



Gender-smart agriculture: An agenda for gender and socially inclusive climate- resilient agriculture

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CGIAR Research Program on Climate Change,
Agriculture and Food Security (CCAFS)

Sophia Huyer

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Abstract

The working paper reviews the evolution of the CCAFS gender and social inclusion agenda towards gender equality and empowerment in relation to climate resilient agriculture. Climate change research typically shows glaring gaps in understanding the different adaptive strategies and capacities of men and women, and the technologies, practices, and enabling environments that will empower women. CCAFS approach to gender, therefore, has been to understand the gender gap in agriculture under climate change (CCAFS Phase I) while also researching climate-smart solutions to promote gender equality and women's empowerment (CCAFS Phase II). A decade of gender research in CCAFS has led to the generation of a 'Gender-Smart Agriculture' approach. Gender research in CCAFS Phase I attempted to explore men's and women's adaptation options and strategies (individual, household, or collective) and the differences in their capacity to adapt. Data collected through household and intra-household surveys across CCAFS Climate Smart Village sites, highlighted influential findings on gender and CSA research by CCAFS and partners to date. The CCAFS work in Phase II (2017-2021) on Gender and Social Inclusion (GSI) expanded on this research to develop an approach, strategies, and monitoring frameworks for a gender-responsive, or gender-smart CSA. CCAFS targeted research to inform, catalyse and target CSA solutions to women and other vulnerable groups, increase the control of disadvantaged groups over productive assets and resources (e.g., climate information, climate finance), and increase participation in decision-making (e.g., in local and national climate adaptation strategies).

GSI has also provided technical and funding support on gender and youth to policy analyses, inputs, and submissions (including NDCs and national climate policy), as well as capacity development to policy makers on gender in global and national climate policy. In addition, keeping in mind the importance of equipping practitioners and policy makers with tools and knowledge of innovative gender-transformative practices and intervention approaches, CCAFS has worked with partners to develop guidelines and toolkits for supporting this work.

Keywords

Gender; agriculture; climate change; youth; resilience.

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Nitya Chanana, CCAFS Gender and Social Inclusion Science Officer from 2020-2021, contributed content on contributions of women's organizations to empowerment and agency.

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Introduction

Rising temperatures and more extreme weather associated with climate change are expected to exacerbate existing social and gender inequalities across the globe (Dankelman, 2010; IPCC, 2014). In a 2°C (or more) world, gender equality will need to encompass women and men's increased resilience and reduce their vulnerability to climate change. 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 (Huyer, Gumucio, et al., 2021; Kabeer, 1999). This paper reviews the evolution towards gender equality and empowerment in relation to climate resilient agriculture of the agenda of the Gender and Social Inclusion Flagship (GSI) of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

Building on analysis of women's capacity and willingness to adopt CSA in the context of the gender productivity gap, CCAFS research generated a "gender-smart agriculture" (GSA) approach. GSA considers women's priorities and access to technology, resources, and information to support climate resilience through equality and agency. It ensures that the needs and priorities of men and women are recognised and addressed in the design and application of climate resilient interventions.

Phase I: The Gender Gap in Agriculture under Climate Change

The CCAFS approach to gender as articulated in the proposal for Phase I (2011-2014) confirmed that any effort to increase productivity, adapt to climate change, manage climate risks better, or mitigate agricultural emissions, will be unsuccessful if it does not address the differences in how women and men manage their assets and activities. It highlighted the need to recognize the role of women in relation to climate change and its impacts on food security and focused on increasing the productivity and well-being of women as central to the wellbeing of children, families, households, and communities. Following on this, the first phase of CCAFS research focused on women's perceptions of climate change, their ability to adapt, and their capacity and interest in adopting CSA¹.

The gender gap in agriculture means that farm women and men in developing countries have different vulnerabilities and capacities to deal with the impact of climate change on agriculture. The gender gap encompasses differences among men and women in financial capital, in ownership and use rights over resources including land, water, livestock, grazing and fisheries; in capacity to capture beneficial environmental services; in labour use and the returns to labour, in political capital (empowerment) and in access to technology, training, information and agricultural advisory services in general. Gender inequalities are significant because women comprise 43 percent of the agricultural labour force in developing countries. Insecure property rights, inequitable opportunities for asset accumulation and for income generation place women (female-headed households) among the most vulnerable segments of the rural poor (Ashby et al, 2012).

Gender research in Phase I focused on gender trends in perception of climate impacts and adaptive capacity. Questions attempted to explore men's and women's adaptation options

¹ CCAFS approach to climate-smart agriculture is "agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes GHGs (mitigation) where possible, and enhances achievement of national food security and development goals (FAO 2013)". In this definition, the principal goal of CSA is identified as food security and development; while productivity, adaptation, and mitigation are identified as the three interlinked pillars necessary for achieving this goal.

and strategies (individual, household, or collective) and the differences in their capacity to adapt. Analyses of intrahousehold gender survey data showed that women and men adopt different CSA practices in particular contexts², although some practices appear to be generally preferred by women or men across diverse environments. For example, women are more likely than men to adopt improved stoves, water harvesting, and small-scale irrigation, while men are more likely than women to adopt stress-tolerant varieties and animal breeds as well as agroforestry practices (Jost et al., 2016; Kristjanson et al., 2017). On the other hand, work in Latin America found that women play a role in agroforestry decisions around household use for food security and income generation (Gumucio et al., 2017).

In 2013 a survey was undertaken in four sites in sub-Saharan Africa, with the intent to understand gendered climate change perceptions, impacts, adaptation, and coping strategies, as well as the constraints to adaptation in Kenya, Senegal, and Uganda. Questions included:

- How do men and women perceive climate change and, particularly, the livelihood risks associated with climate change?
- What are the gender disparities in access to and control over assets and how and to what degree does the disparity in assets affect how men and women experience climate shocks and change?
- How and to what degree does asset disparity determine how men and women respond to climate shocks and change?
- Which coping strategies and adaptation options are favoured by women and men, respectively, and why?

