

FROM VULNERABILITY TO AGENCY IN CLIMATE ADAPTATION AND MITIGATION

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Rising temperatures and more extreme weather associated with climate change are expected to exacerbate existing social and gender inequalities across the globe (Adger et al. 2014, Dankelman 2010). The Intergovernmental Panel on Climate Change (IPCC) projects that the production of major crops such as wheat, rice, and maize will be affected across all regions and that climate change will progressively increase variability in crop yields. All aspects of food security are affected, including food access, utilization, and price stability. In rural areas, major impacts are expected on water availability and supply, food security, and agricultural incomes, with shifts in production of both food and non-food crops as growing zones change as a result of weather variability (Adger et al. 2014, Girvetz et al. 2017).

Climate-influenced migration is seen to be an intensifying factor in the feminization of agriculture in some regions, particularly South Asia and Central America, where out-migration for employment is predominantly male. Women left behind are required to manage farms and households with fewer resources and less family labor, further increasing their vulnerability (Gumucio et al. 2019a, Khatri-Chhetri et al. 2020).¹

In a 2°C (or more)² world, gender equality will need to encompass women and men's increased resilience, as well as reduced vulnerability to climate change. Vulnerability is commonly defined as the extent to which a natural or social system is prone to damage. In the context of climate variability

1 See Chapter 8 of this volume for a broader discussion on the dynamics around the feminization of agriculture.

2 According to the IPCC, global warming is likely to reach 1.5°C if not beyond (2.0°C) between 2030 and 2052. This is expected to increase the risk of heatwaves, heavy rainfall events, crop productivity decline, reduction in water availability, undernutrition, habitat losses and others (Masson-Delmotte et al. 2018), and the effects get significantly worse at 2°C. The world has already witnessed about 1°C of temperature rise and is on track to exhaust the carbon budget for 1.5°C by 2030. Some projections put the world on track for 4°C of warming.

and change, vulnerability is a function of **exposure** to climate risks (such as extreme weather events, losses in agricultural productivity, and alterations in hydrological patterns), **sensitivity** to such risks, and **capacity to adapt**. It is characterized by interrelations between ecological and, increasingly, social systems, such as weather impacts, viability of natural resources, access to markets, and societal safety nets. Resilience is the capacity of communities or households to resist, cope with, or recover from shocks and stresses (Ulrichs et al. 2015) and arrive at a state of reduced or diminished vulnerability (see Perez et al. 2015). Women's agency in relation to climate resilience is the ability to access and act on (make choices based on) information and to participate in decisions that affect their lives. Women's collective action is an effective platform for achieving agency (Kabeer 1999, CCAFS and FAO 2013; see also case study on women's groups in South Asia, later in this chapter).

Climate change has varied effects on women and men, since they are exposed to different climate shocks and experience different impacts related to their gender-differentiated roles, rights, and opportunities (Dankelman 2010, Fisher and Carr 2015). Women and men's vulnerabilities vary according to gender, but also by ethnicity, religion, class, and age conditions. Less is known about men's gender-specific knowledge in relation to adaptation and mitigation but we do know that women's knowledge, networks, and assets are a significant aspect of resilience (Lane and McNaught 2009, Chanamuto and Hall 2015, McKune et al. 2015). Despite the significant roles that both women and men play as agents of change, however, gender discourses on development and climate change have centered overwhelmingly on women's greater vulnerability to climate change. This not only contributes to perpetuating stereotypes of women as victims but also prevents tackling the root causes of gendered vulnerabilities (MacGregor 2010, Arora-Jonsson 2011, Resurreccion 2011) by denying women their agency (Dankelman 2010, MacGregor 2010, Okali and Naess 2013).

Two approaches to climate adaptation and mitigation for sustainable rural development are climate-smart agriculture (CSA) and land use-based management. The goal of CSA is to help farmers adjust to climate change and manage climate risk by implementing strategies to sustainably increase productivity; build resilience of farming systems; and reduce greenhouse gas emissions. It builds on approaches that take into account the impact of land management decisions on ecosystem goods and services on a larger scale (Girvetz et al. 2017). Land use-based management initiatives focus on sustainable and inclusive interventions to reverse land degradation and biodiversity loss while promoting carbon sequestration. Delivering these environmental

benefits also results in benefits of food security, nutrition, market access, and employment opportunities (Smith and Scherr 2002).

This chapter assesses how these climate adaptation and mitigation approaches can reduce women's and men's vulnerabilities, promote their capacities for resilience, support the ability of women to exercise their agency, and, consequently, increase gender equality. We review existing literature and regional case studies in relation to four dimensions of gender in/equality that are connected to these goals in climate-resilient agriculture and land use-based management: (1) participation in decision-making at different levels, (2) work burden, (3) access to and use of productive resources such as agroclimatic information, technology, livelihood incomes, and credit, and (4) collective action (see also Kabeer 1999, Dankelman 2010, CCAFS and FAO 2013).

For example, agricultural technologies and practices for adaptation that reduce workloads can increase production, reduce negative impacts on health, and allow women more time for other activities such as education or enterprises. This is critical since climate impacts such as drought in combination with deforestation are expected to significantly increase women's workload in rural areas (Dankelman 2010). Information and capacity-building to cope with and manage climate risk and variability, while important for both women's and men's capacity to adapt, can also promote women's participation in household decision-making and increase their agricultural production (Rengalakshmi et al. 2018, Huyer 2019b). Women's group organizing and collective action can engender capacity-building tailored to women's needs and constraints, and serve as platforms for women to exercise agency in implementing climate adaptation strategies (see South Asia case study later in this chapter).

We first summarize the gendered effects of climate change, then assess what we know so far about the potential of climate-resilient agriculture and land use-based management practices for gender equality. We next put the spotlight on cases from three different regions—South Asia, Southeast Asia, and West Africa—as potential models for increasing women's resilience and agency through the four dimensions of gender in/equality described above. The first case looks at women's groups as a platform for access, agency and voice in Madhya Pradesh, India, as a collective action approach to enabling women's agency and access to resources and information. The second case illustrates how women's economic empowerment and participation in community decision-making through non-timber forest product processing in Senegal can promote resilience. The third case sheds light on how participatory development of agro-advisories with women and men in Cambodia, Laos,

and Viet Nam can promote agency and reduce work burdens. Finally, we draw out key insights on how these climate adaptation and mitigation approaches can contribute to gender equality, and propose areas for forward-looking research and action.

