

ADVANCED REVIEW

The triple differential vulnerability of female entrepreneurs to climate risk in sub-Saharan Africa: Gendered barriers and enablers to private sector adaptation

Kate Elizabeth Gannon¹  | Elena Castellano¹  | Shaikh Eskander¹  |
Dorice Agol² | Mamadou Diop³  | Declan Conway¹  | Elizabeth Sprout¹ 

¹London School of Economics and Political Science, Grantham Research Institute on Climate Change and the Environment, London, UK

²Independent Researcher, Nairobi, Kenya

³Université Cheikh Anta Diop de Dakar (UCAD), Dakar-Fann, Senegal

Correspondence

Kate Elizabeth Gannon, London School of Economics and Political Science, Grantham Research Institute on Climate Change and the Environment, London, UK.

Email: k.e.gannon@lse.ac.uk

Funding information

UK Economic and Social Research Council, Grant/Award Number: ES/R009708/1; Grantham Foundation for the Protection of the Environment; International Development Research Council, Ottawa, Canada, Grant/Award Number: 109223-001; UK Government's Foreign, Commonwealth & Development Office

Edited by: Lisa Dilling, Domain Editor and Mike Hulme, Editor-in-Chief

Abstract

The ability of businesses to adapt effectively to climate change is highly influenced by the external business enabling environment. Constraints to adaptive capacity are experienced by small and medium enterprises (SMEs) across sub-Saharan Africa, regardless of the gender of the business owner. However, gender is a critical social cleavage through which differences in adaptive capacity manifest and in Africa most entrepreneurs are women. We conduct a systematic review to synthesize existing knowledge on differential vulnerability of female entrepreneurs in Africa to climate risk, in relation to their sensitivity to extreme climate events and their adaptive capacity. We synthesize this literature using a vulnerability analysis approach that situates vulnerability and adaptive capacity within the context of the wider climate risk framework denoted in the IPCC Fifth Assessment Report. In doing so, we identify gendered barriers and enablers to private sector adaptation and suggest women entrepreneurs face a “triple differential vulnerability” to climate change, wherein they: (1) are often more sensitive to climate risk, as a result of their concentration in certain sectors and types of enterprises (e.g., micro SMEs in the agricultural sector in remote regions); (2) face additional barriers to adaptation in the business environment, including access to finance, technologies, (climate and adaptation) information and supportive policies; and (3) are also often concurrently on the frontline of managing climate risk at household levels. Since various forms of inequality often create compounding experiences of discrimination and vulnerability, we pay particular attention to how factors of differential vulnerability intersect, amplify, and reproduce.

This article is categorized under:

Climate and Development > Social Justice and the Politics of Development
Vulnerability and Adaptation to Climate Change > Institutions for
Adaptation

This is an open access article under the terms of the [Creative Commons Attribution](https://creativecommons.org/licenses/by/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2022 The Authors. *WIREs Climate Change* published by Wiley Periodicals LLC.

KEYWORDS

gender differential vulnerability, micro, small and medium enterprises (SMEs), private sector adaptation to climate change, sub-Saharan Africa, women entrepreneurs

1 | INTRODUCTION

It is increasingly recognized that the majority of the decisions and adjustments needed to adapt to climate change will be undertaken by private actors: Individuals, households, and firms. The Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment report (AR5) highlights the private sector as critical to progress on adaptation (“medium evidence, high agreement”; IPCC, 2014a). In sub-Saharan Africa (referred to as “Africa” in this article), the private sector is dominated by micro, small and medium enterprises (SMEs). These businesses are considered at high risk from climate change (Crick, Gannon, et al., 2018). Many SMEs are concentrated in agricultural production, which is very exposed to and dependent on climatic variability and change. However, research has shown that even fairly moderate changes in climate conditions can produce significant, but under-recognized, consequences for SMEs that cascade across a range of urban and rural sectors (Gannon et al., 2018; Siderius et al., 2018).

To some extent, private sector actors will innovate in response to changing climatic impacts and pressures, by adopting measures to reduce costs, manage their internal exposure to risks, minimize disruption to their operations and maximize opportunities where they arise (cf., Mendelsohn, 2012). As such, an emerging body of literature has explored the processes through which businesses institute strategies to manage climate risk—and realize opportunities—within their own operations; what Pauw and Pegels (2013, p. 258) label “domestic private sector adaptation”. In developing countries, this literature is particularly focused on the adaptation that occurs within agricultural production and the adjustments that farmers make to their production systems (e.g., Jost et al., 2016; Kom et al., 2020; Kurukulasuriya et al., 2011; Muchuru & Nhamo, 2019; Nelson & Stathers, 2009). However, more recent empirical enquiry has observed private sector actors from a range of other sectors and positions within value chains taking adaptation actions; such as scaling up or down activities to reduce losses or exploit opportunities, making adjustments to their workforce size and hours of operation, selling or acquiring business assets, and building new business relationships, in order to respond to expected or experienced climate risks (Canevari-Luzardo, 2019a; Carabine & Simonet, 2018; Crick, Eskander, et al., 2018; Gannon et al., 2018).

Such adaptation is often referred to as “autonomous adaptation,” to distinguish it from adaptation actions taken by the public sector, or through the directed intervention of a public agency (Fankhauser, 2017; Smith et al., 1996). Yet, autonomous adaptation can be constrained or enabled by social, economic, cultural, and political factors that serve as barriers and enablers to adaptation. Businesses need to have the incentives, resources, knowledge, and skills to adapt to climate change and their ability to adapt effectively is highly influenced by the external business enabling environment (Crick, Eskander, et al., 2018).

In Africa, the ability of SMEs to cope with climate risks is often constrained by multiple barriers in business enabling environments (Crick, Gannon, et al., 2018; Stenek et al., 2013). These constraints to adaptive capacity are experienced regardless of the gender of the business owner (Bardasi et al., 2007; Crick et al., 2016; Dougherty-Choux et al., 2015). However, barriers to adaptation—and, conversely, access to adaptation knowledge and resources—are highly socially differentiated, shaped by social roles, entitlements (Kelly & Adger, 2000 cf., Sen, 1981), and broader vulnerabilities that reflect and reproduce inequalities. Literature therefore emphasizes that the capacity to adapt to climate change is unequal across and within societies (Thomas et al., 2019).

Gender—and its surrounded socially constructed meanings, behaviors, characteristics, responsibilities, and barriers—is a critical social cleavage through which these differences in adaptive capacity manifest, influencing key dimensions of the roles and resources that women and men in different social contexts, are allowed, able, or expected, to occupy and access (Carr & Thompson, 2014; Terry, 2009). Studies have observed gender differences in private sector adaptation behaviors, particularly within agricultural settings (e.g., Codjoe et al., 2012; Jost et al., 2016; Molua, 2011). Yet, studies of factors shaping gendered dimensions of vulnerability to climate change have focused mostly at individual, household, community and farm-levels (e.g., Daoud, 2021; Nabikolo et al., 2012), with more limited explicit attention given to vulnerability within business environments and within activities that are not directly related to resources and assets directly impacted by climate (i.e., crops or livestock).

In response to this gap, in this article we conduct a systematic literature review to synthesize existing knowledge on differential vulnerability of female-entrepreneurs to climate risk in Africa, in relation to their sensitivity to extreme climate events and their adaptive capacity. We synthesize the literature selected for review through a vulnerability analysis that situates vulnerability and adaptive capacity within the context of the wider climate risk framework denoted in IPCC AR5 (IPCC, 2014a). We include small-scale agricultural producers and pastoralists within our definition of entrepreneur (cf., Canevari-Luzardo, 2019a, 2019b; Carabine & Simonet, 2018; Gannon et al., 2020). However, to keep our review focused on the elements of the business environment required for adaptation to climate change by entrepreneurs in rural and urban, and agricultural and nonagricultural, SMEs in Africa, we structure this vulnerability analysis through the framework of enabling conditions required to support SME adaptation to climate change developed in Crick, Gannon, et al. (2018).

Through our analysis we suggest women entrepreneurs face a “triple differential vulnerability” to climate change wherein they: (1) are often more sensitive to climate risk, as a result of their concentration in certain sectors and types of enterprises (e.g., micro SMEs in the agricultural sector in remote regions); (2) face additional barriers to adaptation in the business environment; and (3) are also often on the frontline of managing climate risk at household levels.

In the sections that follow, first, we outline our motivations for this review; identifying literature which suggests women's entrepreneurship is fundamental to equitable, climate-resilient development and adaptation, while highlighting the need to treat women as a deeply heterogeneous group. We then introduce the conceptual framework and our approach to literature sampling, before conducting our vulnerability analysis. Through this review, we pay particular attention to how factors of gender differential vulnerability interconnect, amplify, and reproduce.

2 | UNLOCKING CLIMATE RESILIENT DEVELOPMENT THROUGH FEMALE ENTREPRENEURSHIP

2.1 | The strategic role of female entrepreneurs in upscaling resilience and adaptation

Literature on gender and adaptation tends to position women as both especially vulnerable to climate change and especially valuable to adaptation; advancing women's empowerment as an underexploited tool in the promotion of resilience. Literature has, for example, linked female representation among decision makers to more effective climate policy (Mavisakalyan & Tarverdi, 2019). Meanwhile, resilience literatures have highlighted development economics literatures which associate gender equality and economic inclusion with progress in macro development and resilience indicators, such as Gross Domestic Product (GDP) growth (Baten & de Pleijt, 2018; Klasen & Lamanna, 2009), agricultural productivity (FAO, 2011; Quisumbing et al., 2014), and sustainable development (Adegbite & Macheche, 2020).

At the micro-level, literatures have positioned female entrepreneurship as fundamental to broader resilience through the understanding that women often make relatively higher contributions to family and social welfare than men. Women's businesses make important and wide-ranging contributions to key value chains (Carabine & Simonet, 2018) and to the provision of goods and services that support wider private sector development and adaptation (Gannon et al., 2021). Yet women are traditionally responsible for food security and household management and are often “necessity entrepreneurs” (Welsh et al., 2013, p. 2); driven to start businesses to support themselves and their families (Halkias et al., 2011; Isaga, 2019; Mazonde & Carmichael, 2016). As such, a number of studies indicate that women often invest more in their families and in their community's resilience and more efficiently allocate returns from SMEs to the most critical household assets, including health, education, and food security (e.g., Dedehouanou & Araar, 2020).

Literature has also emphasized that women's unique responsibilities and roles in households, communities, and economies position them well for finding solutions to changing socio-climatic risks and identifying adaptive livelihood strategies (Agarwal, 2009; Antwi, 2020; Babagura, 2010; Enarson, 2013; Twyman et al., 2014; Umeh & Nwachukwu, 2019). These literatures focus on the different “situated knowledges” (cf., Haraway, 1991) and expertise that women often bring to adaptation, as a result of their unique positions within societies; such as their role in family life (e.g., Peake, 2016) and their high dependence on environmental resources (Caretta, 2014). Much of this literature is founded on classic participation rationales, which suggest that inclusion of different knowledges, experiences, and values in adaptation action supports innovation and more robust solutions. However, in some instances, this literature further suggests that women's specific knowledges can lead to them pursuing comparably more sustainable, equitable or effective adaptation actions than men. Djoudi and Brockhaus (2011), for example, suggest women in livestock-dependent communities in northern Mali have a long-term perspective in their adaptation preferences, focused on

household educational investments and decreasing livelihood dependency on natural resources, which could release ecosystem pressures. Kom et al. (2020), meanwhile, find households headed by female farmers in South Africa are more likely to employ new crops and diversification in response to climate variability and change. Notably these literatures link women's skills in the field of climate change adaptation to their historical fight for social justice, historical exclusion and social disadvantage (Enarson, 2013; Smucker & Wangui, 2016).

2.2 | Understanding vulnerability and adaptive capacity of female entrepreneurs through an intersectional approach

Narratives surrounding the strategic role of women as agents of adaptation are useful in the development of more critical gender analyses that go beyond persistent problematic categorizations of women as marginalized, vulnerable and disempowered (Carr & Thompson, 2014). These literatures also speak to the important role for women's entrepreneurship—and thus adaptation within women's businesses—in upscaling equitable climate resilient development. Presenting these characteristics as universal qualities of “being female,” however, risks reducing an incredibly diverse dimension of identity and misrepresenting the varied causes of vulnerability to climate change (Ahmed et al., 2016; Carr & Thompson, 2014; Fisher & Carr, 2015; Kaijser & Kronsell, 2014). The geographies, economies, social structures, and activities that women in Africa are involved in are diverse (Rao, Lawson, et al., 2019) and thus, as Goodrich et al. (2019, p. 9) writes, “not all women or all men are equally vulnerable”. Instead, the influence of gender on vulnerability must be understood with reference to the way in which gender as a social category interacts in different contexts with multiple other dimensions of identity and social difference, such as age, ethnicity, literacy, income, marital status, social capital, livelihood, class, and caste (Rao et al., 2021; Rao, Mishra, et al., 2019).

In this landscape, the critical feminist concept of intersectionality, first introduced by Crenshaw (1989), provides a helpful framing in which to situate our analysis. Intersectionality emphasizes that the many constraints and opportunities that people face from climate variability and change emerge through the intersections of diverse and multiple identity categories and contextual conditions to which different social responsibilities, opportunities, barriers, and expectations are attached (Osborne, 2015). An intersectional approach therefore recognizes that gendered experiences are an outcome of gendered interactions with other concurrent forms of inequality, which can compound vulnerabilities and which are often not just the sum of their parts. Here we prioritize identification and analysis of the gender-specific factors that shape differential vulnerability and adaptive capacity in entrepreneurship in Africa (cf., Kaijser & Kronsell, 2014). However, we recognize the broader intersectional landscape within which gender differential vulnerability in entrepreneurship sits, including through our vulnerability analysis framework, outlined below, which supports exploration of the ways in which gender interacts with multiple dimensions of vulnerability and which could be built on in future research to, more explicitly, expand and connect our analysis to other factors conditioning intersectional vulnerability.