The survey was undertaken after two years of CCAFS work in the sites on climate-smart agriculture practices. It collected detailed gender-disaggregated data on these issues to inform strategies to increase climate change resilience among both women and men,

² For example, mulching, composting, terracing, and improved feed management (Kristjanson et al, 2017).

including: household make-up; land ownership, management, and decision making; decision-making authority on agricultural, livestock, and household decisions; adoption and knowledge of climate-smart agriculture practices; access to and use of climate and agricultural information services; access to and use of credit; membership in groups; fuel and water use; experience with climate shocks and coping strategies; perception of climate change and its potential impacts; and identification of adaptation strategies (International Food Policy Research Institute, 2018).

The survey found clear gender differences in perceptions of climate change, awareness, and adoption of climate smart agricultural (CSA) practices, as well as types and sources of agro-climatic information (Figure 1). It found that both men and women were experiencing changes in long-run weather patterns and that they changed their behaviours in different ways in response – albeit relatively minor shifts in existing agricultural practices. For example, the most prevalent changes reported included switching crop varieties, switching types of crops, and changing planting dates (Figure 3). Women were less aware of many CSA practices. Encouragingly, this same pattern did not hold in relation to adoption of CSA practices; in many cases, in East Africa in particular, women, when aware, were more likely than or just as likely as men to adopt them. In West Africa, overall, the adoption of these practices was much lower, while access to information from different sources varied greatly between men and women. However, it was also found that those with access to information reported using it to make changes to their agricultural production (Twyman et al., 2014).

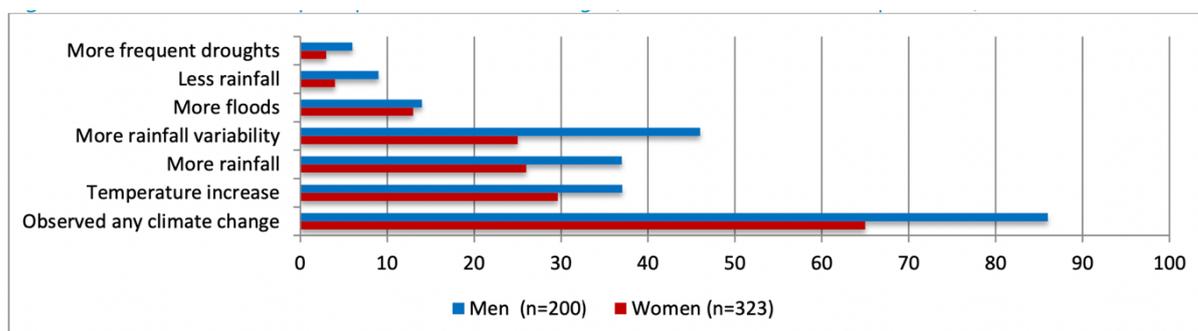


Figure 1: Women and men’s perception of climate change (% of female and male respondents), Source: Kristjanson et al, 2015a

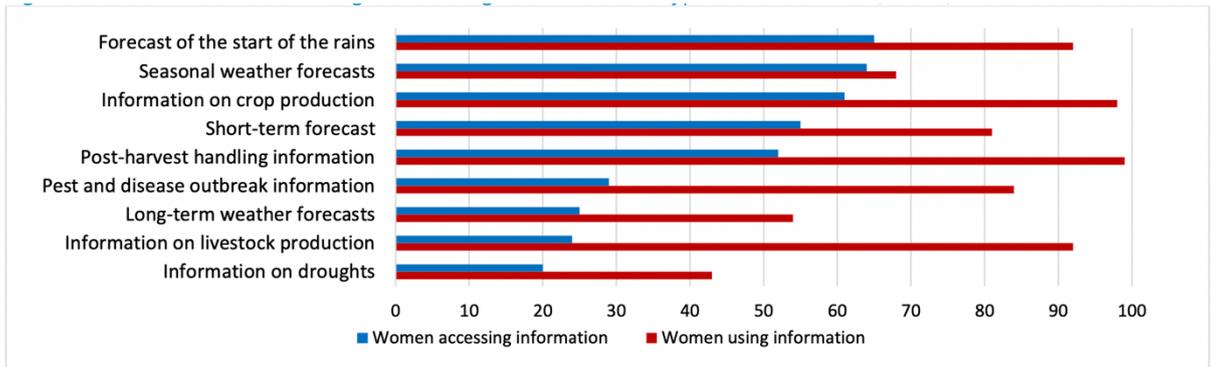


Figure 2: Share of women accessing, and making use of, different types of information (n=323), Source: Kristjanson et al, 2015a

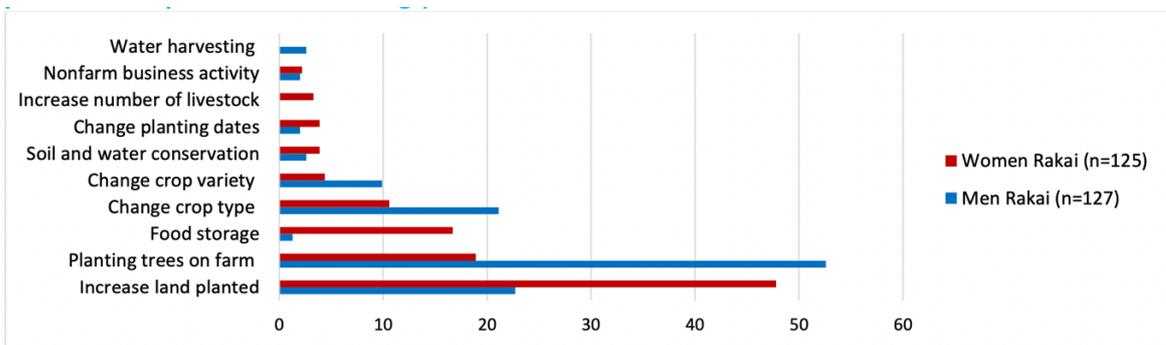


Figure 3: Adaptations to climate change (% female and male respondents reporting changing agricultural practices in response to climate change), Source: Kristjanson et al, 2015b

For example, survey results in Rakai found that having access to weather and agricultural information was essential to overcome women’s adaptive challenges. Women did not have equal access to the information they needed to produce food more effectively and efficiently.