Effects of climate change on women and men

By 2050 a medium–high level of climate change is expected to increase the number of undernourished children by 4.8 million (IFPRI 2017). This will affect food availability and prices, which in turn will lead to a decrease in the amount of food consumed as well as its nutritional quality (Beuchelt and Badstue 2013, Bryan et al. 2017). Climate variability, including extreme events, can have significant impact on women’s and men’s health, well-being, and empowerment. Few studies consider the impacts of climate variability and change on men—yet climate stresses pose a significant health risk for them, including in rural areas. In rural Australia, suicide rates of men quadrupled over the 12-year Millennium Drought, which decimated the country’s agriculture sector (Alston and Kent 2008). In India, suicide rates of men farmers have gone up over the past decade, owing to poverty and indebtedness from crop failures and water depletion (Reddy et al. 2019).

Rural women are at high risk of being negatively affected by climate change, particularly in relation to household responsibilities, agricultural activities, and male out-migration for employment—with resulting consequences on family nutrition and children’s care and education (Kakota et al. 2011, Rao et al. 2017, Ylipaa et al. 2019). Women’s nutrition levels are also affected: for example, when climate shocks affect food access, women tend to eat less to reserve food for the family (Nguyen et al. 2013). Natural disasters and their after-effects kill more women than men on average, for physiological reasons (such as pregnancy) or socio-cultural reasons (in the case of flooding, the clothes women wear or their responsibilities in caring for small children may restrict their ability to run or climb to avoid danger). Women are also at higher risk of physical, sexual, and domestic violence in times of climate shock and natural disaster (Correia 2001, Neumayer and Plumper 2007).

In many cases, women appear to be less able to adapt to climate change, even if they are aware of its effects. Gender inequalities in access to and control over resources, technology, and information, alongside less stable land tenure, restrict women’s ability to act on and implement climate adaptation practices in agriculture (Fisher and Carr 2015, Huyer 2016, Jost et al. 2016, Assan et al. 2018). Gender norms may limit women’s ability to respond to or

make quick decisions in the face of climate events. In households where men are working off-farm in cities, women may lack the power to make timely farming decisions or to convince their husbands to agree to new practices (Goering 2015, World Bank et al. 2015).

Climate-resilient agriculture and land use-based management: can they advance gender equality?

Women have developed a range of coping strategies in response to risks and environmental impacts. Their assets, knowledge, and social networks related to their positions in the household and community are important pillars of resilience. Livestock-keeping is an important food safety net. Indigenous/local breeds and animals, including poultry, sheep, and goats, are inherently resilient to climate stress and can survive on crop and household residues (Kristjanson et al. 2014, Chanamuto and Hall 2015). Women's social networks for agricultural production can have a positive impact on household food security and productivity in the context of climate change (Tadesse et al. 2017, Violon et al. 2016). Community seed banks are repositories of local genetic diversity that can withstand climate stress, and are a useful resilience strategy. Women's role in informal seed networks and the related conservation of genetic resources is connected to dietary diversity and local knowledge. In addition, women often retain ties in their home village while creating new connections in their marriage community, suggesting they can be important avenues of seed distribution (Otieno et al. 2018). When CSA and land use-based initiatives interact with the four dimensions of gender in/equality for climate-resilient agriculture, they can promote gender equality and expand women's resilience strategies.

Climate-smart agriculture: can it exacerbate gender inequalities?

Specific approaches for integrating gender in diagnostics, prioritization, and impact assessment of CSA practices and technologies as well as climate services have been developed and tested (Jost et al. 2014, Nelson and Huyer 2016, Duong et al. 2016, 2017, Gumucio et al. 2018, Gumucio and Schwager 2019). Analysis to date shows that gender equality dimensions of participation in household decision-making, access to finance and information, and position in the household are factors associated with adoption of CSA. It also shows women and men may adopt differing adaptation practices depending on the gender division of labor, their awareness of climate impacts, and the

type of information they have access to (Twyman et al. 2014; Jost et al. 2016, Mutenje et al. 2018, Aryal et al. 2020).

More recently, analysis of whether CSA can contribute to gender equality has started to emerge, indicating that: (1) CSA can exacerbate existing inequalities if implemented in a “gender-neutral” manner; (2) gender equality is in some cases a factor in the adoption of CSA (Huyer and Partey 2020); and (3) CSA can support gender equality if it integrates one or more of the four gender in/equality dimensions of climate-resilient agriculture. Most analysis to date has focused on how CSA can support gender equality. More research is needed to identify the enabling gender equality conditions for adoption of climate-resilient agriculture as well as potential for increased inequality as a result of CSA implementation.

1. CSA can exacerbate gender and social inequalities. Agricultural production is situated within broader societal structures and gender relations that affect the allocation of labor, resources, and other assets (Jordan 2018). CSA interventions will inevitably interact with these gender dynamics. To date, however, research on gender and CSA is relatively new, and has been concerned mostly with a male–female dichotomy that ignores power and social and political status stemming from gender, race, class, ethnicity, religion, and age (Djoudi et al. 2016, Mungai et al. 2017, Colfer et al. 2018).

As a result, the introduction of CSA technologies or practices may intensify inequality: prevailing power and gender relations within a community can be entrenched or solidified if questions are not asked about who is controlling the technology and who benefits (Haapala 2018, IFAD 2018). For example, in the western Indo-Gangetic plains of India, women adopt laser land-leveling (LLL) only through their children or a male relative. This is because of gender norms that prohibit public interaction between women and men: a woman farmer is not permitted to approach a male LLL owner or service provider either in person or by mobile phone (Aryal et al. 2015). However, an additional reason for differences in the adoption rate of LLL between women and men is the gender division of labor: the technology is aimed at men’s agricultural domain exclusively; women’s technology needs, related to their work and priorities, are overlooked.