3 | CONCEPTUAL FRAMEWORK AND APPROACH TO LITERATURE SAMPLING

3.1 | A vulnerability analysis

Vulnerability analyses are often used in development research to synthesize primary or secondary datasets to assess vulnerability (e.g., Verhage et al., 2018), or to create a vulnerability index for a given population or specific geographical area (e.g., Adu et al., 2018). In contrast, we apply the vulnerability analysis concept in a literature review to examine existing knowledge on how gender shapes differentiated vulnerabilities to climate risk among female entrepreneurs across Africa. The vulnerability concept was updated through the IPCC's AR5. Defined as the “propensity or predisposition to be adversely affected” (IPCC, 2014a, p. 179), the concept is a function of sensitivity of people to climate impacts and of their capacity to prepare for and respond to them (their adaptive and coping capacity). Differential vulnerability, meanwhile, considers the way in which vulnerability varies within populations exposed to the same climate stressors (Carr & Thompson, 2014).

To conduct our vulnerability assessment, we take inspiration from the risk assessment framework produced by GIZ and EURAC (2017). Like AR5, it situates vulnerability within the broader climate risk landscape and clarifies the

relationship between risk concepts: The risk that female entrepreneurs in Africa are subject to is an outcome of the interaction between the presence of climatic hazards and the exposure and vulnerability of female entrepreneurs in the face of climate change. Through an impact chain approach, it also provides a framework that we apply to represent cause-and-effect relationships that shape how different risk and vulnerability factors interact and intersect.

3.2 | Analyzing vulnerability of female entrepreneurs to climate risk through the business environment

We structure our vulnerability analysis through the framework of enabling conditions for private sector adaptation, identified in Crick, Gannon, et al. (2018). With a focus on SMEs, this framework synthesizes key “building blocks” of business enabling environments for private sector adaptation, which are summarized through four interdependent categories: The policy, institutional, and regulatory environment; the financial environment; infrastructure, markets, and information communication technologies (ICT); and data, information, and capacity development. Together with more specific elements identified within the framework, these building blocks are designed as an organizing mechanism to identify the key elements of business enabling environments required for SMEs to adapt to climate change, characterized in existing literature.¹ In our article, they serve as themes to structure our analysis of gender differential vulnerability and review of the selected literature.

Given the importance of informal institutions and social norms in female entrepreneurship in Africa and of socio-cultural norms in shaping gender differential vulnerability (Badstue, Elias, et al., 2020; Diop et al., 2018; Etim & Iwu, 2019; Ojediran & Anderson, 2020), we supplement the “policies and institutions” building block in Crick, Gannon, et al. (2018) with additional, specific consideration of the way in which the analyzed literature identifies informal institutions and socio-cultural norms to shape vulnerability of female entrepreneurs to climate risk. We also explicitly broaden the technology focus identified in the Crick, Gannon, et al. (2018) framework beyond ICT, to include the breadth of technologies that may be necessary for adaptation (including improved agricultural inputs, alternative energy sources, water storage technology, etc.). In Figure 1, we illustrate the way in which we integrate and conceptualize IPCC AR5 definitions of vulnerability, the GIZ risk assessment framework and the framework of enabling conditions for private sector adaptation in Crick, Gannon, et al. (2018).

3.3 | Approach to literature sampling

The literature review was underpinned by a systematic approach. In October 2020, the database Scopus was used to conduct the literature search. Key search terms on gender, adaptation, and entrepreneurship,² based on the research questions, were refined during preliminary searches. The literature search was restricted to articles published between 2009 and 2020 and articles were screened for relevance using their title, abstract, introduction, and conclusion.

This review methodology risked missing relevant literatures for at least three reasons. First, within adaptation and resilience literatures, many economic actors in Africa are not well recognized as entrepreneurs and businesses (Gannon et al., 2020). For example, small-scale agricultural producers and pastoralists, who constitute the majority of entrepreneurs in SSA (Dougherty-Choux et al., 2015; International Labour Organisation, 2015), are often not referred to within the literature using terminology of “entrepreneurship” or “business.” As a second terminological challenge, adaptive behavior may be described and explored through related, but broader, terminology, such as ‘innovation’. Third, most barriers to adaptation are not climate specific (Biesbroek et al., 2013) and sustainable private sector adaptation requires many structural deficits within general business environments to be addressed, alongside conditions that support climate-specific adaptive capacity (Carter et al., 2019; Crick, Gannon, et al., 2018). Previous literature on private sector adaptation has therefore helpfully drawn insights from a much larger, yet generally independent, literature on enabling environments for private sector development.

To help respond to these gaps, we extended our review through a snowballing technique wherein, through citations within and of our existing corpus of articles, we purposively identified and sampled additional literatures that consider gendered dimensions of the elements of business enabling environments identified within the Crick, Gannon, et al. (2018) (2018) framework (e.g., access to markets, access to climate information). This approach allowed us to incorporate gray and practitioner literatures and to expand our coverage to more literature from African authors. Given the breadth of terminology used to explore the themes within our review (e.g., farm women, women farmers, innovation capacity,

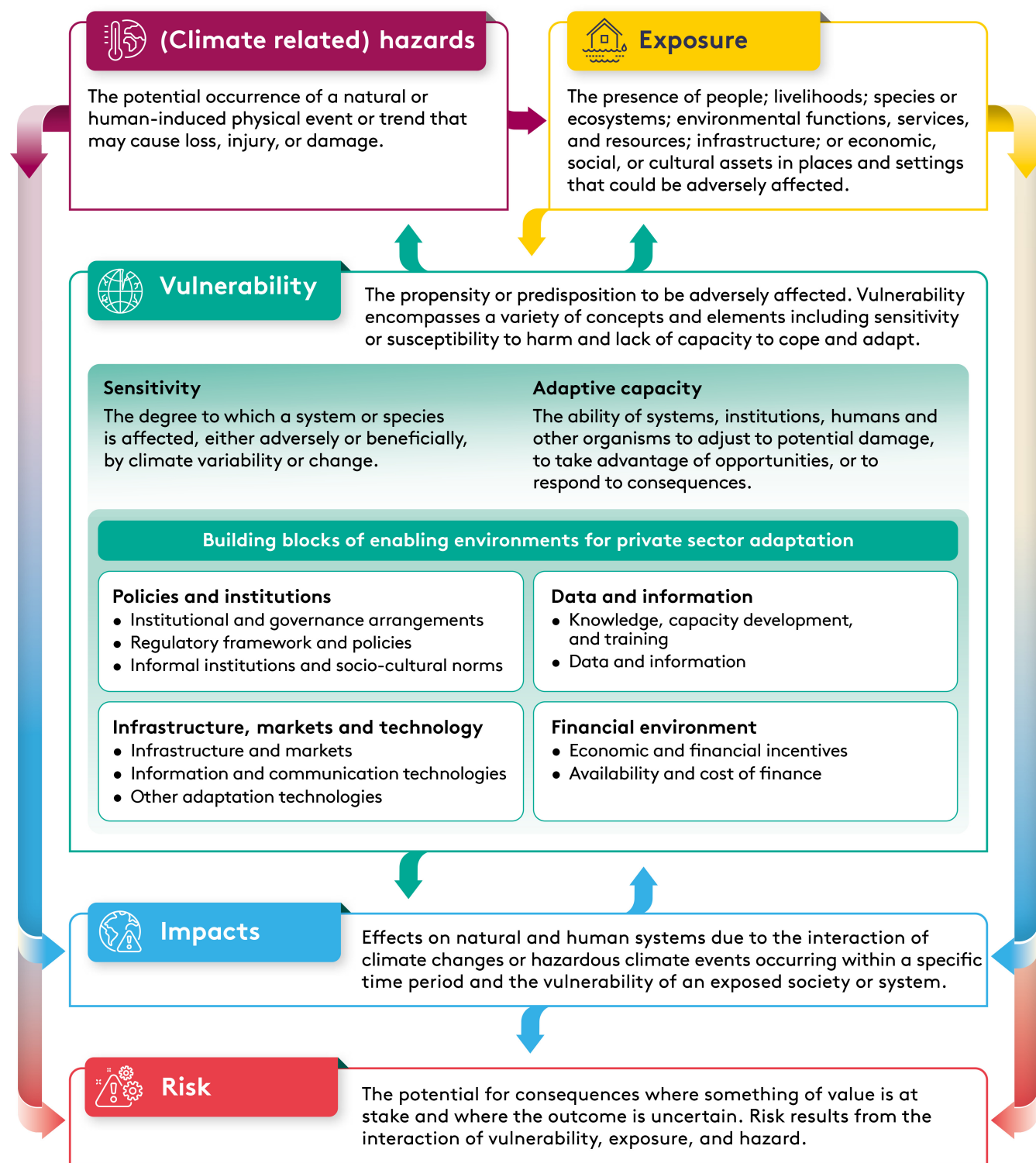


FIGURE 1 The vulnerability analysis conceptual framework. This figure, adapted from the approach to risk analysis outlined in GIZ and EURAC (2017) defines the key concepts employed in our vulnerability analysis and identifies the relationships between them. It also clarifies the way in which the building blocks of enabling environments for private sector adaptation identified in Crick, Gannon, et al. (2018) are integrated as organizing themes within the vulnerability analysis. Definitions are adapted from the glossary from the IPCC Working Group II Fifth Assessment Report (IPCC, 2014b).

resilience, sustainability), it is notable however, that there are related bodies of literature that consider gendered interactions with factors that shape business-level adaptive capacity that will inevitably have been missed, or only partially included, by this approach. These could be used to widen the scope of this review by future authors.

Key interactions between different aspects of risk, that were suggested within the analyzed literature to influence gender differential vulnerability in entrepreneurship, were mapped in Figure 2, using the impact chain approach identified in GIZ and EURAC (2017). To situate the review within the full range of risk concepts (hazard, exposure, etc.), we also drew insights from major synthetic reports for the region, such as the IPCC AR5.

4 | RESULTS

The primary dimensions of differential vulnerability to climate risk, identified or proposed through the literature review—and their connections to the wider risk landscape—are summarized within our conceptual framework in Figure 2. We discuss each aspect in turn, drawing from the literature identified during the review.

4.1 | Climatic hazards

Africa's size and diversity of climate conditions, often with high spatial and temporal variability, alongside limited observations, make it difficult to generalize about the behavior and impacts of hazards. Climate models describe a complex and diverse set of potential climate outcomes for Africa, as multiple, incompletely understood, atmospheric and oceanic processes lead to uncertainty in the detail of future climate. Comprehensive analysis of groups (ensembles) of global (CMIP5 and CMIP6) and regional (CORDEX and CORE) climate model rainfall projections show limited consistency between ensembles in projections of seasonal mean rainfall and large spread between model results, which often show opposite signs in the direction of projected change (Dosio et al., 2021). Nevertheless, increases in aspects of climate variability are ongoing and likely to continue in the future, alongside possibly long-term shifts in climate characteristics, including areas of wetting and drying (Niang et al., 2014). Consistent patterns across ensembles include a decrease in the frequency of daily rainfall events, higher maximum rainfall intensities in all regions during the wet season and an increase in the length of dry spells over southern Africa and the Ethiopian Highlands (Dosio et al., 2021). Observed warming over land in Africa has also increased during the last 50–100 years and is very likely to continue, including higher frequency and intensity of heat waves (Niang et al., 2014).

4.2 | Exposure

There is evidence to suggest that female entrepreneurs are particularly exposed to climate risk, shaped by the roles and responsibilities that they occupy. Socio-cultural norms and gendered barriers to entrepreneurship influence the sectors and types of businesses in which women tend to be concentrated (Bardasi et al., 2007; ILO, 2015; Mugabi, 2014). These vary by region and across rural and urban settings. Nevertheless, in Africa most entrepreneurs are women (World Bank, 2019). These entrepreneurs are concentrated in smaller SMEs (i.bid) and they are often dependent on climatically-sensitive natural resources and engaged in highly climatically exposed sectors, such as agriculture, livestock, fishing, trading, and processing (Diop et al., 2018; Kakota et al., 2011; UN Women, 2018).

Much of the existing evidence on gender-differential exposure to climate risks, identified in this review, comes from context-specific case studies that are difficult to generalize from. Nevertheless, there is evidence that suggests that some women are more likely to be exposed to climate risks through the geographies that they occupy. Research has found, for example, that in some areas women are more likely to be confined to more marginal and degraded agricultural land which is less resilient to climate shock (Djoudi & Brockhaus, 2011; Gnisci, 2016; Gurung et al., 2011; Rossi & Lambrou, 2008) and be more likely to settle in flood-prone areas (Davies, 2017).

