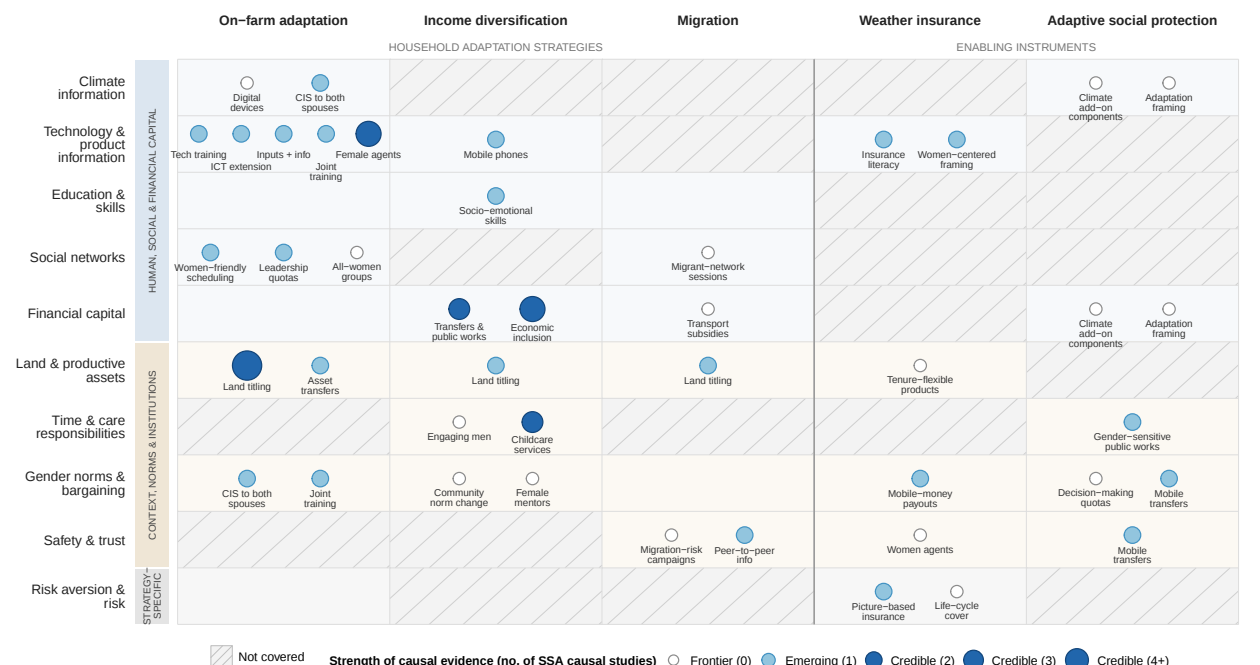
*Notes:* The table counts the studies cited as evidence on gender differences, constraints, or interventions in the context of climate adaptation in Sections 2–6 and in the intervention evidence map (Section 7); gender-blind, background, definitional, and purely methodological citations are excluded. Designs follow each study’s characterization in the text or, for studies cited only in the evidence map, their research design. Studies informing several strategies are counted in each relevant row but only once among distinct studies (nine studies appear in more than one row). Seven of the 165 studies are set outside Sub-Saharan Africa and are cited to motivate research directions where regional evidence is unavailable.

## B Evidence Map

Figure A3 summarizes the evidence map of Table 1 by the constraint each policy option targets rather than by policy objective. This visual summary makes the cross-cutting nature of constraints directly visible—the same constraint often binds across several strategies—and identifies at a glance where rigorous evidence exists, where it is only emerging, and where

none is available.

Figure A3: Evidence Gap Map: Interventions Addressing Women’s Constraints to Climate Adaptation in Sub-Saharan Africa



**Notes:** Each circle represents a policy option listed in Table 1. Rows identify the constraint targeted, grouped into the three categories of the conceptual framework; columns identify the adaptation strategy or enabling instrument promoted. Color indicates the strength of the causal evidence: *credible* (dark blue), *emerging* (light blue), or *frontier* (hollow), as defined in the text. Among credible options, circle size indicates the number of supporting experimental or quasi-experimental studies conducted in Sub-Saharan Africa; emerging and frontier options are displayed at fixed sizes. Hatched cells identify constraint-strategy combinations for which the reviewed literature does not document a binding constraint. Empty cells identify constraints examined by the review for a given strategy but for which no rigorously evaluated intervention was found; these research gaps motivate the questions presented in Table 2. Policy options addressing multiple constraints or evaluated across multiple strategies appear in each relevant cell. Evidence classifications are therefore outcome-specific.