Elsewhere, it has been noted that women can choose to adopt CSA technologies that in fact increase their labor load, counteracting other gender equality benefits such as increased production and control over income. In other cases, it was observed that women were not able to consider the adoption of CSA until barriers of access to family labor and lack of

appropriate energy technology, transportation, and cultivation tools were addressed (Murray et al. 2016, Mutenje et al. 2019).

In the livestock sector, climate-smart interventions tend to assume impacts to be gender-neutral, and, as a result, neglect gendered power relations affecting men's and women's differential roles in livestock-keeping (Djoudi and Brockhaus 2011). These interventions can then intensify inequalities, particularly where they increase labor investment (Arora et al. 2017), overlook the roles of women (Gallina and Rozel Farnworth 2016), or ignore their activities in sectors such as informal dairy (Tavener and Crane 2018). However, once women's roles in production are recognized, and they can access training, credit services, and technologies, the potential for gender equality outcomes improves markedly (see Gallina and Rozel Farnworth 2016). Since women's and men's responsibilities vary according to livestock type, program design should take into account the gender differences in a targeted livestock value chain. For example, cattle ownership is often a male activity because cows are a high-value commodity in comparison with chickens or goats. Gender dynamics like these may constrain women's participation. Participatory planning of livestock interventions can benefit women when it informs project components such as livestock breed selection (KIT et al. 2012).

2. CSA adoption is often contingent on gender equality. Gender equality can be a precondition in the adoption of CSA when women are able to make choices about their farming practices and to access the resources to implement them. In three countries in Southern Africa—Malawi, Mozambique, and Zambia—households with more female adults, and where women had greater bargaining power, were more likely to adopt CSA (Farnworth et al. 2018, Mutenje et al. 2019). In Bangladesh and Nicaragua, women's empowerment was a factor for increased crop diversification, an important element of dietary diversity and food security. Fruit and crop diversification tended to be a strategy in households where women had a say in decision-making in agricultural production (Gumucio et al. 2019a, de Pinto et al. 2019).

Group membership may increase CSA adoption and investment decisions by women. Mutenje et al. (2019) found that being a group member of a social/community platform (such as a savings group, cooperative, church, or mosque) positively influenced women's investment decisions on drought-tolerant maize with legume intercropping. This likely occurred as a result of group exchange of information and/or revolving credit.

3. CSA can contribute to gender equality. While gender equality can be a precondition for CSA adoption, emerging evidence indicates that CSA

can also contribute to gender equality through the four gender in/equality dimensions:

Women in climate-smart villages (CSVs) in two regions of India (Bihar and Haryana) experienced empowerment as a result of CSA adoption, in the form of **increased participation in decision-making** over income from increased agricultural production as well as on farming practices and children's education, among other issues. Men in both regions also experienced increased empowerment, but to a lesser extent (Hariharan et al. 2020). In another region in India, access to agricultural information allowed women to discuss agricultural production with their husbands, increasing their role in decision-making on the farm (Mittal et al. 2016).

Reducing women's work burden by reducing time spent in labor, as well as increasing production, is an important aspect of gender equality in CSA, and often results in increased control over income (Mittal 2016). In East Africa, management of small ruminants (sheep and goats) and poultry that are hardy and adapted to climate stress promotes gender equality, since the livestock require less labor and women have greater control over the returns (Ojango et al. 2016). Climate services can also reduce women's workload by improving planting and harvesting, as a result lessening the risk of replanting later in the season (Simelton et al. 2019).

Gender-responsive CSA technologies reduce the labor required for tasks women engage in, while also increasing agricultural productivity. In Nepal, women's agricultural activities were matched with CSA technologies and practices that had been demonstrated, in other contexts, to reduce labor requirements in relation to efficiency, environment, and sustainability (Khatri-Chhetri et al. 2020). Some CSA technologies benefit both sexes directly. In a case study in Maharashtra, India, both women and men considered the rice drum seeder useful: men appreciated the increased production levels and farming income and women benefited from a reduced workload when seeding rice (Joshi et al. 2019).

The contribution of the third dimension, **access to resources, including information and income**, to gender equality is potentially significant. For example, in Viet Nam, participants in women-targeted training sessions on pest management and livestock-rearing experienced significant increases in self-confidence and participated more actively in household decision-making. Their incomes increased as a result of diversification of their production (they began to raise piglets for market with rice bran feed). Both the women themselves and family members felt their status in the household had increased (Chi et al. 2015). In East Africa, implementing different CSA options and

participating in knowledge-sharing events allowed women to contribute to joint household decision-making on CSA technologies and practices (Radeny et al. 2018).

Agro- and climate information services can promote gender equality if they contribute to the needs and priorities of both women and men in rural areas, increase their resilience, and provide a means for women to challenge gender norms through public discussion and airing of their views (Sekabira and Qaim 2017, Huyer 2019b). In Kenya, hundreds of thousands of women benefited from the television show *Shamba Shape-up*, a show that presents real-life farm “renovations.” Women and men farmers in approximately 428,566 households made changes in their farming practices as a result of watching the program. Production increased for both women and men, with the increase in women’s dairy and maize production being proportionately greater than men’s (AECF and University of Reading 2014). Radio Mang’etele in Kamba, Kenya, was an experiment with an interactive technology that enabled women to record their voices remotely for radio broadcast, without the need for intermediaries to facilitate content production. Use of the technology encouraged women to make suggestions for programming and express their views. They experienced increased agency and voice, adding to their self-confidence while increasing their recognition in the community (Sterling and Huyer 2010).

The gender equality potential of climate information services needs to be further investigated in line with these empowering results. Meeting rural women’s service needs involves attention to communication channels that may differ from those used to reach men, depending on control and cost of technologies. Women may also need different information than men, depending on the gender division of labor in agriculture, including crop production. For example, in Kaffrine, Senegal, men control draft animals and plows, so that women must wait to prepare their fields until men have finished using them. As a result, information provided on rainfall onset benefited men but not women (Tall et al. 2014). Biased institutions and gender differences in group participation and networks can also constrain women’s access to weather and climate information for managing risks and planning production (Gumucio et al. 2019b).