Evidence also suggests that as gender roles are renegotiated under changing climatic conditions, new forms of exposure are being produced, as women take on new responsibilities, including agricultural responsibilities, previously affiliated with men (see e.g., Djoudi & Brockhaus, 2011). At times of climate stress, men in agricultural activities generally also have more flexibility to move between regions to find work and nutritional opportunities, where women often remain with families in hard hit rural areas (e.g., Newborne & Gansaonré, 2017). Meanwhile, the literature analyzed in this review identifies other context-specific factors shaping gendered exposure to climate risks in different regions. For example, in some areas of Africa women raise more climatically sensitive crops than men (Arndt & Tarp, 2000;

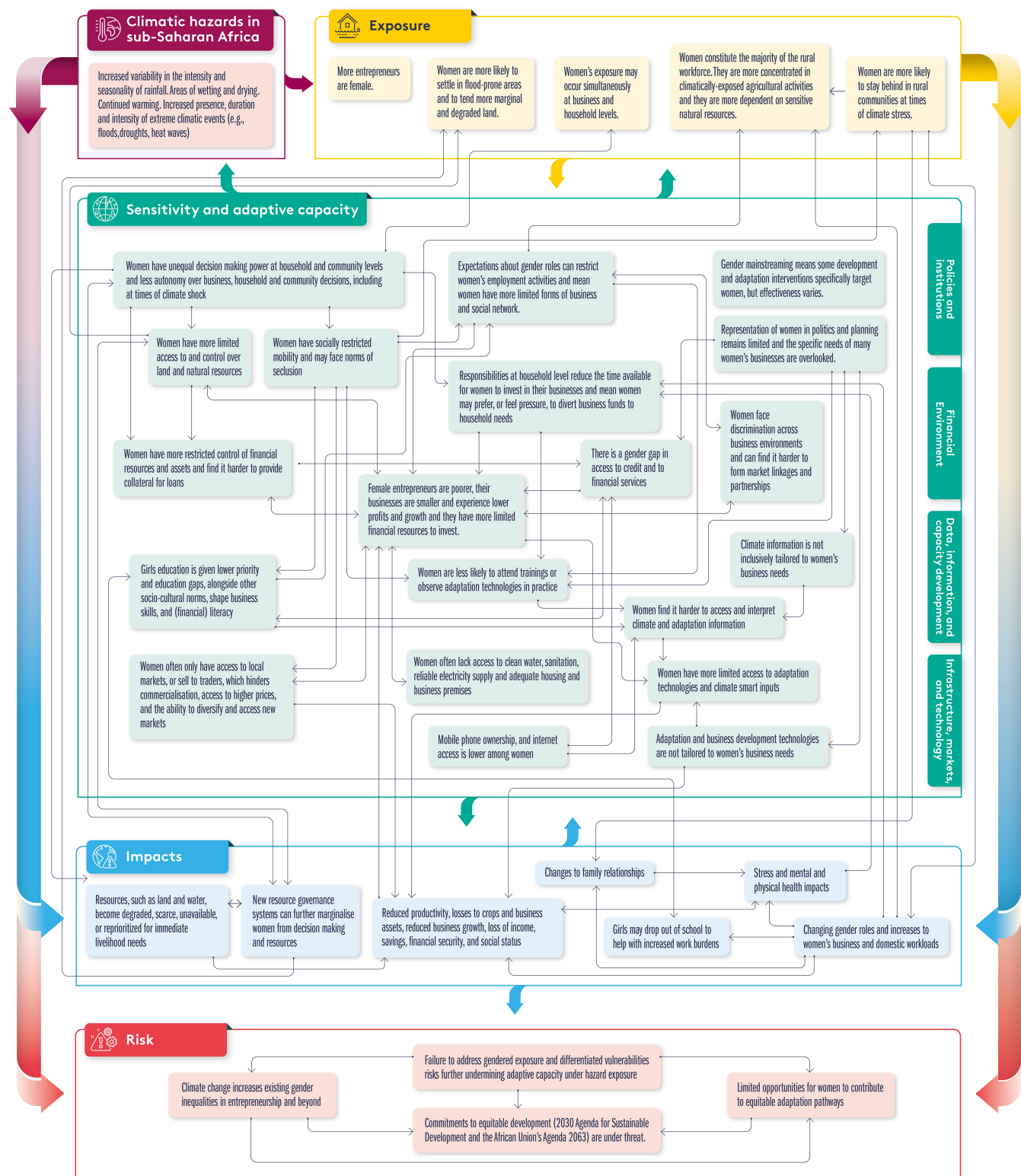


FIGURE 2 A vulnerability analysis of female entrepreneurs to climate risk based on analyzed literature. Uni-directional relationships (Element A affects B, but B does not affect A) are indicated with a uni-directional arrow, and bi-directional relationships (Element A affects B, and B affects A) are indicated with a bi-directional arrow.

Carr, 2008). As women are often the producers and procurers of food, water, fuel and other natural resources for their families, women and girls are also often on the frontline of exposure to climate impacts at the household level (Atela et al., 2018).

4.3 | Potential impacts

A large literature now documents the effects of climate variability and extremes on livelihoods in Africa. As was reflected in the sample of articles analyzed in this research, these literatures have most often focused on agricultural and livestock production in rural areas. However, the envelope of hazard frequency and intensity is changing, and because of rapid rates of urbanization, infrastructure development, and evolving livelihood systems, so too are the pathways by which these hazards impact natural resources and society (Niang et al., 2014). In this context, literatures are increasingly documenting new landscapes of exposure for private sector entrepreneurs and pathways of indirect as well as direct climate impacts for urban and rural business. The El Niño event in 2015/16, for example, was associated with flooding in eastern Africa and drought in southern Africa, impacting among other things hydropower generation and electricity and water supply. This resulted in damage to business assets and the ability of SMEs within the capital cities of Lusaka, Gaborone, and Nairobi to maintain production activities, provide services and fulfill obligations to customers and financial institutions (Gannon et al., 2018).

Figure 2 illustrates some important ways in which impacts, manifesting through gendered experiences of differential vulnerability and exposure, are highlighted within the analyzed literature. These include degraded resources and new governance systems that further marginalize women from accessing them (Atela et al., 2018; Djoudi & Brockhaus, 2011; Jost et al., 2016); reduced business productivity, losses to business assets, and losses to financial and social status (Atela et al., 2018; Jost et al., 2016); social impacts on health and family structures (Kakota et al., 2011; Nelson & Stathers, 2009; Neumayer & Plümper, 2007; UN Women, 2018); and changing gender roles (Babagura, 2010; Rao, Lawson, et al., 2019) that increase women's domestic and household burdens (Djoudi & Brockhaus, 2011; Jost et al., 2016), and increase the likelihood of girls dropping out of school (Chigwanda, 2016).

4.4 | Vulnerability

4.4.1 | Policies and institutions

In recent decades, declarations of political commitment to promote gender equality have emerged at national and international levels (Moser & Moser, 2005; Sweetman, 2012) and most governments and development institutions have adopted gender mainstreaming policies with stated aims to identify and counteract gender-based biases (Woodford-Berger, 2004). Following the understanding that underrepresentation of women in key decision-making processes impedes gender-responsive policy, commitments have emerged among governments and donors to improve gender representation in decision-making, as well as in broader public spaces and institutions (Chingarande et al., 2020; OECD, 2014). Development and adaptation institutions and programs also often directly design and support targeted actions that seek to support gender equality.

Ado et al. (2019) link gender mainstreaming to female-led households in the Aguié district of Niger having better access to public services. Mersha and Sriram (2019) also find women entrepreneurs in Ethiopia benefit more than men from government funding and other community-based programs. Effectiveness of gender mainstreaming in policy (Ampaire et al., 2020; Huyer et al., 2020; Nhamo, 2014; Sweetman, 2012) and development programming (Mannell, 2012; Wendoh & Wallace, 2005) nevertheless varies. Formal law treats men and women equally in their pursuit of economic activities in only three African countries (South Africa, Zimbabwe, and Rwanda), while in some countries laws deny women the right to register a business, sign a contract, open a bank account or own or inherit property (World Bank, 2018, see also Desjardins & St-Onge, 2009; N'Diaye, 2014; Olomola, 2013). Gaps between gender-sensitive policy, and implementation and enforcement of that policy, have been widely reported (e.g., Atela et al., 2018; Diop et al., 2022; Singh & Belwal, 2008) and representation of women in politics and adaptation and development planning remains far from parity across Africa³ (International IDEA, 2021). There are also often additional financial barriers to reaching more vulnerable groups with development and adaptation programs, partnerships and interventions, which additionally challenge commitments around gender targeting for female entrepreneurs (Gannon et al., 2021).

The specific and diverse needs of women as economic and adaptation actors have also often been overlooked through blanket approaches to the design of enabling policies, programs, products and services, that fail to consider the diverse nature of private sector actors and their activities within their design (Gannon et al., 2020; Stevenson & St-Onge, 2005). Research suggests, for example, that private sector adaptation policies have tended to focus primarily on the needs of larger and formal businesses (Crick et al., 2016), with less consideration given to smaller enterprises in the

informal (unregistered) sector, where most female entrepreneurs often operate (Bardasi et al., 2007; World Bank, 2019). The support and supervision structures that do exist for women entrepreneurs, meanwhile, are often concentrated in large urban centers, such as capitals, excluding women in rural areas from access (Diop et al., 2018). These factors exacerbate structural disadvantages faced by many of the poorest female entrepreneurs and further restrict many women entrepreneurs from accessing public-sector services, safeguards and new market and finance opportunities that can support adaptation (Carabine & Simonet, 2018). Empirical case studies of perceptions of the business environment among female entrepreneurs have echoed these findings. Limited female representation was identified as a constraint for growth of female entrepreneurship by women in Ethiopia (Singh & Belwal, 2008), for example. While female entrepreneurs in the Narok region of Kenya identified aspects of the enterprise and adaptation policy environment which they felt were poorly designed for their particular needs (Atela et al., 2018).

Gendered vulnerability to climate change in entrepreneurship is also conditioned by powerful informal institutions and socio-cultural norms at household, business and community levels. These affect all aspects of women entrepreneurs' access to enabling conditions within the business environment by shaping the activities and resources that entrepreneurs, in different social contexts, are allowed, able, or expected to engage in and access. At household levels, the burden of caring for children, running internal family affairs, and meeting household livelihood needs, most often falls on women (Kakota et al., 2011; UN Women, 2018). As such, some research has begun to suggest that women often experience concurrent pressures of managing climate risk at household, as well as SME, levels and, at times of climate stress, their experience of vulnerability occurs simultaneously at business and household levels (Atela et al., 2018 cf., Mazonde & Carmichael, 2016). These climate risks can manifest in interconnected ways (ibid); particularly since women often establish enterprises with the aim of providing for the household (Aspaas, 1998; Diop et al., 2018; Isaga, 2019). The need to balance business and household responsibilities, meanwhile, can present a high opportunity cost, in terms of reducing the time available for women to invest in business development (Donald et al., 2018; McFerson, 2010; Mersha & Sriram, 2019), or to identify and execute strategies to build resilience to climate risk within their SMEs (Atela et al., 2018; see also Porter, 2011).

Women's access to resources, as well as their ability to make decisions about the management of these resources that reflect their adaptation needs, is also often socially restricted at household and community levels (Daoud, 2021; Djoudi & Brockhaus, 2011; Perez et al., 2015; Smucker & Wangui, 2016, see also Badstue, Petesch, et al., 2020; Patel, 2020). This includes land and other natural resources, which women are often strongly dependent on for their entrepreneurship activities and which may become degraded or scarce in response to climatic pressures. Despite being the primary cultivators, women own just 13% agricultural land globally (UN Women, 2018). These gaps in land ownership can restrict a range of business activities that shape vulnerability. For example, SMEs without land tenure may find it challenging to form market linkages and partnerships with other larger companies that prefer to work with businesses with secure entitlements and the accompanying legislative protection and resource security that this can offer (Atela et al., 2018).

Discrimination also occurs in business environments more broadly and prevailing narratives of business success and risk are often inherently gendered (Brindley, 2005; Marshall et al., 2017). Almost 60% of Ethiopian female entrepreneurs surveyed in Singh and Belwal (2008), for example, reported a lack of cooperation from other business parties, such as banks, suppliers and marketing intermediaries, and in Stevenson and St-Onge (2005), women entrepreneurs in Kenya, Tanzania, and Ethiopia reported difficulty negotiating rent prices. Gendered social roles, educational trends, and labor market experiences influence the sectors in which even wealthier women tend to specialize and start businesses in Africa (Mugabi, 2014; Singh & Belwal, 2008). Similarly, gender norms around mobility and seclusion often prevent women from migrating to access employment opportunities, markets and resources (Desjardins & St-Onge, 2009; Porter, 2011). Alongside other cultural and religious norms—such as around the clothes, responsibilities, and behaviors expected from women—these factors are likely to limit opportunities for women to grow, diversify and adapt business models in response to climatic stimuli, to build new business linkages or to make quick decisions, including, as found by Habtezion (2016), at times of emergency. They are also likely to be factors contributing to female entrepreneurs being overwhelmingly confined to smaller, informal SMEs in a more limited range of sectors (Brière et al., 2021; World Bank, 2019).

Women's groups and other forms of collective action and collaboration through formal and informal social networks and cooperatives play an important role in supporting female entrepreneurs in the face of the multiple and concurrent social and economic challenges they experience. This extends into climate change adaptation action, where informal institutions such as women's groups are used to share knowledge on adaptation; identify new opportunities to diversify activities; build market linkages; access extension services; initiate group-based adaptation and resource

management practices (e.g., water harvesting, tree planning); organize informal access to credit; and pool resources to facilitate the introduction of new climate resilient technologies (Agol et al., 2021; Gumucio et al., 2020; Mussema & Yirga, 2020; Ngigi et al., 2017). Research has suggested, however, that those who are best able to maximize the opportunities of these networks are those that benefit from a wider suite of broader enabling factors, such as higher educational attainment (Atela et al., 2018). The resources mobilized through women's groups are also not always sufficient to safeguard women against climate shocks (ibid).

4.4.2 | Financial environment

Finance is a key enabling factor for firm-level investment in adaptation (Crick, Gannon, et al., 2018; Crick, Eskander, et al., 2018; Stenek et al., 2013) and limited access to financial resources constrains all sorts of business investment and adaptation behavior for women. Studies show finance can limit, for example, female farmers' capacities to hire labor during peak agricultural activities, to access markets and to adopt improved inputs and technologies (Adegbite & Machethe, 2020; Anyoha et al., 2015). Research in Cameroon also found women to be more likely to opt for low-cost adaptation options (Molua, 2011).