The ability to access and use information on weather, climate and early warning of disasters is a critical element of adaptation. The gender surveys in 2013 found consistent gender differences in access to information for climate change adaptation, particularly with respect to weather and climate information, but also in relation to agricultural advice on adaptation. The results of a descriptive analysis show that across the African sites, women farmers tend to have significantly less access to many types of agricultural information, (e.g., CSA practices), and climate-related information than men (Kristjanson et al., 2017; Twyman et al., 2014; Jost et al, 2016), with some exceptions (Figure 2). For example, in the two Kenyan sites (Nyando and Wote), women reported higher levels of access to crop and livestock

production and post-harvest handling information than men (Twyman et al., 2014). Radio and TV reach both men and women widely (Africa Enterprise Challenge Fund & University of Reading, 2014; Diouf et al., 2019). In Colombia it was found that while most men and women received information from technicians, radio, TV, neighbours, extension agents, and family members, a higher percentage of men than women reported access to each of these sources of information (Twyman, Muriel, & Clavijo, 2016). In Nicaragua, radio and NGOs are the primary sources of information for agriculture and climate-related information. Men have slightly higher rates of access to these sources (Kristjanson et al, 2017). Preferences for types of climate information is another gender issue, with women and men having different preferences depending on their gender roles, access to resources and access to household labour (Gumucio et al., 2020a). In Senegal, women, unlike men, request forecasts of dry spells and timing of the cessation of the rains, given that they plant later than men owing to lack of control over means of production (Tall et al., 2014).

A review of vulnerability and resilience possibilities for households and communities in nine East and West African countries developed an analysis that was complementary to the work on gender trends in adoption and benefit from CSA and climate information. The analysis compared the agricultural and livelihood systems of women and men farmers, as well as their productive resources, organisation, and access to services. It was found that women have less access than men to common property resources, as well as to cash to obtain goods or services. They control less land than men, the land they control is often of poorer quality, and their tenure is insecure. Perhaps in response to this precarious position, women engage in mutual insurance and risk-sharing networks, and benefit from non-agricultural services provided by social support institutions external to the village. It was also found that formally registered, public, and private external organisations that foster agriculture and livestock production have tremendous anti-women biases and tended to provide support primarily to men (Perez et al., 2015). This finding was echoed in other CCAFS research, including the gender surveys (Kristjanson et al, 2017) as well as research by Cramer et al (2016) and Jost et al (2016) who found that women tended to interact more with community and informal based institutions, while men interacted more with formal organisations.

CCAFS research also recognized that rural women are at high risk of negative impacts from climate change, due to household responsibilities as well as increased agricultural work from

male out-migration. One of the important effects of environmental stress in farming systems (such as those imposed by climate change), for example, is the intensification of women's workloads, while another is decreases in assets of poor households (Agwu & Okhimamwe, 2009; Jost et al., 2016). Migration also plays a role in CSA decisions by women. In Kenya the most rapid adoption of climate-resilient farming for women was among those whose husbands were away and not making the day-to-day decisions. However, the possibility of increased labour loads from CSA practices is a significant barrier for women (Bernier et al., 2015; Jost et al., 2016; Twyman et al., 2014). Other questions that emerged from CCAFS research included how social and gender disparities affect how poor men and women respond to climate impacts on agriculture (Jost et al. 2016). Climate variability and weather-related shocks affect women's and men's assets in different ways and cultural norms can affect changes in control and ownership of assets during drought. For example, in one case women gained increased control of the household's livestock because men sold their livestock first (Kristjanson et al., 2014). Women and men are also changing cropping practices in response to climate variability, with different impacts on control of the income from crops and on workloads (Jost et al. 2016; Nelson & Stathers, 2009).

A special issue in *Gender, Technology and Development* on [Gender, Climate Change and Agriculture](#) (2016), presented influential findings on gender and CSA research by CCAFS and partners to date (see also Huyer et al., 2015)³. In their gender analysis of CSA practices across different farming and cultural systems to facilitate adoption by, and livelihood improvements for, women smallholder farmers, Murray et al. (2016) found that climate posed challenges for their agricultural and labour productivity. They found that labour of women was constrained by lack of access to labour-saving technologies, even to the most basic of farm tools. This produced a poverty trap for poorer smallholders which could not be escaped without access to key resources such as rural energy and labour-saving technologies. Despite the aspirations of women smallholders to engage in CSA, their research found that many women smallholders had either limited or no access to basic agricultural tools, transport, and rural energy. Their research raised the question of whether

³ The special issue came out of a CCAFS event "Gender, Climate Change and Agriculture" in March 2015. See Huyer et al, 2015 for a summary.

future livelihood scenarios for poor farmers will consist of barely surviving or “hanging in”; whether they can “step up” to adapt better to future climate constraints; or whether more of these farmers will “step out” of agriculture. They argued that for women smallholder farmers to become more resilient, gender constraints in accessing basic agricultural technologies need to be addressed, combined with participatory approaches to develop, and adapt CSA tools and technologies to their needs in future climates and agro-ecologies.

Surabhi Mittal (Mittal, 2016) investigated the potential of a mobile phone-enabled information delivery mechanism to reduce the knowledge gap between large and small farmers as well as across gender, by creating awareness about CSA practices and technologies. Her research found that women can feel empowered from access to information through voice enable phone lines if the information targets their interests and activities. Women farmers said that agro-advisory messaging helped them make more efficient use of inputs by increasing their knowledge about climate-smart technologies. It also increased their empowerment through more influence on household decision making, since they were able to discuss the agricultural information used by their husbands with them.

Overall, Phase I research found that linked household-, intrahousehold-, community-, and institutional-level data shed light on significant and nuanced gender differences in the capacity of individuals and communities to adapt to climate change for reasons of the gender gap, access to resources, and access to information. It found that the gender gap was substantial in exposure to climate change and its impacts as well as adoption of new practices to lower vulnerability. To overcome neglect of women’s needs and priorities by service and information providers, their differing needs, access to, and control over resources need to be considered in policy and programming (Kristjanson et al., 2017).