## C Priority Research Questions

This section identifies key under-researched areas critical to understanding and addressing barriers to women’s climate adaptation. While not exhaustive, these questions are derived from the preceding analysis and are organized by adaptation strategy.

## On-farm adaptation

How do risk aversion, preferences, and climate information interact? There is now a large literature on gender differences in the adoption of climate-adaptive practices. What remains much less understood is how women's preferences for long-term strategies, their typically higher risk aversion, and their access and exposure to information about climate change and agricultural technologies interact to influence their adoption decisions. Further causal analysis is needed to better understand women's perceptions and choices of sustainable agricultural practices. Lack of information on climate change and sustainable technologies, combined with higher risk aversion, limits their on-farm adaptation. However, risk aversion could also potentially translate into a higher preference for long-term strategies that are protective against the effects of climate change and extreme climatic events. Providing accurate information on the benefits of sustainable strategies could therefore represent an opportunity for increased adoption among women. However, little is known on how these constraints interact with each other. Key questions that should be explored in priority to better understand how to increase women's on-farm adaptation include: Does women's higher risk aversion represent an opportunity, rather than just a barrier, for increasing their adoption of climate-adaptive practices? If so, can delivering accurate information on climate change and technologies leverage this opportunity?

How best to address women's limited access to climate information? While climate change perceptions have been widely studied, much less is known about how women perceive climate change as a long-term phenomenon which requires adaptation, especially in particularly exposed regions of Sub-Saharan Africa, how these perceptions differ from men's, and whether changing them translates into greater adoption of climate-adaptive practices. More causal evidence is needed on whether access to accurate climate information can change those perceptions and ultimately adaptation decisions. What interventions are most effective at improving women's access to climate information services?

What role do social networks play in on-farm adaptation? Improving women's adoption

of sustainable agricultural practices depends on a comprehensive understanding of knowledge diffusion within social networks and strategies to overcome barriers to learning and training. This includes elucidating the impact of male dominance in agricultural social structures on women's engagement and accessibility within these networks. What are effective approaches to social groups organization that overcome gender barriers and time constraints, thereby facilitating women's long-term adoption of sustainable agricultural practices?

## **Income Diversification**

Which gender norms hinder women's participation in income diversification? To what extent does lack of time hinder women's engagement in off-farm activities? Can engaging men to increase their share of housework be effective in increasing women's income diversification? To what extent does women's lack of decision-making power within the household affect their decisions to diversify income sources for climate change adaptation? There is a need to better understand in which contexts different constraints are more binding for women. For instance, married women may access more information and resources through their husbands, while divorced, widowed, or women in polygamous marriages might have greater decision-making autonomy. How do intra-household dynamics within various household structures influence women's agency and ability to diversify their income in response to climate change, considering both their time and labor constraints and their decision-making power?

## **Migration**

Which interventions can improve women's returns to migration? Can interventions that address gender disparities in migration outcomes, such as skills training or economic inclusion programs designed for women, help them overcome lower returns and limited decision-making power, ultimately increasing their participation in labor migration?

How best to overcome the liquidity constraint? Migration is a costly adaptation strategy, and women, who often experience greater liquidity constraints than men, encounter higher

barriers to pursuing this option. Does easing women's financial constraints, such as subsidizing transportation costs, increase their likelihood of migrating in response to climate shocks, particularly in Sub-Saharan Africa?

What role do social networks play? There is limited understanding of how restricted access to social networks deters women's climate-induced migration. Migrants' networks lower migration costs and aid integration, while limited networks discourage women from migrating. Can interventions such as information sessions that facilitate the social and economic integration of women migrants who lack social networks at their destination improve their migration outcomes?

To what extent does women's land tenure insecurity reduce their willingness to migrate after climate shocks? While there are established causal links between women's fear of expropriation and their reduced ability to monitor their plots remotely, the link has not been formally established with limited climate-induced migration.