Despite these obstacles, women farmers who access climate information can use and benefit from it (Roncoli et al. 2009, Tall et al. 2014, Carr et al. 2016, Carr and Onzere 2017, Huyer et al. 2017, Gumucio et al. 2019b). In Tamil Nadu, India, for example, understanding farmers’ perspectives on local weather and climate, and communicating gender-sensitive climate information and advisories, increased the resilience of women smallholder farmers.

Creating trust in the information accessed and understanding gendered needs within existing communication networks was critical for women to make informed agricultural decisions. Strengthening the social contract between climate experts and farmers in communicating climate information is also an important ingredient (Rengalakshmi et al. 2018). It should be emphasized, however, that climate information services risk reinforcing gender bias if they fail to account for women's concerns and priorities.

In relation to the fourth dimension, participation in **organizing and collective action**, women's organizations and community groups can be platforms for capacity development and agency, while acting as a vehicle for access to and control of resources. They can provide opportunities to share experiences, exchange information, and engage in group activities such as revolving credit, production and processing, and production cooperatives. They can act as mechanisms to magnify women's voice and shift the way they think of themselves and their entitlements, increasing their negotiating power in communities and households (Farnworth et al. 2017, Lecoutere 2017, Mello and Schmink 2017, Kumar et al. 2018). For example, the establishment of women's self-help groups (SHGs) in a highly drought-prone district of India allowed women farmers to interact more effectively with local government officials while improving their access to water (Desai and Olofsgård 2019).

Group membership can also support use of climate information. In Viet Nam, the national Women's Union trained women farmers across the country in low emissions development (LED) practices. It provided an avenue to navigate and overcome the discriminatory social and gender norms that were making it difficult for women to participate in LED, so that extension partners were able to reach women farmers more effectively (Farnworth et al. 2017). The inclusion of women's groups and networks in communication delivery channels can help address challenges women face to access weather and climate change information (Rengalakshmi et al. 2018).

Land use-based management approaches to resilience: can they promote gender equality?

Evidence as to whether land use-based management approaches contribute directly to gender equality is contested. For example, a recent assessment of the literature on gender and land degradation found that gendered biases related to land rights, access to resources and incentives, opportunities to participate in decision-making, and the distribution of costs and benefits hinder international efforts to promote gender equality in land improvement programming (Okpara et al. 2019).

To date, the largest land use management initiative is the program on Reducing Emissions from Deforestation and Forest Degradation (REDD+), that attributes financial value to the carbon stored in forests. As such, it provides incentives for developing countries to protect and manage forests to offset carbon emissions (Brown 2011). The funds gained through these incentives are meant to fund ecosystem services and pro-poor development. One step to empower rural women within the REDD+ framework is to ensure access rights to forest lands and resources (with commensurate carbon rights), thereby increasing their capacity to engage in decision-making and improving their economic and social status (Setyowati 2011).

However, **women have been largely marginalized** as stakeholders in the design and implementation of REDD+ (Larson et al. 2015, Wornell et al. 2015). A synthesis of lessons learned from REDD+ in Viet Nam found a variety of barriers to meaningful integration of gender, including: limited guidance on how to address inequality in forestry policy; limited representation of women in stakeholder groups, such as community organizations, non-governmental organizations, and government; inadequate understanding of women's priority needs; and lack of access by women to information (Thuy and Brockhaus 2015). A review of Indonesia's REDD+ policies found that less than 4 percent of documents substantively integrated gender (Wornell et al. 2015). A review by the Center for International Forestry Research (CIFOR) of 77 villages in 6 countries found that women were less involved in REDD+ design decisions and processes than men, even when they were the primary forest users. Program design focused on participation of women in meetings and training, ignoring deeper structural inequalities. As a result, implementation failed to take women's strategic interests into account in terms of land use and rights to forests (Larson et al. 2015, Evans et al. 2019).

REDD+ programming is also criticized for failing to take into account localized gendered power relations in pursuit of economic goals. Programs are designed to conserve forest resources and limit logging—areas that are largely under men's purview—with the result that access by women to non-timber forest products requires greater effort without commensurate benefits, in effect increasing their workloads. REDD+ initiatives in Burkina Faso perpetuated inequitable gender divisions of labor by shifting formal environmental decision-making “upward” to the state and development institutions and the burden of environmental labor downward onto the poor, in particular women (Westholm and Arora-Jonsson 2015). For policies such as REDD+, the challenge remains to integrate gender equality into implementation as well as design. Accountability for implementation requires tools such as gender

budgeting, and the lack of this kind of incentive poses major challenges (Kristjanson et al. 2017, Ampaire et al. 2020).

Despite these critiques, land use-based management approaches have significant environmental, social, and gender equality benefits, including for resilience (Villamor et al. 2014). In agroforestry, trees or shrubs are grown between crops or around pastures for soil improvement; while fruit, nut, and vegetable production can improve nutrition and increase incomes. The cultivation of indigenous fruits and vegetables represents an important source of income for women in Benin, Burkina Faso, Cameroon, and Tanzania (Kiptot and Franzel 2012). Wood from on-farm woodlots can be sold or used in the household (Kiptot et al. 2014), decreasing women's and girls' workloads significantly. For example, in Malawi and Tanzania, improved access to woodlots decreased the time spent by women in collecting fuel by up to three hours per day (Oduol et al. 2006).

Strengthening women's collective action is an effective strategy for gender equality in agroforestry. In Tanzania, marketing by women's groups has increased revenue from indigenous fruit processing, while the use of marketing and extension services by women's groups in Kenya increased the value generated from fodder shrubs (Kiptot and Franzel 2011). Other strategies include improving women's access to information and extension services related to agroforestry (Kiptot and Franzel 2012) and targeting interventions to improve productivity and marketing of products considered to be women's provenance (for example, wild forest foods, fodder, and branches not considered economically important). Evidence is emerging to suggest that pairing diversification strategies with commercialization has a more positive effect for women smallholders than commercialization alone (Tavener and Crane 2018, Tavener et al. 2019).