Poverty, in its multidimensional forms, affects women disproportionately across Africa (UN Women, 2018) and this trend is reflected in the enterprise landscape. Women's businesses are smaller (Bardasi et al., 2011). They have lower levels of business capital—including equipment, inventory, and property—and smaller workforces than their male counterparts (World Bank, 2019). And, across Africa, women entrepreneurs earn lower profits than men (ibid.), experience slower growth (Nichter & Goldmark, 2009) and consider access to finance to be a major barrier to operating their SMEs (Beck & Cull, 2014; Isaga, 2019; Singh & Belwal, 2008).

As Figure 2 illustrates, the reasons for this are manifold and interconnected with the breadth of vulnerabilities across the enterprise landscape. However, to understand women's differential capacity to invest in business development and climate change adaptation measures, it is particularly notable that: Women's livelihood options are generally more limited than men's and women are often excluded from more profitable activities and concentrated in lower-growth sectors (Eriksen et al., 2005; World Bank, 2019); female entrepreneurs start from a lower base, having less start-up and investment capital (Bardasi et al., 2011); women farmers experience lower productivity than their male counterparts (Kilic et al., 2015; World Bank, 2014); women can find it harder to access markets that command higher prices for products (Mandipaka, 2014); unequal bargaining power at the household and family level can restrict women's control of financial resources and assets, even within their own business activities (Nordman & Vaillant, 2014; Otoo et al., 2011; Rao, 2019); and evidence suggests women may be more likely to prefer, or feel more pressure, to divert business funds and loans toward other household and family needs (ibid).

Female entrepreneurs also experience broader financial exclusion, with gender gaps in financial inclusion growing in some countries (Duflo & Udry, 2004; Fafchamps et al., 2014; Rao, 2019). Research in Nigeria demonstrated the positive effects access to savings mechanisms can have on business investment (Adegbite & Machethe, 2020). However, women in Africa—particularly those that are older, or poorer, or in rural areas—are less likely to hold a formal bank account, or mobile money account (Adegbite & Machethe, 2020; Dupas & Robinson, 2013; Patel, 2020) and business account ownership is low (Dermirgüç-Kunt et al., 2018). Access to credit, meanwhile, remains a barrier in business environments across Africa. And while the gender gap in access to formal credit shows some signs of having improved in recent years, with the micro-finance industry playing an important role in reducing disparities (International Trade Centre, 2018), the share of women receiving loans remains lower (Aterido et al., 2011). The loans women entrepreneurs receive are also smaller (Dermirgüç-Kunt et al., 2018) and are thus harder to use productively.

Multiple interacting reasons for this differential in access to credit are identified in the selected literature. First, available finance—including climate finance—is often not well-tailored to women's businesses. Women are underrepresented in finance and climate change decision-making fora, meaning women's roles as economic actors—and their priorities and needs—are more marginal in the development of financing mechanisms (World Bank, 2019). As a result, the ability of female entrepreneurs to access and benefit from finance opportunities is often constrained by a lack of awareness of the specific barriers to accessing finance experienced by women (Aguilar et al., 2009). Carabine and Simonet (2018) highlight, for example, that many new streams of international climate finance for the private sector have not recognized the diversity in type, size, and formality of private sector actors, which has closed down access to these funds for smallholder farmers, where women predominate.

Second, control of a smaller asset base and more limited savings, reduces the ability of female entrepreneurs to provide collateral and to access large enough loans to invest in adaptation (World Bank, 2019). Since property rights are often the most acceptable collateral to guarantee loans from financial institutions, gaps in land ownership are particularly restrictive (*ibid*). Third, socio-cultural norms and broader gender-based discrimination—perhaps founded on stereotypes of business owners being male, of women being less capable of economic success and of women having reduced capacity to repay loans—also constrain the financial environment (Djoudi & Brockhaus, 2011; FAO, 2011; Olomola, 2013).

The terms on which women receive loans can also be less favorable: In some countries, for example, women have a greater need than men to present collateral (Aguilar et al., 2009; Stevenson & St-Onge, 2005), pay higher interest rates, or receive loans with shorter maturities (Demirgüç-Kunt et al., 2008; Olomola, 2013; World Bank, 2019). Among a survey of female entrepreneurs in Addis Ababa, almost 60 percent of respondents reported a lack of cooperation from institutions such as banks, suppliers and marketing intermediaries (Singh & Belwal, 2008). Women may also experience greater transaction costs from securing loans (due in part to the relative size of their loans) (Aguilar et al., 2009) and may struggle to access financing from regulated banks as a result of complexities navigating the application process itself and high levels of financial illiteracy (Epo, 2012; Ngoasong & Kimbu, 2019).

4.4.3 | Data, information and capacity development

Private sector adaptation requires access to a wide range of skills, data, and information. These range from business and financial literacy skills, to climate information across a range of time scales, and awareness of adaptation and resilience opportunities and risks (Crick, Gannon, et al., 2018; Stenek et al., 2013). Such knowledge and skill development can be acquired from multiple sources, including through formal education, business and social networks, national and regional government (e.g., weather forecasting services from national meteorological departments and agricultural extension services) and NGOs (see, e.g., McKune et al., 2018).

Evidence suggests that women experience wide and persistent gaps across many of these knowledge and skill domains and in accessing data and information for adaptation, which can have profound implications on their ability to navigate adaptation and business decision-making and to choose optimal adaptation strategies. This begins from childhood, where education of boys is often prioritized at family levels, meaning girls are more likely to be out of school than boys (UN Women, 2018). Combined with other customary traditions, such as expectations surrounding early marriage and motherhood (Desjardins & St-Onge, 2009; UN Women, 2018), this has led to a clear education gender gap in Africa (The GEM Report, 2020). Gaps in formal education act alongside entrenched gender biases to mean women have reduced opportunities to develop management, entrepreneurship and technical skills (Diouf et al., 2019; Partey et al., 2018; Roncoli et al., 2009). These include financial literacy and the ability to form supportive business relationships, which can be essential for adaptation within business networks and value chains (McKenzie & Woodruff, 2015; Mersha & Sriram, 2019). They can also shape gender differences in the ability to *interpret and use* climate and adaptation information (Nciizah & Wakindiki, 2015; Nelson & Stathers, 2009).

The material selected for this review also highlights wide ranging reasons that women can be disadvantaged in their *access* to information for adaptation, including climate information. These include cultural norms—as well as personal safety risks from traveling outside of their home in some areas—that can prevent women from participating in spaces where they may acquire this information first-hand. Their more limited mobility to travel within and between regions, for example, means in some studies women have been found to be less likely to attend trainings and observe climate resilient practices directly (Mersha & Sriram, 2019; Perez et al., 2015; Singh & Belwal, 2008). Women also often have less time available to attend trainings due to their household responsibilities (Arbache et al., 2010; Jost et al., 2016) and they may have to seek permission from their spouses to attend (Nyantakyi-Frimpong, 2019; World Bank, 2014). They may not be able to interact effectively with male extension agents and other actors due to cultural norms of seclusion (Bernier et al., 2013; Jost et al., 2016; see also Porter, 2011). They can also find it harder to access large and diverse social and business networks, which support access to new information and the acquisition of new business and adaptation skills (Mayoux, 1995; Nyantakyi-Frimpong, 2019; World Bank, 2014).

Men and women also often have very different adaptation information needs for reasons including: Their different roles within societies; the different sectors and activities in which their economic activities are concentrated; their different risk exposure; and their different perceptions, values and adaptation preferences (Gumucio et al., 2020; Habtemariam et al., 2016; Jost et al., 2016; Kom et al., 2020; Koyenikan & Anozie, 2017; Molua, 2011). This can include

differences in needs relating to the nature of the information required, the timing when information is needed and the format and medium through which information can best be communicated and accessed (Fafchamps, 2001; World Bank, 2019). Access to tailored climate information influences the adaptation strategies that private sector actors undertake to minimize harm to their activities and maximize opportunities (Carr & Onzere, 2018; Diouf et al., 2019; Henriksson et al., 2021; Twyman et al., 2014). Yet gender biases mean climate information and extension services are often not designed for, or effectively targeted at women (Archer, 2003; Henriksson et al., 2021). Where gender-sensitive services are developed, they are often hampered by oversimplified framings of women as a homogenous group, and only address some women's needs (Demetriades & Esplen, 2008; Henriksson et al., 2021; Twyman et al., 2014).

4.4.4 | Infrastructure, markets and technology

Infrastructure, markets, and technologies are key aspects of business enabling environments for adaptation. Deficient infrastructure, including power, transportation, water, and telecommunications, is a key constraint to the development and growth of SMEs in Africa (Carr et al., 2016). This can limit opportunities to access adaptation information and cause major disruption to business activities at times of climate stress (AfDB, 2013; APPG, 2015; Gannon et al., 2018; Nellemann et al., 2011; Page & Söderbom, 2015). Limited access to markets can prevent businesses from innovating and developing—or accessing—new, more climate resilient products or services, or forming new adaptation partnerships (Nyasimi et al., 2017). Meanwhile, without access to adaptation technologies—such as climate-smart agricultural inputs and equipment, water recycling technologies and flood defenses—adaptation options will always be limited. These dimensions of enabling business environments are also often mutually dependent: Poor quality transportation and communication infrastructure, for example, can limit opportunities to access markets for new products and services and to access improved inputs and technologies (Gannon et al., 2021).

Wide-ranging gender gaps can again be identified across all of these dimensions of business enabling conditions. More than half of urban women live in slums where they frequently lack access to clean water, sanitation, reliable electricity supply, durable housing, and sufficient living areas (AfDB, 2018). Alongside an inability to afford adequate premises for their business (UN Women, 2018), for many women this likely limits the time, space and resources available for creative and productive practice. Meanwhile, gender—at times compounded by age and wealth—can shape entrepreneurs' ability to access markets (e.g., Jost et al., 2016; Porter, 2011; Stevenson & St-Onge, 2005). Alongside the earlier discussed social norms restricting mobility, women are, for example, less able to manage the high transaction costs of participating in larger markets which, in rural areas, are often long distances away (ibid).

Women also often have more restricted access to a range of technologies that can support adaptation. Women, for example, have unequal access to and uptake of a variety of productive and climate smart inputs (Adegbite & Machethe, 2020; Carr & Hartl, 2018; Huyer, 2016) while mobile phone ownership, and internet access, is also higher among men, which can, for example, limit access to weather and climate information (Doss, 2014; Fisher & Carr, 2015; Gumucio et al., 2020; Huyer et al., 2021; Peterman et al., 2010; World Bank, 2014). Core drivers of differences in access to technologies identified in the sampled literature are addressed through the other building blocks of enabling business environments. Women entrepreneurs have less time and fewer resources and capital to invest in technologies, and male entrepreneurs have accordingly been found to show higher engagement in adaptation strategies that are more capital and labor intensive (Coulibaly et al., 2017; UN Women, 2018; Wesolowski et al., 2012; World Bank, 2019). A lack of power to make decisions about climate change within their own business, as well as insecurity and absence of land tenure can also weaken women's ability (Jost et al., 2016; Kakota et al., 2011; Molua, 2011) and incentive (Bernier et al., 2013; Fisher & Carr, 2015) to make long-term investments.

Women's barriers to mobility and exclusion from some business networks and training can also reduce their exposure to new technologies (Bezabih et al., 2016; Olsen et al., 2010; Smucker & Wangui, 2016; World Bank, 2014). Similarly, enabling policies and programs, often reproduce assumptions that technology users are male (Aguilar et al., 2009; Carr & Hartl, 2018; Jost et al., 2016) and fail to reflect the context, motivations and power structures in which actors take adaptation decisions (e.g., Carr & Thompson, 2014). The example in Atela et al. (2018) of mobile bee-hives that are used to support mobility in response to climate trends and which are often too heavy for women to carry, highlights the way in which even fairly simple inputs and technologies could be designed in ways that are more responsive to women's needs.

5 | DISCUSSION AND CONCLUSIONS

This article suggests women entrepreneurs in Africa experience a “triple differential vulnerability” to climate change, wherein they (1) are often more sensitive to climate risk as a result of their concentration in certain sectors, activities and types of enterprise (e.g., micro SMEs in agricultural production in remote regions); (2) face additional barriers to adaptation across policy, institutional, regulatory and financial environments and in accessing supportive infrastructure, markets and technology, data, information, and training; and (3) are also on the frontline of managing climate risk at household levels.

The impact chains in Figure 2 illustrate that as gendered dimensions of vulnerability, exposure and impacts interact with climate change, they create pathways of compounding vulnerabilities, reinforced through complex interactions and feedback loops. For example, where women struggle to participate in larger markets, they may have less interaction with other value chain actors (Adegbite & Machethe, 2020). This can further limit their access to markets, information and finance for adaptation (Triki & Faye, 2018). In parallel, gender norms mean climate stress—and adaptation—can increase women's entrepreneurs' workload (Jost et al., 2016), which may reduce the amount of time available for women to invest in their businesses (Kakota et al., 2011). These factors may combine to reduce the financial resources female entrepreneurs have available to invest in adaptation and thus make them more vulnerable to future shocks (Adegbite & Machethe, 2020), which—when they occur—may further erode adaptive capacity. Figure 2 therefore illustrates the potential for climate change to entrench and reinforce existing inequalities and to further undermine the adaptive capacity of female entrepreneurs across Africa. From this, three clear lessons can be gleaned.