Phase II: Developing an approach to gender-smart agriculture

The CCAFS work in Phase II (2017-2021) on Gender and Social Inclusion (GSI) expanded on this research to develop an approach, strategies, and monitoring frameworks for a gender-responsive, or gender-smart, CSA. This approach targets gender equality and empowerment of women and men, taking CCAFS research beyond diagnostic and equity approaches towards research to inform, catalyse and target CSA solutions for women and youth, increase their control over productive assets and resources (e.g., climate information, climate finance), and increase their leadership and decision-making (e.g., in local and national climate adaptation) (Huyer et al., 2016). This expanded approach included a focus on social inclusion⁴, involving gender, socioeconomic status, ethnicity, disability, and age (youth and seniors) (FAO and CCAFS 2013).

Charting an Agenda for Gender-smart Agriculture

Analysis in Phase II increased understanding of what are the gender equality aspects and results of designing and implementing CSA practices, and how gender equality or empowerment results in CSA are measured, towards the development of a framework for gender-smart agriculture (GSA). A key challenge for gender and CSA research is to identify the trade-offs and co-benefits from different combinations of options in different contexts that benefit women, youth and poor farmers, and promote the transformation of agriculture and rural development in ways that promote equality (Locatelli et al. 2015; CCAFS 2016). A range of approaches for integrating gender into prioritization and impact measurement of CSA technologies and climate services were also developed and tested (see section on Tools below).

A Learning and Action Workshop on Gender Transformative CSA in 2019 as well as a special issue of *Climatic Change*, on “Gender Equality and CSA: Frameworks, Opportunities and Action” (January 2020) assessed research to date and highlighted findings around a gender

⁴ The World Bank defines social inclusion as improving the ability, opportunity and dignity of people disadvantaged on the basis of their identity to take part in society. This is achieved through increasing opportunities, voice and decision-making as well as equal access to assets and services and to social, political and physical spaces (World Bank, 2013).

equality framework in CSA. The Learning and Action workshop, held at the University of Canberra on 1-2 April 2019, was an opportunity to identify opportunities for gender equality in climate-smart agriculture (CSA) through knowledge sharing and discussion of next steps. The workshop involved researchers across CCAFS who reviewed the existing knowledge base, noted key gaps, and identified future research questions and themes (Huyer et al, 2019). The discussions were based on an action framework that conceptualized the integration of gender equality into CSA and mapped the CSA approach outlined by Lipper et al. (Figure 4).

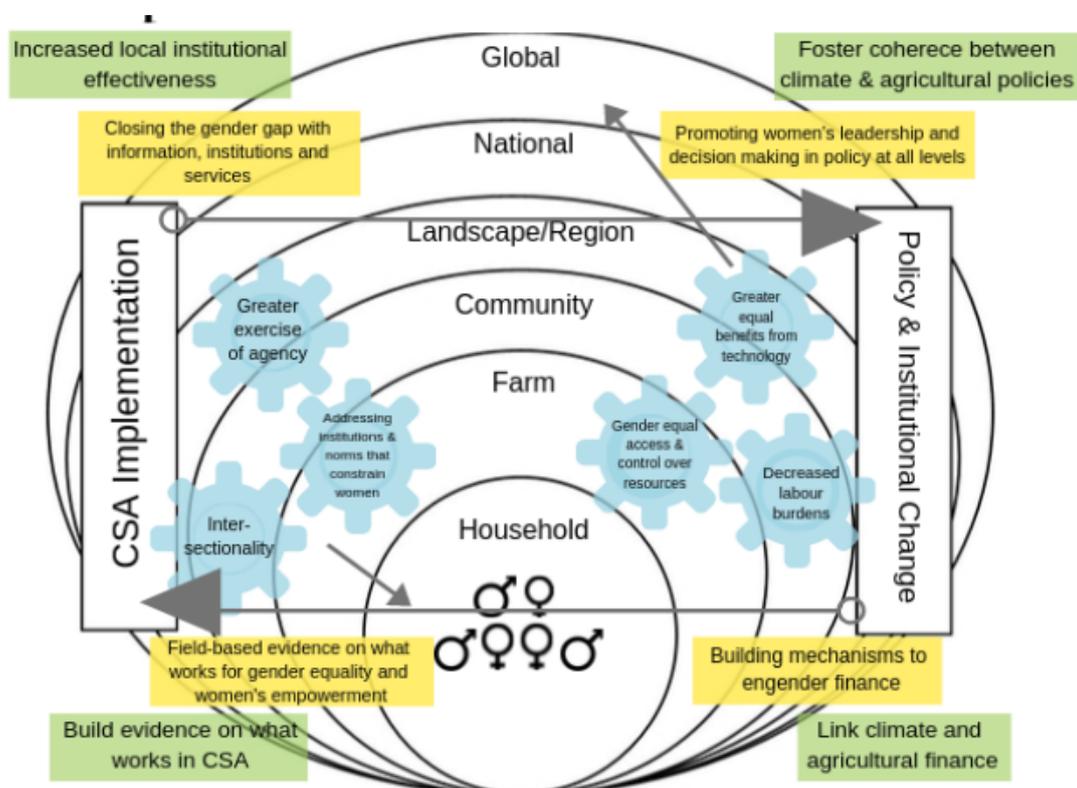


Figure 4: Gender empowerment and CSA framework, Source Huyer et.al, 2019

Phase I of CCAFS research demonstrated that climate-smart agriculture (CSA) has the potential to bridge the gender gap by providing a range of benefits for women, if implemented in such a way that they can take advantage of them. But Phase II research found that for CSA to be a positive strategy for women, differences in priorities and in ability to adopt new practices between women and men of different ages and social classes need to be considered. Stemming from these differences, women have different needs and priorities for training, technology, and climate information, based in their differing access to

resources, social and gender norms, and gender division of labour (World Bank, FAO, and IFAD, 2015; Jost et al. 2016; Tall et al. 2014; Huyer 2016).

As a result, CSA will not be relevant to, or beneficial for women by definition. Some argue that CSA is a compilation of market-led and productivity-oriented practices that are antithetical to feminist approaches in agriculture for development (Collins, 2018) and CCAFS research found it has the potential to entrench and solidify prevailing power and gender relations within a community if questions are not asked about who is controlling the technology and who benefits from the practice (Haapala, 2018). The tendency to allocate new labour-intensive activities to women can mean they will be hesitant to adopt new adaptive practices in agriculture out of concern that their workload will increase (Beuchelt & Badstue, 2013), and it has been argued that “gender” research in CSA is mostly concerned with a men-women dichotomy that ignores power and social and political relations, stemming from gender, race, class, ethnicity, religion, and age (Djoudi et al., 2016; Mungai et al., 2017).