Promising gender equality approaches in the context of climate change: regional experiences

Promising models for promoting gender equality in the context of agriculture and climate change are emerging. Three regional case studies presented here involve participatory approaches to climate adaptation and mitigation interventions as part of the CSV approach,³ in the context of one or more of

3 A CSV is a platform for action research to test, develop, and support the scaling of CSA technologies and approaches and develop practical adaptation options for food security, resilience, and decreased carbon emissions (Aggarwal et al. 2018).

the four dimensions for gender in/equality. A common element is to promote women's agency and enhanced resilience through active partnerships with farmers organizations, both mixed-gender and women-only. Two of the case studies (India and Southeast Asia) are CSA-focused; the other (Senegal) combines both CSA and land use-based management approaches.

Women's groups as a platform for access, agency, and voice in South Asia: Madhya Pradesh, India

Collective action is a common strategy for women across the South Asian region, in the form of SHGs that serve as a platform for the adoption and spread of successful resilience strategies while promoting members' increased agency.

In 2017, a project was implemented by the CGIAR research program on Climate Change, Agriculture and Food Security (CCAFS) and the Madhya Pradesh, Uttar Pradesh, and Bihar states of India to improve women farmers' adaptive capacity. Components of the project included women-led groups, capacity-building, CSA technologies and practices, and climate information services, all placed within a larger initiative on climate-smart interventions for climate resilience. Preferences and needs of men and women were assessed and integrated into the design of the project. The representation of SHGs and other women-led groups in management and implementation was a strategic priority, as was strengthening women's agency and voice.

The women's collective action component was implemented⁴ in a region identified as a "hotspot" of gender and climate risk in Madhya Pradesh. The area is characterized by significant involvement of women in agriculture, with high levels of drought risk (Chanana-Nag and Aggarwal 2020). The socio-cultural norms defining participation of women in public activities in Madhya Pradesh are less stringent in comparison with other regions (for instance women cover their faces when talking to strangers). During the project baseline assessment, it was observed that women's savings SHGs were well established in the region, and members of the community were familiar with and accepting of (to an extent) the idea of women's group-based activities. A participatory consultation process resulted in a focus on local institution-building, which involved leveraging the social capital of SHGs for project decision-making and implementation. Two mechanisms were used: participation of SHGs in Village Climate Management Committees to manage

⁴ Implemented by CCAFS, BAIF Development Research Foundation, and farmers' organizations in Betul district of Madhya Pradesh, funded by USAID and CCAFS.

and implement CSA; and setting up women-led Custom-Hiring Centers (CHCs) to rent out climate-smart technologies to farmers at affordable rates. While the two types of groups were part of a design implemented across all three project sites, in Madhya Pradesh the Village Climate Management Committee was women-only, in line with women's significant participation in agricultural production. The CHCs in all three project districts were women-led, to promote economic independence and group-based agency. This approach was used to counter local norms constraining male–female interaction, to ensure women farmers could dependably access the technologies made available.

Through information and communication technology (ICT)-based agro-advisory and weather/climate information services, women farmers became aware of new practices, even implementing some of them. Women farmers also participated equally—or in some cases more than men—in capacity-building events, technology prioritization, and community consultation, ensuring attention to their production preferences. Focus group discussions revealed that several technologies reduced women's work in the labor-intensive activities of weeding (conco-weeder), water management (solar pumps), and harvesting (harvesting machine).

In this case, collective action was a platform for gender equality, agency, and resilience. Women gained better access to information; their production is increasing; their workloads have decreased; and they participate in community decision-making. They no longer rely solely on their social networks for information, and regularly access the project's ICT-based agro-advisories for information on weather, markets, crop cultivation practices, and technology use. Survey results indicate that the percentage of household income generated from rice and wheat production has increased from 44 percent to 50 percent. Women are also actively sharing their new knowledge with other farmers.

Promoting resilience through processing of non-timber forest products in West Africa: Daga-Birame CSV, Senegal

CGIAR and partners implemented a collective action and technology training approach in the CSV of Daga-Birame in Senegal. The purpose was to promote women's resilience through increased agricultural production and participation in community management of natural resources. Activities included (1) planting fruit trees for improved vegetation cover and income generation, (2) gardening to increase nutrition and market sales, and (3) baobab (*Adansonia digitata*) processing. In West Africa, it is traditionally women who lead non-timber forest product processing. This offered a

significant opportunity to increase incomes for women, to make up for decreasing agricultural production resulting from climate change.

A component of the project involved the establishment of a community-based Innovation Platform (IP). As one of its actions, the IP set up a committee responsible for processing baobab powder; the committee subsequently founded a women-run micro-enterprise for processing and selling the powder. The micro-enterprise was specifically developed with and for women members of the community.

Members of the micro-enterprise were trained in fruit processing and financial management, while environmental restoration activities such as increased vegetation cover and use of indigenous trees were introduced. To demystify beliefs about the length of time required for fruit production, and to provide training, five tree species were tested on community land as well as women farmers' individual plots. This approach was used for selecting fruit tree options and products: farmers were convinced to plant baobab once they learned that the grafted varieties produced fruit in a shorter time period (Sanogo et al. 2016).

Their involvement in the demonstration trials meant that the women farmers were trained in tree planting and grafting. They now grow baobab trees on their own plots, using the fruit, leaves, and bark for household purposes. A mixed-gender committee, also set up by the IP, manages community protected areas, including trees in the field and forest, and makes decisions on when to harvest fruit. Marketing and income management are carried out exclusively through the women-run enterprise (Sanogo et al. 2016). A village savings pool invests in community resilience activities.

Overall, the project has increased women's access to and control over forest resources, while the women's group controls the funds used for community improvement. Incomes have increased through fruit powder sales, and, as members on the different committees, women participate in community decision-making on tree management. Mixed- and single-gender collective action approaches have been used in combination to promote gender equality and resilience by increasing incomes, and agency through participation in community decision-making.

Despite these gender equality gains, the question of the long-term sustainability of the fruit processing enterprise remains. The product is sold locally, where there is limited demand. New commercialization initiatives need to be explored that can link the enterprise to subnational, national, and international markets, requiring investment in quality control and certification.

Promoting agency and reducing work burdens through participatory development of agro-advisories: Cambodia, Laos, and Viet Nam

The Agro-Climate Information Services project (ACIS) in Cambodia, Laos, and Viet Nam explored both mixed- and single-gender participatory approaches for integrating the preferences and activities of women and men in agro- and climate advisories (Le et al. 2018, Simelton et al. 2018b). The approach to gender equality went beyond provision of information in itself to enabling both women and men to co-develop the design, timing, and format of the agro-advisories. Unintended gender equality results of the approach included increased agency of women in the form of public speaking and joint household decision-making.