First, interactions across vulnerabilities reinforce the need for an intersectional approach to adaptation policy, that positions gender within the heterogeneity of gender identities and the multiple other dimensions of identity and social difference that shape vulnerability. Only through creating space to examine the multiplicities of these interactions can we understand the depths of gendered vulnerabilities and identify the particular challenges and unique adaptation needs facing the most vulnerable female entrepreneurs. This suggests that, while policy—and indeed sometimes literature—tend to homogenize women as a single category, a “one size fits all” approach will not work. Instead, if policy interventions are to inclusively target that population's needs, decision makers and development practitioners will need to focus on identifying context-specific assemblages of vulnerabilities within target populations. Methodological innovation to support and include intersectional approaches in vulnerability analysis and interventions will also be required, since we currently have limited tools to address this challenge in research or policy domains or within vulnerability assessments and indices (see e.g., Acosta et al., 2021; Chaplin et al., 2019; Kaijser & Kronsell, 2014; Ravera et al., 2016; Van Aelst & Holvoet, 2016).

Second, compounding vulnerabilities emphasize the need for an integrated approach to building gender-sensitive enabling environments for private sector adaptation. This will require gender inequalities to be addressed across many structural deficits within business environments (such as limited access to markets, finance and transport, and communication infrastructure) as well as in the development of conditions that support climate-specific adaptive capacity (such as access to climate information services). Overcoming these barriers to adaptation will support the growth, development, and resilience of female entrepreneurship more broadly.

Third, the interaction between gendered vulnerability, exposure to climatic hazards and increasing climate variability in Africa determine not only the potential impacts on women entrepreneurs, but also the risks for society overall from failing to account for the diverse and specific needs of women in business and adaptation environments. Current adaptation and development trajectories risk gender differentiated vulnerabilities further undermining adaptive capacity under hazard exposure, and risk climate change entrenching and increasing existing gender inequalities in entrepreneurship and beyond. They also risk limiting opportunities for women to contribute to equitable adaptation pathways and threaten commitments to equitable development under the 2030 Agenda for Sustainable Development and the African Union's Agenda 2063.

As we move forward and aim to reorient these trajectories, this review suggests some notable gaps in the literature on gender, entrepreneurship, and adaptation. Of particular note, the evidence we found in the sample of literature included within our review was concentrated in agricultural production and was sparse among businesses at other stages of agricultural value chains and within other sectors. We believe this reflects trends across literature more broadly. Since these businesses also experience significant, but under-recognized indirect climate impacts (Gannon et al., 2018), expanding this evidence base should be a priority for further research. Additionally, most of the studies that we identified, that focused specifically on gender and firm-level adaptation, are qualitative case studies; the external validity of which is often difficult

to assess. As a result, in many instances, the interlinkages captured in Figure 2 constitute tentative hypotheses, that suggest how gendered vulnerabilities may interact and enmesh in wider settings, and which future research can investigate, test, and elaborate. Notably, greater sex-disaggregation in SME survey data, which has previously been a limiting factor in quantitative and econometric analysis (GBA, 2016), can support these endeavors.

We suggest future research should also more closely explore the links between adaptation in female-led enterprise and within households since, although a gender lens highlights connections between business and household level resilience, we found surprisingly little analysis of these interactions within the sample of literature that we reviewed. It is additionally notable that during this review, we found very limited existing research focused on male-specific experience of vulnerability in firm-level adaptation, despite men also experiencing gender-specific climate impacts and vulnerabilities; for example, as a result of migrating, taking out loans, or the pressure of being majority income earners. This review also reaffirms the need for greater integration of the private sector adaptation literature with other literatures, such as those on private sector development and livelihoods. Indeed, we expect that extending this review to these literatures could deepen insights under each of the four building blocks analyzed in this article.

Despite these gaps, some clear directions for enhancing the adaptive capacity of female entrepreneurs have emerged from this review. Particularly, it is clear that policies, programs, products, and services need to be designed in the context of the diverse and specific needs of a wider range of female entrepreneurs and their different activities, adaptation responses, modes of production, and ways of doing business. Business finance opportunities especially need to be broadened to more inclusively target women and their varied circumstances; for example, being made accessible to informal enterprises, individual producers, women's collectives and producer cooperatives, as well as those with more restricted access to formal land ownership. With increasing emphasis on mobilizing the private sector in adaptation action (what Pauw and Pegels (2013, p. 258) call "the private sector for adaptation"), companies too need to be supported to develop equitable business linkages and partnerships with a wider range of other businesses, including with those that do not have the formal land entitlements that larger companies, seeking legislative protection, and resource security, often require.

The failure to account for the diverse and specific characteristics and needs of women in business and adaptation environments to date has arisen, in part, as a result of the voices, aspirations, and capabilities of female entrepreneurs not yet being clearly articulated in public policy, legislative, and investment domains and women not having the power to shape development and adaptation provision according to their own specific needs and realities. Moving forward, women need to be at the heart of adaptation and entrepreneurship planning. This will require critical examination of the forums that represent women. Informal institutions such as women's groups and producer cooperatives, particularly, are increasingly positioned as important platforms for building capacities in climate adaptation and they are used by government and nongovernmental institutions to provide services such as agricultural extension and training services. However, these groups risk reproducing local power dynamics and their effective mobilization will require learning from literatures which have highlighted the challenges of ensuring equitable participation in local institutional arrangements and the potential for localized adaptation and development planning responses to reproduce existing politics of exclusion, subordination and vulnerability (e.g., Eriksen et al., 2015; Eriksen et al., 2021; Sovacool et al., 2015; Tanner & Allouche, 2011). In a policy and research landscape, where female entrepreneurship is often cast as a tool through which to not only empower women, but also to address broader resilience agendas, such actions will be fundamental to making adaptation work for women, and not just making women work for adaptation.

AUTHOR CONTRIBUTIONS

Kate Elizabeth Gannon: Conceptualization (lead); data curation (supporting); formal analysis (lead); funding acquisition (lead); investigation (lead); methodology (equal); project administration (lead); resources (equal); supervision (lead); validation (equal); visualization (equal); writing – original draft (lead); writing – review and editing (lead). **Elena Castellano:** Data curation (lead); formal analysis (supporting); investigation (supporting); methodology (equal); project administration (supporting); resources (equal); validation (equal); visualization (equal); writing – original draft (supporting); writing – review and editing (supporting). **Shaikh Eskander:** Conceptualization (supporting); funding acquisition (supporting); investigation (supporting); project administration (supporting); resources (supporting); supervision (supporting); validation (supporting); writing – review and editing (supporting). **Dorice Agol:** Conceptualization (supporting); investigation (supporting); resources (supporting); validation (supporting); writing – review and editing (supporting). **Mamadou Diop:** Conceptualization (supporting); investigation (supporting); resources (supporting); validation (supporting); writing – review and editing (supporting). **Declan Conway:** Funding acquisition (supporting); project administration (supporting); supervision (supporting); writing – review and editing (supporting). **Elizabeth Sprout:** Data curation (supporting); resources (supporting); validation (supporting).

ACKNOWLEDGMENTS

This work was produced in partnership with Kenya Markets Trust, Nairobi. For insightful discussions and earlier collaborations that shaped this article we thank Robina Abuya, Florence Crick, Joanes Atela, Ginny Rose, and Antonio Avila.

FUNDING INFORMATION

This work was carried out through The Women Entrepreneurs in Climate Change Adaptation ('WECCA') Project with financial support from the UK Government's Foreign, Commonwealth & Development Office (FCDO) and the International Development Research Centre (IDRC), Ottawa, Canada. Kate Gannon and Declan Conway also acknowledge financial support from the Grantham Foundation for the Protection of the Environment, and the UK Economic and Social Research Council (ES/R009708/1) through the Centre for Climate Change Economics and Policy.

CONFLICT OF INTEREST

The authors have declared no conflicts of interest for this article.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

ORCID

Kate Elizabeth Gannon  <https://orcid.org/0000-0001-6742-8982>

Elena Castellano  <https://orcid.org/0000-0001-9276-5569>

Shaikh Eskander  <https://orcid.org/0000-0002-3325-5486>

Mamadou Diop  <https://orcid.org/0000-0002-4208-0577>

Declan Conway  <https://orcid.org/0000-0002-4590-6733>

Elizabeth Sprout  <https://orcid.org/0000-0002-2995-4225>

RELATED WIREs ARTICLES

[Adaptation to climate change by organizations](#)

[Women and adaptation](#)

[Multinational and large national corporations and climate adaptation: are we asking the right questions? A review of current knowledge and a new research perspective](#)

[Enabling private sector adaptation in sub-Saharan Africa](#)

[Gender and climate change](#)

ENDNOTES

¹ These broad categories demonstrate notable overlap with dimensions of adaptive capacity identified by the IPCC and in the GIZ Risk Assessment Framework. They also crosscut the three main drivers of vulnerability identified by Adger (2006): Resource availability, resource distribution, and regulatory institutions.

² Adapt* AND Wom?n OR gender* OR female AND Climate change AND Entrepreneur* OR business OR enterprise.

³ Although it is notable that there has been increasing political participation among African women and 15 countries in Africa demonstrate female representation in national parliaments that surpasses the global average (UN Women, 2018).

FURTHER READING

Agarwal, B. (1994). *A field of ones own: Gender and land rights in South Asia*. Cambridge University Press.

Doss, C. R. (2001). Designing agricultural technology for African women farmers: Lessons from 25 years of experience. *World Development*, 29, 2075–2092. [https://doi.org/10.1016/S0305-750X\(01\)00088-2](https://doi.org/10.1016/S0305-750X(01)00088-2)

REFERENCES

Acosta, M., Riley, S., Bonilla-findji, O., Martínez-barón, D., Howland, F., Huyer, S., Castellanos, A., Martínez, J. D., & Chanana, N. (2021). Exploring women's differentiated access to climate-smart agricultural interventions in selected climate-smart villages of Latin America. *Sustainability*, 13, 10951. <https://doi.org/10.3390/su131910951>

- Adegbite, O. O., & Machethe, C. L. (2020). Bridging the financial inclusion gender gap in smallholder agriculture in Nigeria: An untapped potential for sustainable development. *World Development*, 127, 104755. <https://doi.org/10.1016/j.worlddev.2019.104755>
- Adger, W. N. (2006). Vulnerability. *Global Environmental Change*, 16, 268–281. <https://doi.org/10.1016/j.gloenvcha.2006.02.006>
- Ado, A. M., Savadogo, P., & Abdoul-Azize, H. T. (2019). Livelihood strategies and household resilience to food insecurity: Insight from a farming community in Aguié district of Niger. *Agriculture and Human Values*, 36, 747–761. <https://doi.org/10.1007/s10460-019-09951-0>
- Adu, D. T., Kuwornu, J. K. M., Anim-Somuah, H., & Sasaki, N. (2018). Application of livelihood vulnerability index in assessing smallholder maize farming households' vulnerability to climate change in Brong-Ahafo region of Ghana. *Kasetsart Journal of Social Sciences*, 39, 22–32. <https://doi.org/10.1016/j.kjss.2017.06.009>
- AfDB (2013). *Supporting the transformation of the private sector in Africa*.
- AfDB (2018). Chapitre 3: Les infrastructures africaines: un potentiel considérable, mais un impact limité sur la croissance équitable. In *Perspectives Économiques En Afrique 2018*. Banque africaine de développement, pp. 69–107.
- Agarwal, B. (2009). Gender and forest conservation: The impact of women's participation in community forest governance. *Ecological Economics*, 68, 2785–2799. <https://doi.org/10.1016/j.ecolecon.2009.04.025>
- Agol, D., Reid, H., Crick, F., & Wendo, H. (2021). Ecosystem-based adaptation in Lake Victoria Basin; synergies and trade-offs. *Royal Society Open Science*, 8, 201847. <https://doi.org/10.1098/rsos.201847>
- Aguilar, L., Corat, S. G., Duer, E. M., Anderson, C. L., Sasvari, A., Pearl, R., Meesters, H., Wanjiru, L., Dentler, A., Meyreles, L., Karlsson, G., Rathgeber, E., Williams, M., & Conze, Y. (2009). *Training manual on gender and climate change*. International Union for Conservation of Nature (IUCN) and United Nations Development Programme (UNDP).
- Ahmed, A., Lawson, E. T., Mensah, A., Gordon, C., & Padgham, J. (2016). Adaptation to climate change or non-climatic stressors in semi-arid regions? Evidence of gender differentiation in three agrarian districts of Ghana. *Environmental Development*, 20, 45–58. <https://doi.org/10.1016/j.envdev.2016.08.002>
- Ampaire, E. L., Acosta, M., Huyer, S., Kigonya, R., Muchunguzi, P., Muna, R., & Jassogne, L. (2020). Gender in climate change, agriculture, and natural resource policies: Insights from East Africa. *Climatic Change*, 158, 43–60. <https://doi.org/10.1007/s10584-019-02447-0>
- Antwi, S. H. (2020). The trade-off between gender, energy and climate change in Africa: The case of Niger Republic. *GeoJournal*, 9, 183–195. <https://doi.org/10.1007/s10708-020-10246-9>
- Anyoha, N. O., Chikaire, J. U., & Nwakwasi, R. N. (2015). Effects of gender based discriminatory practices on poverty reduction and women empowerment in Ngor-Okpala area of IMO State Nigeria. *International Journal of Development and Emerging Economics*, 3, 39–48.
- APPG (2015). *From subsistence to successful businesses: Enabling smallholder agribusiness in sub-Saharan Africa*. All-party parliamentary group (APPG) on Agriculture and Food for Development, Houses of Parliament, Westminster, UK.
- Arbache, J.S., Kolev, A., & Filipiak, E. (2010). *Gender disparities in Africa's labor market*. Africa Development Forum Series, AFD and World Bank.
- Archer, E. R. M. (2003). Identifying underserved end-user groups in the provision of climate information. *American Meteorological Society*, 84, 1525–1532.
- Arndt, C., & Tarp, F. (2000). Agricultural technology, risk, and gender: A CGE analysis of Mozambique. *World Development*, 28, 1307–1326. [https://doi.org/10.1016/S0305-750X\(00\)00017-6](https://doi.org/10.1016/S0305-750X(00)00017-6)
- Aspaas, H. R. (1998). Heading households and heading businesses: Rural Kenyan women in the informal sector. *The Professional Geographer*, 50, 192–204. <https://doi.org/10.1111/0033-0124.00114>
- Atela, J., Gannon, K. E., & Crick, F. (2018). Climate change adaptation among female-led micro, small and medium enterprises in semi-arid areas: A case study from Kenya. In W. Leal Filho (Ed.), *Handbook of climate change resilience* (pp. 1–18). Springer. https://doi.org/10.1007/978-3-319-71025-9_97-1
- Aterido, R., Beck, T., & Iacovone, L. (2011). *Gender and finance in sub-Saharan Africa are women disadvantaged? Policy research*. (Working Paper No. 5571). World Bank.
- Babagura, A. (2010). *Gender and climate change: South Africa case study*. Heinrich Böll Foundation Southern Africa.
- Badstue, L., Elias, M., Kommerell, V., Petesch, P., Prain, G., Pyburn, R., & Umantseva, A. (2020). Making room for manoeuvre: Addressing gender norms to strengthen the enabling environment for agricultural innovation. *Development in Practice*, 30, 541–547. <https://doi.org/10.1080/09614524.2020.1757624>
- Badstue, L., Petesch, P., Farnworth, C. R., Roeven, L., & Hailemariam, M. (2020). Women farmers and agricultural innovation: Marital status and normative expectations in rural Ethiopia. *Sustainability (Switzerland)*, 12, 1–22. <https://doi.org/10.3390/su12239847>
- Bardasi, E., Blackden, C.M., & Guzman, J. C., 2007. Chapter 1.4. Gender, entrepreneurship, and competitiveness in Africa. In *Africa competitiveness report*, pp. 69–85.
- Bardasi, E., Sabarwal, S., & Terrell, K. (2011). How do female entrepreneurs perform? Evidence from three developing regions. *Small Business Economics*, 37, 417–441. <https://doi.org/10.1007/s11187-011-9374-z>
- Baten, J., & de Pleijt, A. (2018). *Female autonomy generates superstars in long-term development: Evidence from 15th to 19th century Europe*. Centre for Economic Policy Research.
- Beck, T. & Cull, R. (2014). *Small- and medium-sized enterprise finance in Africa. Africa growth initiative*. (Working Paper No. 16).
- Bernier, Q., Franks, P., Kristjanson, P., Neufeldt, H., Otzelberger, A., & Foster, K. (2013). *Addressing gender in climate-smart smallholder agriculture*. (Policy Brief 14). World Agroforestry Centre (ICRAF).