Constraints from outside agriculture also influence women’s ability to adopt and benefit from CSA. Some researchers have noted a tendency for women to adopt labour-intensive CSA technologies for their own work (probably due for cost reasons) which may mitigate against other equality benefits by increasing their workloads (Mutenje et al., 2019). Inadequate infrastructure for water or transportation will increase women’s unpaid care work and time expended in fetching water or taking produce to market, while social norms restrict women’s public interactions, participation in decision-making, and control over resources (Huyer & Partey, 2020).

While CSA can have negative effects for women, CCAFS research also showed a two-way relationship between CSA and gender equality. Gender equality can be a factor in the adoption of CSA (Mutenje et al., 2019) – in Malawi, households where women were more empowered were more likely to adopt CSA – while in other situations CSA adoption can facilitate empowerment. CSA 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 a critical gender and climate issue since climate impacts such as drought in combination with deforestation are

expected to significantly increase women's workload (Dankelman, 2010). Information and capacity-building to cope with and manage climate risk and variability, is important for women's and men's capacity to adapt, can promote women's participation in household decision-making and increase their agricultural production (Huyer, 2019; Mittal, 2016; Rengalakshmi et al., 2018).

The special issue of *Climatic Change* research addressed this in two ways, for both policymakers and practitioners, by (1) analyzing the status of women and gender equality in relation to climate change and agriculture and (2) presenting methods and indicators to better understand the potential of CSA for increasing gender equality in the context of climate change.

The first two articles in the special issue, "Woman in agriculture and climate risks: hotspots for development (Chanana-Nag & Aggarwal, 2020)" and "Potential of climate-smart agriculture in reducing women farmers' drudgery in high climatic risk areas (Khatri-Chhetri et al., 2020)," add a gender dimension to climate hotspots. Gender and climate hotspot mapping compares areas that are food insecure and vulnerable to the impacts of climate change (availability, access, and utilization of food) with the level of climate change exposure affecting agricultural systems. The adapted gender methodology maps three main indicators: (i) the participation of women in agriculture, (ii) degree of climate risks (drought and floods, changes in rainfall patterns, and dependency on natural resources), and (iii) poverty in India and Nepal. The resulting maps identify "hotspots" or high-risk areas where climatic risks overlap with a high proportion of women in agriculture. While this kind of macro-level approach has been criticized for failing to consider important differences in socioeconomic level, status, etc., affecting women's situation, it offers a large-scale overview for policymakers and support organisations to identify those areas where the greatest climate risk and vulnerability exist⁵.

An analysis of the extent of gender integration in climate-related policies in Tanzania and Uganda, and how gender is budgeted for in implementation plans at district and lower

⁵ This methodology has been adapted for the sub-Saharan African context in collaboration with AGNES and the African Development Bank.

governance levels (Ampaire et al., 2020) builds on work in Latin America by Gumucio and Rueda (2015) analysing the inclusion of gender in climate-related policies in Latin America. The East Africa analysis showed that while there is increasing gender responsiveness in climate-related policy in both countries, (i) gender issues are still interpreted as “women’s issues,” (ii) there is a lack of harmony in gender mainstreaming across governance levels, (iii) budgeting for gender is not yet fully embraced by governments, (iii) allocations to gender at sub-national level remain consistently low, and (iv) gender activities do not address structural inequalities. The article goes on to propose approaches that increase capacity to develop and execute gender-responsive policies, implementation plans, and budgets.

A second group of articles presented in the special issue look at how implementation of CSA practices and technologies affect gender equality and empowerment within households. The approaches presented consist of both new and adapted methodologies to better understand the following: (i) gender equality in relation to CSA and climate-resilient agriculture approaches (Khatri-Chhetri et al., 2020) (ii) exploration of whether CSA practices can lead to greater empowerment for women and men (Hariharan et al., 2020) and (iii) development of indicators to measure gender equality results (Gutierrez-Montes et al., 2020).

Khatri-Chhetri and colleagues (2020) focus on one critical gender equality aspect of agriculture in the context of climate change: women’s work burden. As they note, there is significant concern that women are likely to be more negatively affected by climate impacts, especially in developing countries where they are highly reliant on natural resources for livelihoods and household well-being. Most analyses have been limited to their access to resources and decision-making, but the effects on women’s workload in agriculture could be very significant. In this context, women’s agricultural activities in South Asia tend to be labour-intensive: sowing, weeding, and harvesting. Climate change impacts such as decreasing crop residues and biomass for energy and livestock feed, the need to re-sow or transplant crops, and decreases in crop yields are likely to increase women’s workload more, given their involvement in these and related activities. A methodology was proposed to assess the labour-reducing potential for women of selected CSA technologies and practices: farmers’ practice (FP), direct-seeded rice (both zero tillage and low tillage with machine), system of rice intensification (SRI), green manuring, and laser land levelling (LLL). The analysis in the pilot sites found that direct seeded rice, zero tillage machines, laser land

levelling, and green manuring have potential to significantly reduce women's workloads, with direct seeded rice (zero tillage and low tillage using machine) and green manuring (GM) being the most likely to significantly reduce their labour hours. This finding is corroborated by analysis elsewhere in the region that found drum rice seeders can significantly reduce women's workload (Aryal et al., 2020). The interrelationship of labour-reducing technologies with other factors, such as access and control of resources, participation in decision-making about the adoption of CSA technologies, and linkages to new markets, needs further attention (Khatri-Chhetri et al, 2020).