Across Southeast Asia, climate services value chains⁵ are generally top-down. The forecast is disseminated via TV whereas advice is transferred via extension. In this context, gender equality is influenced by differential access to information (extension workers are men and male trainers are often the norm); time poverty (women work long hours every day); gender division of labor (women tend to be responsible for small livestock and home gardens, and men for forestry); unequal decision-making (while many couples say that they take shared decisions, women more often than men will consult with their spouse before spending their own or joint money); and migration for employment (increasingly changing both household composition and farming itself).

The core of the project was to provide a seasonal forecast to groups made up of women and men farmers, who then developed their own agro-advisories, in their preferred format. The basic package of weather forecast plus participatory agro-advisory development was either integrated into community development research projects (such as in My Loi CSV, Viet Nam) and rural development projects (CARE Viet Nam) or included as an add-on to already-existing projects (CARE in Cambodia and Laos; Ekxang CSV, Laos). The agro-advisory design component revealed gender differences in uses and formats: women wanted both text and visuals so that their children could read the advisory to them while they worked in the kitchen, whereas men relied more on visuals. The group work helped participants understand the underlying reasons for gender differences in agro-advisory needs and preferences.

5 A climate services value chain approach looks at improving the way decision-makers and users understand and use climate information (WMO 2018).

Local gender dynamics and differing project contexts led to project modifications in the different sites. In three sites, the project was combined with rural development projects targeting women-only village savings and loans associations (VSLAs) managed by CARE. VSLAs constitute a regular group activity for women in this region, and were considered an effective platform for ACIS, in addition to being empowering for women. The three sites all included ethnic minority populations, where local socio-cultural norms made women-only groups a better option: Cambodia, for example, has a high rate of male out-migration, with women left behind to manage the farm. In the CSV site in Viet Nam, the project utilized mixed-gender groups because both women and men participated significantly in household farming decisions.

Project activities were intended to facilitate social learning, collaboration, and trust between women and men through different methods. The format of mixed-gender group activities (including gender awareness training) encouraged discussion and exchange of information between household members and among group members. Both women and men said they had learned from each other. A combination of female and male trainers was used whenever possible, to facilitate women's active involvement. An unintended result was that the female trainers became role models for women in the community, who began to feel more confident to speak in public. Husbands and wives participated interchangeably in the mixed groups and both joined the savings group—ensuring they kept each other informed and encouraging greater communication at home.

The localized format of the agro-advisories improved timeliness and relevance for the agricultural planning needs of both women and men. More efficient resource use resulted, with fewer wasted inputs and less replanting, reducing women's work hours. The participatory design of the agro-advisories increased accessibility of content for both women and men farmers, which they shared with others, often through social media. Collective action approaches were successful in promoting women's participation and facilitated joint decision-making. In sites where gender roles were strictly defined and women's participation in mixed-gender groups was constrained, the project leveraged already existing women-led groups—the VSLAs—for gender equality results; in the site where more flexible gender norms allowed for collaboration between women and men in farming, work with mixed-gender groups was possible and encouraged joint decision-making in the household.

Despite these positive results, it should be noted that significant changes in gender relations do not occur overnight. Building mutual trust behind husband and wife—including adoption of new roles—takes time, as does the

development of relationships between development practitioners and project participants.

From learning to action: lessons from the regions

All three projects, despite responding to different economic, environment, and socio-cultural contexts, exhibit common trends and approaches. The focus on women's participation in collective action supported resilience and promoted women's enhanced agency in all three communities. Resilience improved in relation to one or more dimensions of gender in/equality in climate-resilient agriculture. Increasing women's access to resources, technologies, and practices for climate-resilient production increased household incomes and resilience in two cases. The use of CSA technologies and practices to reduce women's work burden was a component of two projects, in South and Southeast Asia. Integral to any labor reduction outcomes was the meaningful involvement of women farmers in consultations to identify their technology needs and preferences.

All three cases are examples of how approaches that promote women's collective action (either mixed-gender or women-only), in combination with one or more of the other three dimensions for gender in/equality, can redress gender inequalities. The diversity of successful approaches to collective action demonstrates the importance of designing approaches that fit the local context.

Toward gender equality in climate-resilient agriculture and land management systems

Climate change has different effects on women and men farmers, in relation to their access to resources and income, stemming from gender norms around decision-making in different cultural contexts, and as a result of male out-migration for employment. Climate adaptation and mitigation strategies can perpetuate or, at worst, exacerbate gender inequalities when implemented in a gender-neutral approach—by, for example, diminishing or diverting the resources to which women have access. Gender-responsive approaches can promote equality while increasing resilience; at the same time, when women experience some degree of gender equality, they can be more apt to adopt CSA. This is predicated upon one or more dimensions related to agency and resilience: (1) participation in decision-making at local, national, and global levels, (2) work burden, (3) access to and use of productive resources such as

agro-climatic information, livelihood incomes, credit, and climate finance, and (4) collective action.

To date, research on gender equality and climate-resilient agriculture has focused largely on “diagnostic” analyses of women’s vulnerability, and on differences in how women and men perceive, are affected by, and respond to climate change (Kristjanson et al. 2017). The critical priority now is to focus on *how* to promote gender equality and increase resilience. We need more action-oriented, participatory research that explores strategies to build on previous diagnostic research. We know that gender equality and women’s agency constitute an integral aspect of this research agenda, and there is a need for further exploration of the long-term interconnections between resilience and gender equality. For example, what are the longer-term effects of decreased work burdens on resilience and agency? Research is also needed on the conditions promoting gender equality along with women’s agency and voice in different contexts through collective action. Promising examples need to be identified and methodologies tested to better understand what constitute successful approaches.