- Bezabih, M., Holden, S., & Mannberg, A. (2016). The role of land certification in reducing gaps in productivity between male- and female-owned farms in rural Ethiopia. *Journal of Development Studies*, 52, 360–376. <https://doi.org/10.1080/00220388.2015.1081175>
- Biesbroek, G. R., Klostermann, J. E. M., Termeer, C. J. A. M., & Kabat, P. (2013). On the nature of barriers to climate change adaptation. *Regional Environmental Change*, 13, 1119–1129. <https://doi.org/10.1007/s10113-013-0421-y>
- Brière, S., Auclair, I., & Tremblay, M. (2021). Soutenir les femmes entrepreneures en contexte Africain: vers une nouvelle approche dynamique et collective. *Revue Internationale PME*, 30, 69–97.
- Brindley, C. (2005). Barriers to women achieving their entrepreneurial potential: Women and risk. *International Journal of Entrepreneurial Behaviour and Research*, 11, 144–161. <https://doi.org/10.1108/13552550510590554>
- Canevari-Luzardo, L. M. (2019a). Climate change adaptation in the private sector: Application of a relational view of the firm. *Climate and Development*, 12, 216–227. <https://doi.org/10.1080/17565529.2019.1613214>
- Canevari-Luzardo, L. M. (2019b). Value chain climate resilience and adaptive capacity in micro, small and medium agribusiness in Jamaica: A network approach. *Regional Environmental Change*, 19, 2535–2550. <https://doi.org/10.1007/s10113-019-01561-0>
- Carabine, E. & Simonet, C. (2018). *Value chain analysis for resilience in drylands (VC-ARID): Identification of adaptation options in key sectors. VC-ARID synthesis report, pathways to resilience in semi-arid economies (PRISE)*. Working Paper.
- Caretta, M. A. (2014). “Credit plus” microcredit schemes: A key to women's adaptive capacity. *Climate and Development*, 6, 179–184. <https://doi.org/10.1080/17565529.2014.886990>
- Carr, E. R. (2008). Men's crops and Women's crops: The importance of gender to the understanding of agricultural and development outcomes in Ghana's central region. *World Development*, 36, 900–915. <https://doi.org/10.1016/j.worlddev.2007.05.009>
- Carr, E. R., Fleming, G., & Kalala, T. (2016). Understanding women's needs for weather and climate information in agrarian settings: The case of Ngetou Maleck, Senegal. *Weather, Climate, and Society*, 8, 247–264. <https://doi.org/10.1175/WCAS-D-15-0075.1>
- Carr, E. R., & Onzere, S. N. (2018). Really effective (for 15% of the men): Lessons in understanding and addressing user needs in climate services from Mali. *Climate Risk Management*, 22, 82–95. <https://doi.org/10.1016/j.crm.2017.03.002>
- Carr, E. R., & Thompson, M. C. (2014). Gender and climate change adaptation in agrarian settings: Current thinking, new directions, and research Frontiers. *Geography Compass*, 8, 182–197. <https://doi.org/10.1111/gec3.12121>
- Carr, M., & Hartl, M. (2018). *Lightening the load: Labour saving technologies and practices for rural women*. International Fund for Agricultural Development and Practical Action.
- Carter, S., Steynor, A., Vincent, K., Visman, E., & Waagsaether, K. L. (2019). *Co-production in African weather and climate services: Manual*. WISER and FCFA.
- Chaplin, D., Twigg, J., & Lovell, E. (2019). *Intersectional approaches to vulnerability reduction and resilience-building*. Resilience Intel 35. doi: <https://doi.org/10.13140/RG.2.2.13404.03209>
- Chigwanda, E. (2016). *A framework for building resilience to climate change through Girls' education programming. The 2016 echidna global scholars policy brief*. Centre for Universal Education at Brookings.
- Chingarande, D., Huyer, S., Lanzarini, S., Makokha, J. N., Masiko, W., Mungai, C., Njuki, J., Adera, E. O., Omolo, N., Wamukoya, G., & Waroga, V. (2020). *Background paper on mainstreaming gender into National adaptation planning and implementation in sub-Saharan Africa*. (Working Paper No. 323). CGIAR research program on climate change, Agriculture and Food Security (CCAFS).
- Codjoe, S. N. A., Atidoh, L. K., & Burkett, V. (2012). Gender and occupational perspectives on adaptation to climate extremes in the Afram Plains of Ghana. *Climatic Change*, 110, 431–454. <https://doi.org/10.1007/s10584-011-0237-z>
- Coulibaly, J. Y., Birachi, E. A., Kagabo, D. M., & Mutua, M. (2017). *Climate services for agriculture in Rwanda what farmers know about climate information services in Rwanda*. Climate Change Agriculture and Food Security (CCAFS).
- Crenshaw, K. (1989). *Demarginalizing the intersection of race and sex: A black feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics*. University of Chicago Legal Forum, pp. 139–167.
- Crick, F., Diop, M., Sow, M., Diouf, B., & Muhwanga, J. (2016). *Enabling private sector adaptation in developing countries and their semi-arid regions—Case studies of Senegal and Kenya. Grantham research institute on climate change and the environment* (Working Paper No. 258).
- Crick, F., Eskander, S., Fankhauser, S., & Diop, M. (2018). How do African SMEs respond to climate risks? Evidence from Kenya and Senegal. *World Development*, 108, 157–168.
- Crick, F., Gannon, K. E., Diop, M., & Sow, M. (2018). Enabling private sector adaptation in sub-Saharan Africa. *WIREs Climate Change*, 9, e505.
- Daoud, M. (2021). Is vulnerability to climate change gendered ? And how ? Insights from Egypt. *Regional Environmental Change*, 21, 52.
- Davies, J. (2017). *Barriers and enablers to climate change adaptation in north - Central Namibia, ASSAR (adaptation at scale in semi-arid regions)*. ASSAR, University of Cape Town.
- Dedehouanou, S. F. A., & Araar, A. (2020). Gender, entrepreneurship and food security in Niger. *Review of Development Economics*, 24, 815–830. <https://doi.org/10.1111/rode.12657>
- Demetriades, J., & Esplen, E. (2008). The gender dimensions of poverty and climate change adaptation. *IDS Bulletin*, 39, 24–31. <https://doi.org/10.1111/j.1759-5436.2008.tb00473.x>
- Demirgüç-Kunt, A., Beck, T., & Honohan, P. (2008). *Finance for all? Policies and pitfalls in expanding access*. World Bank.
- Dermirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2018). *The global Findex database 2017: Measuring financial inclusion and the Fintech revolution*. World Bank.

- Desjardins, S. & St-Onge, A. (2009). *Les facteurs qui affectent les entreprises féminines: Perspectives de croissance: Le cas du Cameroun*. Bureau International du Travail and Banque Africaine de Développement.
- Diop, M., Crick, F., Sow, M., & Diouf, B. (2018). Genre, vulnérabilité et adaptation. Cas des femmes entrepreneures en zones semi-arides du Sénégal. Pathways to Resilience in Semi-Arid Economies (PRISE) programme, Innovation, Environnement, Développement en Afrique (IED Afrique), Dakar, Senegal.
- Diop, M., Gannon, K., Castellano, E., Eskander, S., & Agol, D. (2022). *Les femmes entrepreneures du secteur agricole en zones semi-arides du Sénégal: entre vulnérabilité multiple et adaptation au changement climatique*. Grantham Research Institute on Climate Change and the Environment.
- Diouf, N. S., Ouedraogo, I., Zougmore, R. B., Ouedraogo, M., Partey, S. T., & Gumucio, T. (2019). Factors influencing gendered access to climate information services for farming in Senegal. *Gender, Technology and Development*, 23, 93–110. <https://doi.org/10.1080/09718524.2019.1649790>
- Djoudi, H., & 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, 123–135. <https://doi.org/10.1505/1465548117974066606>
- Donald, A., Vaillant, J., Campos, F., & Cucagna, M. E. (2018). *Caring about carework: Lifting constraints to the productivity of women farmers in The Democratic Republic of the Congo*. World Bank.
- Dosio, A., Jury, M. W., Almazroui, M., Ashfaq, M., Diallo, I., Engelbrecht, F. A., Klutse, N. A. B., Lennard, C., Pinto, I., Sylla, M.B., & Tamoffo, A. T. (2021). *Projected future daily characteristics of African precipitation based on global (CMIP5, CMIP6) and regional (CORDEX, CORDEX-CORE) climate models*. Climate Dynamics. doi:<https://doi.org/10.1007/s00382-021-05859-w>
- Doss, C. (2014). If women hold up half the sky, how much of the world's food do they produce? *Gender in Agriculture: Closing the Knowledge Gap*, pp. 69–88. doi:https://doi.org/10.1007/978-94-017-8616-4_4
- Dougherty-Choux, L., Terpstra, P., Kammila, S., & Kurukulauriya, P. (2015). *Adapting from the ground up. Enabling small businesses in developing countries to adapt to climate change*. World Resources Institute and United Nations development Programme.
- Duflou, E., & Udry, C. (2004). *Intrahousehold resource allocation in Côte D'ivoire: Social norms, separate accounts and consumption choices*. National Bureau of Economic Research (Working Paper No. 10498).
- Dupas, B. P., & Robinson, J. (2013). American economic association savings constraints and microenterprise development: Evidence from a Field experiment in Kenya. *American Economic Journal: Applied Economics*, 5, 163–192.
- Enarson, E. (2013). Two solitudes, many bridges, big tent: Women's leadership in climate and disaster risk reduction. In M. Alston & K. Whittenbury (Eds.), *Research, action and policy: Addressing the gendered impacts of climate change* (pp. 63–74). Springer Science + Business Media.
- Epo, B. N. (2012). *Implications of access to microcredit and social capital for female entrepreneurship in cameroon*. Cameroun investment climate and business environment research fund research report no 39/12. Investment Climate and Business Environment Research Fund.
- Eriksen, S., Schipper, E. L. F., Scoville-Simonds, M., Vincent, K., Adam, H. N., Brooks, N., Harding, B., Khatri, D., Lenaerts, L., Liverman, D., Mills-Novoa, M., Mosberg, M., Movik, S., Muok, B., Nightingale, A., Ojha, H., Sygna, L., Taylor, M., Vogel, C., & West, J. J. (2021). Adaptation interventions and their effect on vulnerability in developing countries: Help, hindrance or irrelevance? *World Development*, 141, 105383. <https://doi.org/10.1016/j.worlddev.2020.105383>
- Eriksen, S. H., Brown, K., & Kelly, P. M. (2005). The dynamics of vulnerability: Locating coping strategies in Kenya and Tanzania. *Geographical Journal*, 171, 287–305. <https://doi.org/10.1111/j.1475-4959.2005.00174.x>
- Eriksen, S. H., Nightingale, A. J., & Eakin, H. (2015). Reframing adaptation: The political nature of climate change adaptation. *Global Environmental Change*, 35, 523–533. <https://doi.org/10.1016/j.gloenvcha.2015.09.014>
- Etim, E., & Iwu, C. G. (2019). A descriptive literature review of the continued marginalisation of female entrepreneurs in sub-Saharan Africa. *International Journal of Gender Studies in Developing Societies*, 3, 1–19. <https://doi.org/10.1504/ijgsds.2019.096755>
- Fafchamps, M. (2001). Networks, communities and markets in Sub-Saharan Africa: Implications for firm growth and investment. *Journal of African Economies*, 10, 109–142. <https://doi.org/10.1093/jae/10.suppl2.109>
- Fafchamps, M., McKenzie, D., Quinn, S., & Woodruff, C. (2014). Microenterprise growth and the flypaper effect: Evidence from a randomized experiment in Ghana. *Journal of Development Economics*, 106, 211–226. <https://doi.org/10.1016/j.jdeveco.2013.09.010>
- Fankhauser, S. (2017). Adaptation to climate change. *Annual Review of Resource Economics*, 9, 209–230. <https://doi.org/10.1146/annurev-resource-100516-033554>
- FAO (2011). *The state of food and agriculture. Women in agriculture 2010–2011: Closing the gender gap for development*, pp. 100–300. doi: <https://doi.org/10.1097/00010694-196510000-00017>
- Fisher, M., & Carr, E. R. (2015). The influence of gendered roles and responsibilities on the adoption of technologies that mitigate drought risk: The case of drought-tolerant maize seed in eastern Uganda. *Global Environmental Change*, 35, 82–92. <https://doi.org/10.1016/j.gloenvcha.2015.08.009>
- Gannon, K. E., Conway, D., Pardoe, J., Batisani, N., Ndiyoi, M., Odada, E., Olago, D., Opere, A., Kgosietsile, S., Nyambe, M., Omukuti, J., & Siderius, C. (2018). Business experience of El Niño associated floods and drought in three cities in in sub-Saharan Africa. *Global Sustainability*, 1(e14), 1–15. <https://doi.org/10.1017/sus.2018.14>
- Gannon, K. E., Crick, F., Atela, J., Babagaliyeva, Z., Batool, S., Bedelian, C., Carabine, E., Conway, D., Diop, M., Fankhauser, S., Jobbins, G., Ludi, E., Qaisrani, A., Rouhaud, E., Simonet, C., Suleri, A., & Wade, C. T. (2020). Private adaptation in semi-arid lands: A tailored approach to 'leave no one behind'. *Global Sustainability*, 3(e6), 1–12.