Significant progress was made in developing indicators to measure gender equality results and the empowerment of women in the context of climate-resilient agriculture. The Gender Empowerment Index for CSVs (GEI-CSV) proposes an index tested in two regions in India—Bihar and Haryana (Hariharan et al., 2020) . The Index builds on two global initiatives—the Global Gender Gap Index (World Economic Forum 2018) and the Women's Empowerment in Agriculture Index (WEAI) (Alkire et al., 2013)—to construct a framework that measures four domains of empowerment: political, economic, social, and agricultural. Indicators measure both increases in degree of empowerment (e.g., increased access to credit; better access to a mobile phone) as well as the achievement of empowerment in the form of participation in village- or household-level decision-making, better control of money for various uses, increased participation in agricultural decisions, among other factors. The added dimensions of the GEI-CSV include a focus on agricultural technologies and management practices in the context of climate change, as having the greatest influence on participation in agriculture in the climate context by households and household members and on agricultural production. As a result, the expanded set of agricultural indicators measures empowerment both in the recognized sense of increased decision-making in household agricultural decisions and increased incomes (FAO and CCAFS 2013) but also in relation to climate vulnerability and resilience of women and men, i.e., the ability to respond to and adapt to the impacts of climate change (Perez et al. 2015). Resilience indicators include ability to manage agricultural risk, use of climate insurance, crop diversification, and access to weather and agro-information. The GEI can be adapted to different regional and agricultural contexts.

The pilot in Bihar and Haryana found increased empowerment for both women and men in CSVs in both regions, compared with non-CSVs. This study concludes that climate-smart

approaches can increase empowerment of women and men in agriculture by increasing their resilience and adaptive capability while also increasing gender equality in decision-making and control of resources. The GEI is in process of being further tested in 9 countries five regions: Nepal, Vietnam, Kenya, Ethiopia, Senegal, Mali, Ghana, Nicaragua, and Guatemala, with additional indicators on workload and political participation.

Gutierrez-Montes and colleagues (2020) propose a set of indicators to measure equality and empowerment in CSA, based on a framework developed by the Mesoamerican Agro-environmental Program of Norway (MAP-Norway). MAP-Norway was implemented in Central America in 2009 and uses a “climate-smart territory” approach to address poverty, food, and nutrition insecurity, gender inequality, degradation of ecosystem services, and vulnerability to climate change. It incorporates a set of gender indicators for local and household levels; the regional level with businesses and territorial governance platforms; and the national level. It includes indicators that can provide useful signals about the degree and nature of gender equality—such as how many businesses have gender-sensitive statutes or recruitment processes that address gender equity issues. Based on work with focus groups, the authors propose a set of qualitative indicators to add to quantitative results, for assessing decision-making around agricultural productivity and food security. They include questions on both women and men’s perceptions of women’s roles and workload in household, community, and business organisations. They also propose additional quantitative indicators to assess the use by female-headed households of farm equipment, fertilizers, and pesticide, as well as distribution of assets within a household. This set of indicators can be a model for the development of gender indicators for adaptation and mitigation in CSA, for example, to monitor issues such as access to water for irrigation and household use (Gutierrez et al, 2020).

Work on gender aspects of climate information services (CIS) continued in Phase II. Samuel Partey et al (2020) demonstrate the value of collecting disaggregated data in the sector to understand gender differences in access to CIS. This research expands earlier CCAFS research that identified a gender climate information gap in CIS (Tall et al, 2014). Coming out of an initiative to support farmers with more effective and timely climate information, Partey et al present research on gender trends in use and access to climate information services delivered through mobile phone platforms (2020). The research assessed (i) whether

perceptions on climate change and variability differ between men and women farmers; (ii) whether gender is a determinant of climate information use; and (iii) whether men and women benefit and face similar constraints to the use of climate information services. Results showed that while 85.2% (representing 767) of farmers were aware of climate change and its implications for their agriculture and other livelihood activities, and that while men and women were found to have similar perceptions about climate change, use of CIS may be influenced by gender. Men tended to use the service more than women, likely because they were more able to buy and use mobiles to access the climate and agro-information. Women generally used their husbands' phones. This echoes research and data from the GMSA that show that the digital gender divide is greater in ownership and control of mobiles than in access to them, and that the gap is not noticeably closing (GSMA Connected Women 2019). Nevertheless, despite these differences in access to CIS, both men and women found it beneficial for farm decision-making on issues such as when to begin land preparation, when to plant, and which crop to select. As well, both men and women were found to face similar constraints (such as poor network connectivity and limited of training) to accessing and using CIS through the Esoko platform, although women's constraints were slightly more likely to be based on resource limitations and illiteracy than men. Building on research elsewhere (Gumucio et al., 2018; Tall et al., 2014), the authors recommend the need to explore different dissemination channels for information for women and men, as well as design of CIS that meet gender-specific needs and capacities.

Gumucio et al (2020b) in their review of the rural climate services work of CCAFS assessed the empirical knowledge base on gender-based differences in access, use and benefits to analyse gender equality challenges and identify pathways for making climate services more responsive to the needs of rural women and men. While existing research is limited, the review identifies key gender-related factors and processes that influence inequalities in access and use. The review found that differential access to group processes and to information and communications technologies (ICTs) can significantly limit women's access to weather and climate information. Socio-cultural norms that define women's and men's labour roles can also influence the resources and decisions under women's and men's control, affecting their differing climate information needs and demand. Ways forward suggested by the literature concern inclusion of women's groups and networks in

communication channels and development of ICTs that respond to women's preferences. Meeting women's climate information needs and pursuing cross-sectoral collaboration will be important for successful climate action. Research opportunities include analyses of the potential for women's and mixed-gender groups to enhance women's access to climate information; evaluation of the communication processes that improve women's understanding of climate information; and further connection with the body of knowledge on intra-household decision-making processes.

Analysis by Huyer (2019) of how women use ICT and access to CIS for empowerment found they play a critical role in food security in the developing world, but their agricultural activities are often characterised by gaps in information and resource access, with deficiencies in several areas: land, labour, credit, information, extension, and technology (Huyer, 2016). CIS are not sufficiently providing women with the information, services, and knowledge they need and want. Sufficient evidence and experience exist, however, to develop agricultural information strategies for food security that support women and promote gender equality. Successful strategies for reaching women, include mixed approaches of radio (Ingabire, 2021), TV (Africa Enterprise Challenge Fund & University of Reading, 2014), and mobiles that may be the most appropriate approaches to reach women with agriculture and climate information, in view of women's low access to resources and widespread gender norms that inhibit women's information access. Intermediary organisations, such as social networks and community organisations, health clinics, farmer associations and women's organisations, are also important avenues for women to access and use information (Huyer, 2019).