The full range of structural factors underlying gender inequalities in climate adaptation and mitigation also needs to be explored. This includes recognizing power relations between women and men, within households, communities, and countries, as well as among different groups in a community (Colfer et al. 2018, Haapala 2018). Power relationships are expressed through a range of structures—judicial, economic, social, and political—so that overcoming power imbalances involves promoting greater equality in control over resources (physical, human, intellectual, intangible) and ideology (beliefs, values, attitudes), as well as changes in institutions and structures (Rao and Kelleher 2005, Twyman et al. 2015). At the global level, the term “climate justice” has been used in relation to mitigation and locus of responsibility for global warming (Richards et al. 2015), and can be expanded to include climate adaptation (Boyd 2002, Rossi and Lambrou 2008).

The intersection of men and masculinities with women’s resilience and gender equality is another underlying structural factor that is under-researched in relation to climate-resilient agriculture—although studies on CSA adoption do carry out sex-disaggregated analyses (see Villaneuva et al. 2016). More research is needed on the gendered impacts of climate change on men, as well as their experience of and responses to climate change (see Correia 2001). The role of men in promoting women’s resilience and agency is an important area for research in relation to their response to women’s increased incomes or their attitudes toward women-targeted initiatives. Questions to consider

here include: How do we engage with men and power-holders to overcome resistance to gender equality (Hearn 2001)?⁶ As the case studies showed, participatory, collective action approaches in the context of CSA and land use management are one avenue to address entrenched norms and attitudes.

Three specific research areas critical to the promotion of gender equality and women's agency and resilience in climate adaptation and mitigation are (1) use of CSA technologies and practices to reduce women's work burden; (2) access to agro-climatic information; and (3) gender and climate policy.

More analysis is needed on how CSA technologies can promote gender equality by reducing women's work burden and increasing their incomes. The examples from the literature review and case studies suggest CSA technologies can contribute to labor-saving outcomes for women when women's activities and priorities are taken into account. Apart from more insight into which technologies are appropriate, better understanding is needed of women's access to them, and the reasons women use or don't use them. They may relate to cost, lack of information, or a design that is culturally or physiologically inappropriate. There is evidence that, when women are not consulted, or when the gender division of labor and localized power relations are not taken into account, CSA technologies may benefit some community members more than others, or inadvertently increase women's workloads (Beuchelt and Badstue 2013, Haapala 2018). How can CSA technology approaches ensure women retain control over them and the proceeds of increased production? It is also necessary to assess how new technologies and practices may displace women's paid work in different socio-economic contexts (Paris and Chi 2005, Khatri-Chhetri et al. 2020).

Evidence to date indicates that access to agro-climatic information in different formats can enable women to play a greater role in household decision-making, increase production, and improve household health and nutrition. Training sessions and workshops, joint agro-advisory development, and Farmers' Field Schools are successful models. In cases where market and advisory information have been relevant to women's economic activities, access to information has also been associated with increased income.

Considering the importance of agro-climatic information and capacity-building for managing climate and related risk (Hansen et al. 2019), targeted research is necessary to identify the conditions and approaches that

6 This occurs in the context of *resistance* of men to involvement in gender equality debates, policies, and activities; the need to recognize the *responsibility* of men (and power-holders) to take part in the promotion of gender equality; and the process of *reaching out* to those who are less interested and less involved (Hearn 2001).

promote gender equality in climate services (Gumucio et al. 2019b). What kind of information do women want and need? What are women's priorities for information content and formats? What are the empowering effects of the use of climate information (Mittal 2016, Huyer 2019b)? What partnerships and platforms, including women's and community-based organizations, mobile service providers, and others, will support generation, access to, and use of climate information?

Increasing reliance on ICT- and digital-based information services—as well as research and survey approaches—also poses new questions. What are the equality implications of the digital gender gap in rural areas and the predominance of men in the IT sector (see García et al. 2019, Huyer 2019a)? How accurate are digital surveys?

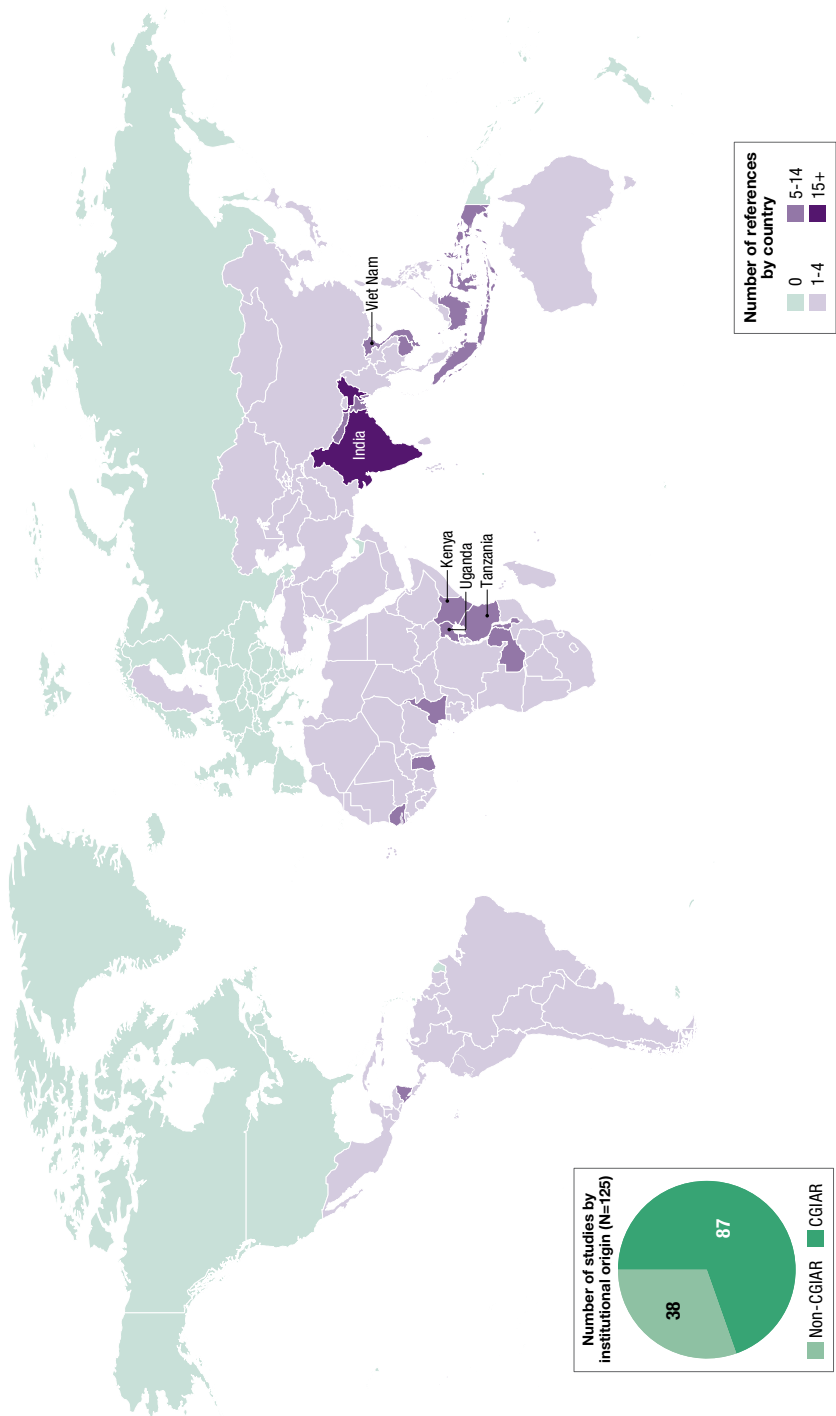
Research with policymakers at all levels, complemented by advocacy, is also needed in order to understand the types of support, partnerships, policy structure, coordination mechanisms, and climate finance instruments that are most effective for achieving gender equality goals. Policy has largely failed to recognize women as agents of change in climate adaptation and mitigation (Dankelman 2010, UNDP 2016, Evans et al. 2019), to acknowledge the root causes of gender inequalities, or to promote gender equality in implementation (Acosta et al. 2019, Ampaire et al. 2020). A research agenda on strategies to increase the participation of women and men in the formulation of climate policy is critical and largely neglected. Policy can lead to climate action, if women are recognized as key stakeholders and change agents for adaptation and recovery, in a low-carbon society (Michael et al. 2019).