- Gannon, K. E., Crick, F., Atela, J., & Conway, D. (2021). What role for multi-stakeholder partnerships in adaptation to climate change? Experiences from private sector adaptation in Kenya. *Climate Risk Management*, 32, 100319. <https://doi.org/10.1016/j.crm.2021.100319>
- GBA (2016). *Measuring women's financial inclusion: The value of sex-disaggregated data*. Global Banking Alliance for Women (GBA).
- GIZ, EURAC (2017). *Risk supplement to the vulnerability sourcebook. Guidance on how to apply the vulnerability Sourcebook's approach with the new IPCC AR5 concept of climate risk*. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).
- Gnisci, D. (2016). *Women's roles in the West African food system: Implications and prospects for food security and resilience*. (West African Papers No. 03). OECD Publishing.
- Goodrich, C. G., Udas, P. B., & Larrington-Spencer, H. (2019). Conceptualizing gendered vulnerability to climate change in the Hindu Kush Himalaya: Contextual conditions and drivers of change. *Environmental Development*, 31, 9–18. <https://doi.org/10.1016/j.envdev.2018.11.003>
- Gumucio, T., Hansen, J., Huyer, S., & van Huysen, T. (2020). Gender-responsive rural climate services: A review of the literature. *Climate and Development*, 12, 241–254. <https://doi.org/10.1080/17565529.2019.1613216>
- Gurung, J. D., Mwanundu, S., Hartl, M., & Firmian, I. (2011). *Gender and desertification: Expanding roles for women to restore dryland areas*. International Fund for Agricultural Development IFAD.
- Habtemariam, L. T., Gandorfer, M., Kassa, G. A., & Heissenhuber, A. (2016). Factors influencing smallholder farmers' climate change perceptions: A study from farmers in Ethiopia. *Environmental Management*, 58, 343–358. <https://doi.org/10.1007/s00267-016-0708-0>
- Habtezion, S. (2016). *Gender, climate change adaptation and disaster risk reduction*. United Nations Development Programme.
- Halkias, D., Nwajuba, C., Harkiolakis, N., & Caracatsanis, S. M. (2011). Challenges facing women entrepreneurs in Nigeria. *Management Research Review*, 34, 221–235. <https://doi.org/10.1108/01409171111102821>
- Haraway, D. (1991). *Simians, cyborgs and women. The reinvention of nature*. Routledge.
- Henriksson, R., Vincent, K., Archer, E., & Jewitt, G. (2021). Understanding gender differences in availability, accessibility and use of climate information among smallholder farmers in Malawi. *Climate and Development*, 13, 503–514. <https://doi.org/10.1080/17565529.2020.1806777>
- Huyer, S. (2016). Closing the gender gap in agriculture. *Gender, Technology and Development*, 20, 105–116. <https://doi.org/10.1177/0971852416643872>
- Huyer, S., Acosta, M., Gumucio, T., & Ilham, J. I. J. (2020). Can we turn the tide? Confronting gender inequality in climate policy. *Gender and Development*, 28, 571–591. <https://doi.org/10.1080/13552074.2020.1836817>
- Huyer, S., Simelton, E., Chanana, N., Mulema, A. A., & Marty, E. (2021). Expanding opportunities: A framework for gender and socially-inclusive climate resilient agriculture. *Frontiers in Climate*, 3, 1–18. <https://doi.org/10.3389/fclim.2021.718240>
- ILO (2015). *Engaging informal Women entrepreneurs in East Africa: Approaches to greater formality*.
- International IDEA (2021). *Women's political participation: Africa barometer 2021*. International Institute for Democracy and Electoral Assistance.
- International Labour Organisation (2015). Small and medium-sized enterprises and decent and productive employment creation. In Report IV. *International Labour Conference, 104th Session*.
- International Trade Centre. (2018). *Promoting SME competitiveness in Africa data for de-risking investment*. International Trade Centre.
- IPCC (2014a). Climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea, L. L. White, L.L. (Eds.), *Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change*. Cambridge University Press.
- IPCC (2014b). AR5 climate change 2014: Impacts, adaptation, and vulnerability. Annex II Glossary. Intergovernmental Panel on Climate Change (IPCC).
- Isaga, N. (2019). Start-up motives and challenges facing female entrepreneurs in Tanzania. *International Journal of Gender and Entrepreneurship*, 11, 102–119. <https://doi.org/10.1108/IJGE-02-2018-0010>
- Jost, C., Kyazze, F., Naab, J., Neelormi, S., Kinyangi, J., Zougmore, R., Aggarwal, P., Bhatta, G., Chaudhury, M., Tapio-Bistrom, M. L., Nelson, S., & Kristjanson, P. (2016). Understanding gender dimensions of agriculture and climate change in smallholder farming communities. *Climate and Development*, 8, 133–144. <https://doi.org/10.1080/17565529.2015.1050978>
- Kajjser, A., & Kronsell, A. (2014). Climate change through the lens of intersectionality. *Environmental Politics*, 23, 417–433. <https://doi.org/10.1080/09644016.2013.835203>
- Kakota, T., Nyariki, D., Mkwambisi, D., & Kogi-Makau, W. (2011). Gender vulnerability to climate variability and household food insecurity. *Climate and Development*, 3, 298–309. <https://doi.org/10.1080/17565529.2011.627419>
- Kelly, P. M., & Adger, W. N. (2000). Theory and practice in assessing vulnerability to climate change and facilitating adaptation. *Climatic Change*, 47, 325–352. <https://doi.org/10.1023/A:1005627828199>
- Kilic, T., Palacios-López, A., & Goldstein, M. (2015). Caught in a productivity trap: A distributional perspective on gender differences in Malawian agriculture. *World Development*, 70, 416–463. <https://doi.org/10.1016/j.worlddev.2014.06.017>
- Klasen, S., & Lamanna, F. (2009). The impact of gender inequality in education and employment on economic growth: New evidence for a panel of countries. *Feminist Economics*, 15, 91–132. <https://doi.org/10.1080/13545700902893106>
- Kom, Z., Nethengwe, N. S., Mpandeli, N. S., & Chikoore, H. (2020). Determinants of small-scale farmers' choice and adaptive strategies in response to climatic shocks in Vhembe District, South Africa. *GeoJournal*, 7, 677–700. <https://doi.org/10.1007/s10708-020-10272-7>

- Koyenikan, M. J., & Anozie, O. (2017). Climate change adaptation needs of male and female oil palm entrepreneurs in Edo State, Nigeria. *Journal of Agricultural Extension*, 21, 162–175.
- Kurukulasuriya, P., Kala, N., & Mendelsohn, R. (2011). Adaptation and climate change impacts: A structural ricardian model of irrigation and farm income in Africa. *Climate Change Economics*, 2, 149–174. <https://doi.org/10.1142/S201000781000255>
- Mandipaka, F. (2014). An investigation of the challenges faced by women entrepreneurs in developing countries: A case of king Williams' town, South Africa. *Mediterranean Journal of Social Sciences*, 5, 1187–1193. <https://doi.org/10.5901/mjss.2014.v5n27p1187>
- Mannell, J. (2012). "It's just been such a horrible experience." Perceptions of gender mainstreaming by practitioners in South African organisations. *Gender and Development*, 20, 423–434. <https://doi.org/10.1080/13552074.2012.731753>
- Marshall, M., Ockwell, D., & Byrne, R. (2017). Sustainable energy for all or sustainable energy for men? Gender and the construction of identity within climate technology entrepreneurship in Kenya. *Progress in Development Studies*, 17, 148–172. <https://doi.org/10.1177/1464993416688830>
- Mavisakalyan, A., & Tarverdi, Y. (2019). Gender and climate change: Do female parliamentarians make difference? *European Journal of Political Economy*, 56, 151–164. <https://doi.org/10.1016/j.ejpoleco.2018.08.001>
- Mayoux, L., 1995. *From vicious to virtuous circles? Gender and micro-enterprise development*. Occasional Paper 3. United Nations Research Institute for Social Development.
- Mazonde, N. B., & Carmichael, T. (2016). The influence of culture on female entrepreneurs in Zimbabwe. *The Southern African Journal of Entrepreneurship and Small Business Management*, 8, 10. <https://doi.org/10.4102/sajesbm.v8i1.101>
- McFerson, H. M. (2010). Poverty among women in Sub-Saharan Africa: A review of selected issues. *Journal of International Women's Studies*, 11, 50–72.
- Mckenzie, D., & Woodruff, C. (2015). *Business practices in small firms in developing countries*. NBER Working Paper Series. National Bureau of Economic Research.
- McKune, S., Poulsen, L., Russo, S., Devereux, T., Faas, S., McOmber, C., & 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. <https://doi.org/10.1016/j.crm.2018.08.002>
- Mendelsohn, R. (2012). The economics of adaptation to climate change in developing countries. *Climate Change Economics*, 3, 1250006. <https://doi.org/10.1142/S2010007812500066>
- Mersha, T., & Sriram, V. (2019). Gender, entrepreneurial characteristics, and success: Evidence from Ethiopia. *Thunderbird International Business Review*, 61, 157–167. <https://doi.org/10.1002/tie.21984>
- Molua, E. L. (2011). Farm income, gender differentials and climate risk in Cameroon: Typology of male and female adaptation options across agroecologies. *Sustainability Science*, 6, 21–35. <https://doi.org/10.1007/s11625-010-0123-z>
- Moser, C., & Moser, A. (2005). Gender mainstreaming since Beijing: A review of success and limitations in international institutions. *Gender and Development*, 13, 11–22. <https://doi.org/10.1080/13552070512331332283>
- Muchuru, S., & Nhamo, G. (2019). A review of climate change adaptation measures in the African crop sector. *Climate and Development*, 11, 873–885. <https://doi.org/10.1080/17565529.2019.1585319>
- Mugabi, E. (2014). *Women's entrepreneurship development in Uganda: Insights and recommendations*. International Labour Organisation.
- Mussema, R., & Yirga, C. (2020). Gender differences in climate change adaptation strategies in maize-legume based farming system in Ethiopia. *Journal of Environment and Earth Science*, 10, 10–24. <https://doi.org/10.7176/jees/10-6-02>
- Nabikolo, D., Bashaasha, B., Mangheni, M. N., & Majaliwa, J. G. M. (2012). Determinants of climate change adaptation among male and female headed farm households in eastern Uganda. *African Crop Science Journal*, 20, 203–212.
- Nciizah, A. D., & Wakindiki, I. I. C. (2015). Climate smart agriculture: Achievements and prospects in Africa. *Journal of Geoscience and Environment Protection*, 3, 99–105. <https://doi.org/10.4236/gep.2015.36016>
- N'Diaye, M. (2014). Rappports sociaux de sexe et production du droit de la famille au Sénégal et au Maroc. *Cahiers du Genre*, 57, 95–113. <https://doi.org/10.3917/cdgc.057.0095>
- Nellemann, C., Verma, R., & Hislop, L. (2011). *Women at the frontline of climate change: Gender risks and hopes. A rapid response assessment, cartography*. United Nations Environment Programme (UNEP).
- Nelson, V., & Stathers, T. (2009). Resilience, power, culture, and climate: A case study from semi-arid Tanzania, and new research directions. *Gender and Development*, 17, 81–94. <https://doi.org/10.1080/13552070802696946>
- Neumayer, E., & Plümper, T. (2007). The gendered nature of natural disasters: The impact of catastrophic events on the gender gap in life expectancy, 1981–2002. *Annals of the Association of American Geographers*, 97, 551–566. <https://doi.org/10.1111/j.1467-8306.2007.00563.x>
- Newborne, P., & Gansaonré, N. R. (2017). *Agriculture, water, climate and migration in semi-arid lands in Burkina Faso, pathways to resilience in semi-arid economies (PRISE)*. Working Paper. London, UK.
- Ngigi, M. W., Mueller, U., & Birner, R. (2017). Gender differences in climate change adaptation strategies and participation in group-based approaches: An intra-household analysis from rural Kenya. *Ecological Economics*, 138, 99–108. <https://doi.org/10.1016/j.ecolecon.2017.03.019>
- Ngoasong, M. Z., & Kimbu, A. N. (2019). Why hurry? The slow process of high growth in Women-owned businesses in a resource-scarce context. *Journal of Small Business Management*, 57, 40–58. <https://doi.org/10.1111/jsbm.12493>