In 2019-2020, a review of CCAFS work in its second Phase assessed how 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, as a result increase gender equality. Existing literature and regional case studies were analysed in relation to four dimensions of gender in/equality: (1) participation in decision-making at different levels, (2) women's work burdens, (3) access to and use of productive resources such as agro-climatic information, technology, livelihood incomes, and credit, and (4) collective action (Huyer, Gumucio, et al., 2021).

Collective action emerged as a key strategy / ingredient for promoting gender equality and women's agency. Women's group organising 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 (Chanana et al., 2018; Huyer et al, 2021). Different organisations in the form of farmers or producer organisations (FOs and POs), women's organisations, and community-based organisations (CBOs) have been able to promote or work towards empowerment from a base of economic support and increased access to resources (Huyer et al., 2022). This when combined with aspects such as participation in decision making in the household or community, increased voice and agency, and ability to influence decisions in their local or national contexts, act as contributing factors to empowerment. For instance, in Uganda, women members of the Manyakabi Area Cooperative Enterprise were able to generate multiple benefits in the form of increased incomes, improved connections with traders from local and external regional markets, greater independence and status, new leadership and business skills. Women felt empowered by having a stronger voice in the community (they now negotiate prices with wholesalers), a new bargaining position that has increased their standing with both business partners and family members (Ferguson and Kepe, 2011).

Similarly, self-help groups (SHGs) are a widespread form of collective action in South Asia and were leveraged in scaling climate smart agricultural practices in Madhya Pradesh, India. Women's participation in committees to manage and implement CSA practices and technologies, supported their empowerment by integrating them into a successful village activity, improved their knowledge of climate-resilient practices, increased their access to information, and resulted in increased visibility and leadership in the community.

Building on the gender profile of climate-smart agriculture in Ghana (CCAFS 2021) and the Gender Empowerment Index for CSVs, a "gender-smartness" framework was developed to plan and measure impacts of gender-smart agriculture. GSA is implemented in four key stages including situational analysis, planning, implementation and monitoring and evaluation. The first step, situation analysis, explores the entry points for investing in priority GSA initiatives at scale. Content of the situation analysis is usually based on existing global and national data sources, as well as expert input and surveys ideally including farmers and technical experts and can also incorporate more localized data if available. The planning step

involves participatory targeting and prioritisation consultations with all stakeholders. It results in the development and design of a final portfolio is informed by an understanding of the existing socio-cultural and economic barriers that can enable or disable adoption by men and women. For the third stage, several participatory approaches enable inclusive implementation of GSA. They involve leveraging the existing institutional environment to build upon the agency and capacities of women that can considerably impact the adoption of technology. Finally, a gender-smart indicator can be used to assess the effectiveness of the selected GSA options to address the following:

- Gender gap in access to resources including income, credit, inputs, production, and climate information services
- Gender differences in intra-household decision making participation
- Gender gap in agency/ leadership at community level
- Gender differences in workloads.

Can We Turn the Tide? Gender and Climate Policy

Emerging global crises such as climate change, massive migrations, pandemics, and environmental degradation are posing serious risks and threatening ecosystems and rural livelihoods across the globe. Climate change in particular is expected to exacerbate pre-existing social inequalities, including gender inequalities. Innovative and equitable climate adaptation and mitigation strategies will be needed, including substantive integration of a gender perspective into climate change policy discussions and agreements at global and national levels (Huyer et al., 2020).

Policy change takes time, along with ongoing engagement with policy makers and influencers (Mulema et al., 2021). GSI focused on work with the Africa Group of Negotiators Expert Support (AGNES) and the African Development Bank from 2017 to 2021, with the purpose to build capacity and generate momentum in gender and climate policy in the African region.

The goal of the GSI work in this context was to “work with AGNES and other organisations to ensure climate change-related policies and activities are not only conceptually inclusive, but also provide a space for women and youth to take an active role in advocating for themselves (Freeman & Mulema, 2021).” To this end, GSI provided technical and funding support on gender and youth to policy analyses, inputs, and submissions (including NDCs and national climate policy), as well as capacity development to policy makers on gender in global and national climate policy. In collaboration with Women in Global Science and Technology (WISAT) it also contributed to analysis of gender in NDCs.

Technical support on gender and climate policy

In 2017, CCAFS GSI contributed to 3 submissions to the UNFCCC on the Gender Action Plan, by Kenya, Ghana (in May) and the AGN (during COP23) on 18 April 2017. Analysis of the text in the Kenya, Ghana and AGN submissions included text from a CCAFS presentation, and the Ghana submission includes acknowledgement of CCAFS’ role in supporting the submission. Mary Nyasimi, GSI Science Officer, was asked to represent Kenya at these meetings and contributed to the Kenya submission.

Ongoing collaboration between GSI and AGNES produced several successful gender-related climate policy outcomes. In the lead up to the 25th Conference of the Parties (COP), the United Nations Framework Convention on Climate Change (UNFCCC) called for submissions to their Gender Action Plan (GAP). The GAP, which sets out plans for gender-responsive climate action, is an essential component of ensuring inclusive and meaningful participation for all genders in the UNFCCC process. In 2017, GSI facilitated and contributed to the text for the African Group of Negotiators' (AGN) submission to the UNFCCC GAP and, in 2019, CCAFS' support was instrumental in finalizing the GAP at COP25. This support included the co-production of the CCAFS-AGNES working paper "Gender Implications of the Gender Action Plan and Koronivia Joint Work on Agriculture (Masiko et al., 2019)" and included ongoing collaboration with the facilitator of the negotiations, Winnie Masiko. In a discussion about the support offered to AGNES by CCAFS, George Wamukoya, AGNES Coordinator, stated, "CCAFS should be proud of the outcome (Freeman and Mulema, 2021)."

On behalf of AGNES, CCAFS, and the International Center for Tropical Agriculture (CIAT), GSI contributed text and facilitated a joint submission to the UNFCCC on Best Practices in Gender Mainstreaming in National Adaptation Plans (NAPS) and Nationally Determined Contributions (NDCs). The submission was submitted by the UNFCCC Adaptation Office to the Adaptation Committee 2020 agenda.