What is the role of gender norms in limiting women's climate-induced migration? There is a lack of causal estimation to comprehensively understand how factors such as women's role as caregivers and shock absorbers, and their limited participation in intra-household decision-making, influence and restrict women's migration following adverse climate events. Experimental designs are needed to assess whether economic inclusion programs that take into account women's time allocation and household roles can improve their opportunities in climate-induced migration. Empirical studies are needed to assess whether addressing gender imbalances in bargaining power through joint training for wives and husbands can improve decision-making around who in the household migrates, and potentially increase women's migratory prospects.

What is the impact of male migration on women's adaptive capacity? The male dominance in climate-induced migration restricts women's ability to migrate and increases their household tasks and responsibilities. However, this shift can also empower women by giving them greater control over household resources, enabling them to take on leadership roles

and engage in traditionally male-dominated activities. Further empirical and causal analysis is therefore needed to understand whether and how male migration in response to adverse weather events may mitigate or exacerbate gender inequalities in climate change adaptation. To what extent does male migration create a burden on women's labor load, relative to the increase in empowerment afforded by men's absence?

## **Weather Insurance**

Which insurance products work for women? There is currently little evidence on alternative insurance products that are designed to work for women and to increase women's take-up. Do combined weather insurance products that also cover women's life cycle risks, such as pregnancy and their children's health events, increase women's uptake and use of such products? Do insurance products that also address women's lack of land tenure security, such as offering coverage for crops grown on leased or borrowed land, increase their uptake compared to traditional insurance options? More empirical evidence is also needed on the design of insurance parameters, such as how benefits are paid out.

What are effective ways to deliver information on insurance products to women in Sub-Saharan Africa? What types of trainings and communication products can alleviate women's information and literacy constraint? Does subsidizing access to training sessions on insurance products, through covering transportation costs for example, increase women's participation and ultimate take-up of products? Would increasing access to information on weather insurance and its efficiency increase women's uptake by increasing their trust in financial institutions and products and reducing inaccurate beliefs? More evidence is needed on the effect of "women-friendly" framing of insurance products and on the extent to which feminizing insurance institutions might alleviate women's reluctance to enroll in insurance schemes. These questions are particularly relevant in Sub-Saharan Africa, where only few farmers have access to agricultural insurance and women still face significant barriers to financial services. How does improving women's access to climate adaptation information

increase their take-up of weather insurance by increasing the relevance of the product to their needs, given their typically higher risk aversion?

## **Adaptive Social Protection**

How to enhance women’s participation and decision-making in adaptive social protection? Which program design elements enhance women’s participation and retention in adaptive social protection schemes? Empirical evidence is needed to assess the impact of gender-sensitive provisions—such as flexible work hours, childcare support, and safe transportation—on women’s ability to engage in public works programs and other adaptive social protection interventions. To what extent do mobility constraints and domestic responsibilities limit women’s ability to benefit from adaptive social protection? Further research should examine the role of gender norms and intra-household decision-making in shaping women’s uptake and use of adaptive social protection, as well as potential interventions to relax these constraints. What mechanisms can strengthen women’s leadership and decision-making power in adaptive social protection programs? Investigating the impact of female representation in welfare decision-making bodies and participatory governance mechanisms could help ensure that social protection programs are designed to effectively address women’s needs.

What are the most effective complements to economic inclusion packages for supporting women’s climate resilience? Research should explore which additional components—such as financial training, access to savings mechanisms, or bundled climate-adaptive interventions—are most cost-effective in promoting women’s investments in sustainable adaptation strategies. How can adaptive social protection prevent maladaptive coping strategies among women and girls? Evidence is needed on the effectiveness of social protection in reducing harmful climate-induced responses—such as child marriage, school dropout, or reduced labor market participation—and promoting sustainable adaptation pathways.

How can adaptive social protection facilitate women’s access to climate risk management

tools? More evidence is needed on how linking cash transfers and economic inclusion programs to early warning systems, weather insurance, and anticipatory action can enhance women's resilience to climate shocks. How can digital payment systems and financial training improve the long-term resilience benefits of cash transfers for women? More research is required to determine whether and how innovations such as mobile money, early payment options, and financial literacy training influence women's ability to allocate transfers toward adaptation investments rather than short-term consumption.