- Nhamo, G. (2014). Addressing women in climate change policies: A focus on selected east and southern African countries. *Agenda*, 28, 156–167. <https://doi.org/10.1080/10130950.2014.946734>
- Niang, I., Ruppel, O., Abdrabo, M., Essel, A., Lennard, C., Padgham, J., & Urquhart, P. (2014). Climate change 2014: Impacts, adaptation, and vulnerability. Part B: Regional aspects. In V. Barros, C. Field, D. Dokken, M. Mastrandrea, K. Mach, T. Bilir, M. Chatterjee, K. Ebi, Y. Estrada, R. Genova, B. Girma, E. Kissel, A. Levy, S. MacCracken, P. Mastrandrea, L. White (Eds.), *Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change*. Cambridge University Press, pp. 1199–1265.
- Nichter, S., & Goldmark, L. (2009). Small firm growth in developing countries. *World Development*, 37, 1453–1464. <https://doi.org/10.1016/j.worlddev.2009.01.013>
- Nordman, C. J. & Vaillant, J. (2014). *Inputs, gender roles or sharing norms? Assessing the gender performance gap among informal entrepreneurs in Madagascar*. Institute for the Study of labour discussion paper No. 8046. Institute for the Study of Labor, Bonn, Germany.
- 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, 102079. <https://doi.org/10.1016/j.apgeog.2019.102079>
- Nyasimi, M., Kimeli, P., Sayula, G., Radeny, M., Kinyangi, J., & Mungai, C. (2017). Adoption and dissemination pathways for climate-smart agriculture technologies and practices for climate-resilient livelihoods in Lushoto, Northeast Tanzania. *Climate*, 5, 1–22. <https://doi.org/10.3390/cli5030063>
- OECD (2014). *From ambition to results: Delivering on gender equality in donor institutions*. DAC Network on Gender Equality (GENDERNET).
- Ojediran, F., & Anderson, A. R. (2020). Women's entrepreneurship in the global south: Empowering and emancipating? *Administrative Sciences*, 10, 87. <https://doi.org/10.3390/admsci10040087>
- Olomola, A. (2013). *Policy options for agricultural investments and governance of markets: In support of small-scale agriculture in Nigeria*. Oxfam Research Report. Oxfam.
- Olsen, J., Rubin, D., & Wangui, E. (2010). *Gender, agriculture, and climate change: An analysis for USAID/East Africa*. USAID. doi:<https://doi.org/10.13140/RG.2.1.4503.2481>
- Osborne, N. (2015). Intersectionality and kyriarchy: A framework for approaching power and social justice in planning and climate change adaptation. *Planning Theory*, 14, 130–151. <https://doi.org/10.1177/1473095213516443>
- Otoo, M., Fulton, J., Ibro, G., & Lowenberg-Deboer, J. (2011). Women entrepreneurship in West Africa: The cowpea street food sector in Niger and Ghana. *Journal of Developmental Entrepreneurship*, 16, 37–63. <https://doi.org/10.1142/S1084946711001732>
- Page, J., & Söderbom, M. (2015). Is small beautiful? Small Enterprise, aid and employment in Africa. *African Development Review*, 27, 44–55. <https://doi.org/10.1111/1467-8268.12138>
- Partey, S. T., Dakorah, A. D., Zougmore, R. B., Ouedraogo, M., Nyasimi, M., Nikoi, G. K., & Huyer, S. (2018). Gender and climate risk management: Evidence of climate information use in Ghana. *Climatic Change*, 158, 61–75. <https://doi.org/10.1007/s10584-018-2239-6>
- Patel, J. (2020). *Despite perceptions of gender equality, Africa's rural women bear brunt of economic exclusion*. Afrobarometer Dispatch, pp. 1–13.
- Pauw, P., & Pegels, A. (2013). Private sector engagement in climate change adaptation in least developed countries: An exploration. *Climate and Development*, 5, 257–267. <https://doi.org/10.1080/17565529.2013.826130>
- Peake, L. (2016). The twenty-first-century quest for feminism and the global urban. *International Journal of Urban and Regional Research*, 40, 219–227. <https://doi.org/10.1111/1468-2427.12276>
- Perez, C., Jones, E. M., Kristjansson, P., Cramer, L., Thornton, P. K., Förch, W., & 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. <https://doi.org/10.1016/j.gloenvcha.2015.06.003>
- Peterman, A., Behrman, J., & Quisumbing, A. (2010). *A review of empirical evidence on gender differences in non-land agricultural inputs, technology, and services in developing countries*. (ESA Working Paper No. 11-11). Food and Agriculture Organisation of the United Nations.
- Porter, G. (2011). I think a woman who travels a lot is befriending other men and that's why she travels': Mobility constraints and their implications for rural women and girls in sub-Saharan Africa. *Gender, Place and Culture*, 18, 65–81. <https://doi.org/10.1080/0966369X.2011.535304>
- Quisumbing, A. R., Meinzen-Dick, R., Raney, T. L., Croppenstedt, A., Behrman, J. A., & Peterman, A. (2014). Closing the knowledge gap on gender in agriculture. *Gender in agriculture: Closing the knowledge gap*. Food and Agriculture Organisation of the United Nations. doi:<https://doi.org/10.1007/978-94-017-8616-4>
- Rao, N. (2019). From abandonment to autonomy: Gendered strategies for coping with climate change, Isiolo County, Kenya. *Geoforum*, 102, 27–37. <https://doi.org/10.1016/j.geoforum.2019.03.017>
- Rao, N., Lawson, E. T., Raditloaneng, W. N., Solomon, D., & Angula, M. N. (2019). Gendered vulnerabilities to climate change: Insights from the semi-arid regions of Africa and Asia. *Climate and Development*, 11, 14–26. <https://doi.org/10.1080/17565529.2017.1372266>
- Rao, N., Mishra, A., Prakash, A., Singh, C., Qaisrani, A., Poonacha, P., Vincent, K., & Bedelian, C. (2019). A qualitative comparative analysis of women's agency and adaptive capacity in climate change hotspots in Asia and Africa. *Nature Climate Change*, 9, 964–971. <https://doi.org/10.1038/s41558-019-0638-y>
- Rao, N., Prakash, A., Hans, A., & Patel, A. (2021). Gender, climate change and the politics of vulnerability: An introduction. In N. Rao, A. Prakash, A. Hans, & A. Patel (Eds.), *Engendering climate change: Learnings from South Asia* (pp. 1–16). Routledge.

- Ravera, F., Martín-López, B., Pascual, U., & Drucker, A. (2016). The diversity of gendered adaptation strategies to climate change of Indian farmers: A feminist intersectional approach. *Ambio*, 45, 335–351. <https://doi.org/10.1007/s13280-016-0833-2>
- Roncoli, C., Jost, C., Kirshen, P., Sanon, M., Ingram, K. T., Woodin, M., Somé, L., Ouattara, F., Sanfo, B. J., Sia, C., Yaka, P., & Hoogenboom, G. (2009). From accessing to assessing forecasts: An end-to-end study of participatory climate forecast dissemination in Burkina Faso (West Africa). *Climatic Change*, 92, 433–460. <https://doi.org/10.1007/s10584-008-9445-6>
- Rossi, A., & Lambrou, Y. (2008). *Gender and equity issues in liquid biofuels production minimizing the risks*. Food and Agriculture Organisation.
- Sen, A. K. (1981). *Poverty and famines: An essay on entitlement and deprivation*. Clarendon.
- Siderius, C., Gannon, K. E., Ndiyoi, M., Opere, A., Batisani, N., Olago, D., Pardoe, J., & Conway, D. (2018). Hydrological response and complex impact pathways of the 2015/2016 El Niño in eastern and southern Africa. *Earth's Future*, 6, 2–22. <https://doi.org/10.1002/2017EF000680>
- Singh, G., & Belwal, R. (2008). Entrepreneurship and SMEs in Ethiopia: Evaluating the role, prospects and problems faced by women in this emergent sector. *Gender in Management*, 23, 120–136. <https://doi.org/10.1108/17542410810858321>
- Smith, J., Bhatti, N., Menzhulin, G., Benioff, R., Budyko, M. I., Campos, M., Jallow, B., & Rijsberman, F. (1996). *Adapting to climate change: An international perspective*. Springer-Verlag.
- Smucker, T. A., & Wangui, E. E. (2016). Gendered knowledge and adaptive practices: Differentiation and change in Mwangi District, Tanzania. *Ambio*, 45, 276–286. <https://doi.org/10.1007/s13280-016-0828-z>
- Sovacool, B. K., Linnér, B.-O., & Goodsite, M. E. (2015). The political economy of climate adaptation. *Nature Climate Change*, 5, 616–618.
- Stenek, V., Amado, J.-C., & Greenall, D. (2013). Enabling environment for private sector adaptation—An index assessment framework. International Finance Corporation.
- Stevenson, L., & St-Onge, A. (2005). *Support for growth-oriented women entrepreneurs in Tanzania*. International Labour Organization. International Labour Office, Geneva and African Development Bank, Tunis.
- Sweetman, C. (2012). Introduction. *Gender and Development*, 20, 389–403. <https://doi.org/10.1080/13552074.2012.743266>
- Tanner, T., & Allouche, J. (2011). Towards a new political economy of climate change and development. *IDS Bulletin*, 42, 1–14.
- Terry, G. (2009). No climate justice without gender justice: An overview of the issues. *Gender and Development*, 17, 5–18.
- The GEM Report (2020). *Global education monitoring report 2020: Gender report, a new generation: 25 years of efforts for gender equality in education*. Global Education Monitoring Report Team UNESCO.
- Thomas, K., Hardy, R. D., Lazrus, H., Mendez, M., Orlove, B., Rivera-Collazo, I., Roberts, J. T., Rockman, M., Warner, B. P., & Winthrop, R. (2019). Explaining differential vulnerability to climate change: A social science review. *Wiley Interdisciplinary Reviews: Climate Change*, 10, 1–18. <https://doi.org/10.1002/wcc.565>
- Triki, T., & Faye, I. (2018). *Financial inclusion in Africa*. African Development Bank Group (AfDB).
- Twyman, J., Green, M., Bernier, Q., Kristjanson, P., Russo, S., Tall, A., Ampaire, E., Nyasimi, M., Mango, J., McKune, S., Mwongera, C., & Ndurba, Y. (2014). *Adaptation actions in Africa: Evidence that gender matters*. (Working Paper No. 83). CCAFS Working Paper. CGIAR research program on climate change, agriculture and food security (CAAFS).
- Umeh, O. J., & Nwachukwu, I. (2019). Behavioural approaches of rural women farmers to mitigation and adaptation measures of climate change in Abia state, Nigeria. In W. L. Filho & R. Leal-Arcas (Eds.), *University initiatives in climate change mitigation and adaptation*. Springer International Publishing. <https://doi.org/10.1007/978-3-319-89590-1>
- UN Women (2018). *Turning promises into action: Gender equality in the 2030 agenda for sustainable development*. United Nations.
- Van Aelst, K., & Holvoet, N. (2016). Intersections of gender and marital status in accessing climate change adaptation: Evidence from rural Tanzania. *World Development*, 79, 40–50. <https://doi.org/10.1016/j.worlddev.2015.11.003>
- Verhage, F., Cramer, L., Thornton, P., & Campbell, B. (2018). *Climate risk assessment and agricultural value chain prioritisation for Malawi and Zambia*. CGIAR research program on climate change, agriculture and food security (CAAFS). (Working Paper No. 228).
- Welsh, D. H. B., Melimi, E., Kaciak, E., & Ahmed, S. (2013). Sudanese Women Entrepreneurs. *Journal of Developmental Entrepreneurship*, 18, 1350013. <https://doi.org/10.1142/S1084946713500131>
- Wendoh, S., & Wallace, T. (2005). Re-thinking gender mainstreaming in African NGOs and communities. *Gender and Development*, 13, 70–79. <https://doi.org/10.1080/13552070512331332288>
- Wesolowski, A., Eagle, N., Noor, A. M., Snow, R. W., & Buckee, C. O. (2012). Heterogeneous mobile phone ownership and usage patterns in Kenya. *PLoS One*, 7, 1–6. <https://doi.org/10.1371/journal.pone.0035319>
- Woodford-Berger, P. (2004). Gender mainstreaming: What is it (about) and should we continue doing it? *IDS Bulletin*, 35, 65–72. <https://doi.org/10.1111/j.1759-5436.2004.tb00157.x>
- World Bank (2014). *Levelling the field: Improving opportunities for women farmers in Africa*. World Bank Group/One Campaign.
- World Bank (2018). *Women, business and the law 2018, Women, business and the law 2018*. World Bank. doi:<https://doi.org/10.1596/978-1-4648-1252-1>
- World Bank (2019). *Profiting from parity: Unlocking the potential of women's businesses in Africa*. World Bank Group.

How to cite this article: Gannon, K. E., Castellano, E., Eskander, S., Agol, D., Diop, M., Conway, D., & 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. *WIREs Climate Change*, 13(5), e793. <https://doi.org/10.1002/wcc.793>