Research is needed on several fronts: substantive intersectional gender analysis should inform the *content* of climate policy, while we also need better understanding of *how* to integrate gender into climate policy. This includes how to build capacity of policymakers to mainstream gender (UNDP 2016, Ampaire et al. 2020), as well as identifying key aspects of national instruments such as National Determined Contributions, National Adaptation Plans, climate finance, etc. Political will as well as support from the private sector is needed, to ensure the commitment of financial and other resources to empowering farmer and women's organizations. Coordinated multistakeholder efforts with government, civil society, women's organizations, farmers, and youth as well as the private sector are needed to ensure that rhetoric about climate action and gender equality becomes reality.

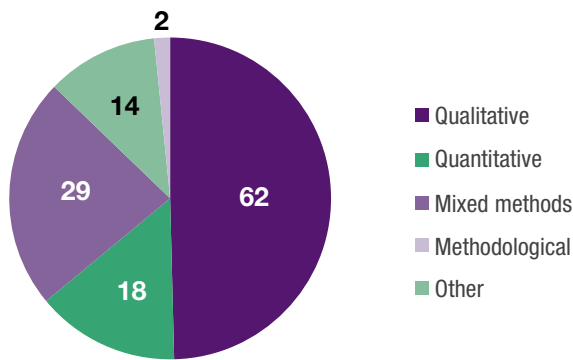
A final critical question is how the scaling-up of climate-resilient approaches can be consistent with gender equality. Limiting global warming to the 2°C target to which countries have committed in the 2015 Paris

Agreement, and reaching the Sustainable Development Goals by 2030, will require large-scale expansion of climate-resilient approaches in agriculture, food systems, and land management. How can such approaches integrate the conditions and mechanisms necessary for gender equality? Can small-scale, inclusive, and localized approaches that incorporate cultural and socioeconomic differences be coordinated with the broad-brush approaches required to scale up? Can women's collective action around climate-resilient agriculture and land use management be a mechanism for scaling up successful equality approaches? Questions need to be asked as to what constitutes inclusive scaling: Who and what is it for? How do scaling strategies take into account the capacities, priorities, and goals of all groups in society? These are the challenges in a warming climate.

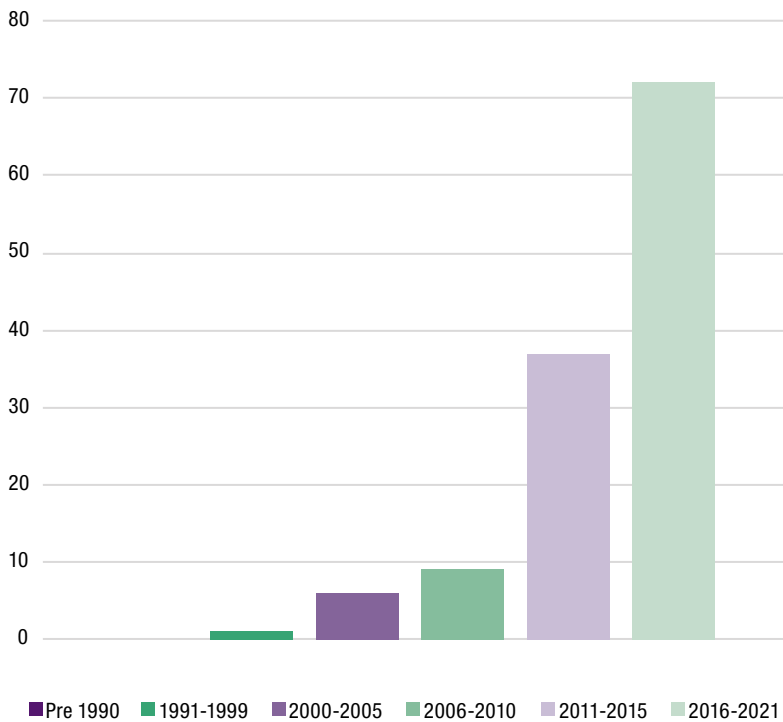
Geography of study sites for publications cited in Chapter 7



Number of cited studies by research methodology (N=125)



Timeline for references cited



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