In collaboration with the Women Environment Program (WEP) and the Ministry of the Environment, GSI supported the development of the National Action Plan on Gender and Climate Change in Nigeria (Federal Government of Nigeria, 2020). The National Action Plan was officially approved by the Government of Nigeria in August 2020. AGNES views this Action Plan as a model for similar policies in the region, including current work in the CGIAR program Accelerating the Impact of CGIAR Climate Research in Africa (AICCRA) to develop GCAPs in Ethiopia and Senegal.

As well as the work in Nigeria, WISAT and GSI wrote the two-page section on "Gender and Social Inclusion" in the Means of Implementation of the updated NDC of Papua New Guinea, submitted to UNFCCC on December 15, 2020.

GSI also supported the identification of priority areas and actions leading to a set of recommendations on gender, forestry, water and energy for the update of the Uganda NDC

that is currently ongoing. Winifred Masiko, AGNES member, worked with staff in the relevant ministries to develop the recommendations. In Kenya, support and inputs were provided to the Ministry of Agriculture in its update of the Gender Agriculture Policy. Both reports are currently under review in the relevant Ministries.

Other policy-related documents included development of a conceptual framework on gender mainstreaming of NAPs and NDCs (Chingarande et al., 2020); and the AGNES Policy Brief “Closing the Gender Gap in African Agriculture in the Face of Climate Change” (AGNES - Africa Group of Negotiators Experts Support, 2020).

Capacity development in gender and climate policy

Capacity development activities included ongoing support to participation of youth and gender experts in AGNES to the annual COP meetings; and a series of national workshops co-organised with the African Development Bank for policy makers on gender policy development and negotiations:

- Training of Tanzania MPs on gender and climate change (Natai et al., 2019)
- Workshop with national policymakers in East Africa on gender in national climate policy (<https://ccafs.cgiar.org/news/east-african-policy-makers-advocate-gender-climate-policy>)
- AGNES training workshop on gender in global climate negotiations, Dakar, September 2018.

Navigating Sustainable Futures: CCAFS Work with Youth

A framework for CCAFS work in youth was initially developed in 2017, based on work in Phase I Flagships and regions, and target and equip youth with knowledge on climate-smart agriculture (CSA) practices and technologies to increase productivity, resilience, and employment opportunities (CCAFS, 2016). This youth strategy was revised and developed during Phase II to comprise 6 areas of focus:

1. Identify CSA options and incentives that offer attractive opportunities for young farmers and youth entrepreneurs along value chains, including digital-based opportunities.
2. Understand the relation and interactions of youth migration with climate change and related factors (e.g., food security, employment, disasters, and conflict).
3. Explore the use of digital technologies and engagement processes to meet the CSA and climate information needs of youth to strengthen their entrepreneurship and climate resilience.
4. Undertake strategic research on youth engagement in policy and how it can be improved at local, national, and global policy levels (e.g., through civil society organisations, social media, youth networks, and negotiation processes).
5. Engage in the capacity development of young people, including through social media, webinars, participatory learning approaches (e.g., use of participatory video, theatre, and information and communication technologies (ICTs), climate change research opportunities, and access to professional networks.
6. Include age-disaggregated indicators (data) in monitoring, evaluation, and learning (MEL) processes (Bullock et al., 2020).

The Youth Strategy was interwoven with the CCAFS Gender and Social Inclusion (GSI) Strategy (Huyer et al., 2016) and advocated for approaches that build the agency of youth to navigate and negotiate opportunities for more sustainable futures. To understand youth, broader geographic characteristics that influence local opportunities for employment,

including improving productivity, adaptive capacities, and youth migration, must also be understood. While structural and rural transformation interact with conditions for CSA initiatives, social factors need to be equally considered for their inter-relation with agency to pursue options based in their priorities and abilities. Socially inclusive and intersectional approaches provide a better understanding of the ways in which local and cultural contexts structure young people's opportunities and challenges. The social networks that youth are embedded in often mediate agency and their ability to secure resources, both of which will be important to support their ability to kickstart, participate in, and benefit from CSA initiatives (Bullock et al., 2020).

The Youth Strategy was supported in part by research in East Africa on young women and men's participation in agricultural decision making and trends in migration of youth. Research on "Youth Decision Making in Agricultural Adaptation to Climate Change" (Amsler et al., 2017) explored the extent to which young people in East Africa have decision making power in the implementation of agricultural adaptation practices due to climate change, Africa's "youth bulge" and their perceived disinterest in pursuing agricultural livelihoods. Using a comparative political ecology framework, focus groups discussions, interviews with key informant and individuals were conducted with a total of 155 rural youth and 42 policymakers and stakeholder representatives in selected sites in Tanzania, Kenya, and Uganda. Findings suggested that young people have an understanding of climate change and how to adapt to it, but they are unable to implement this knowledge due to lack of agricultural inputs and financial capital, insufficient land ownership, indirect participation in decision making and limited access to markets.

Initial research on the nexus between climate change, agriculture, international migration in East Africa and youth provides a starting point for expanding research and analysis in the continent (Bezu et al., 2020). Migration is related to climate trends in the region – East Africa will experience longer and more frequent droughts, suggesting that agricultural livelihoods will become more vulnerable in the coming decades. The region experienced significant growth in outmigration in the past few decades and climate change is likely to accelerate this trend. The quantitative analysis provides suggestive evidence to support this hypothesis, demonstrating that a higher number of average dry days for a country is positively correlated with higher stock of emigrants from that country. This research found that the

prospect of youth international migration from East Africa is high and likely to increase with climate change. This is a critical issue, given that the youth population in the region is not only the highest in the continent, but is more likely to be unemployed, less encumbered with family responsibilities and more educated than the previous generation. All these factors support the likelihood of higher youth migration in the context of climate change (Bezu et al, 2020).

Implementing and measuring gender-smart agriculture:

Toolkits and guidance

Experience in Phase I of CCAFS gender research was that there were few clear guidelines for addressing the needs of men and women in different environments and agricultural systems. To close this gap, CCAFS worked with partners to develop guidelines and toolkits for supporting this work, keeping in mind the importance of equipping practitioners and policy makers with tools and knowledge of innovative gender-transformative practices and intervention approaches. Key resources include the 2012 CCAFS and FAO Training Guide, “Gender and Climate Change Research in Agriculture and Food Security for Rural Development”. This manual was a product of collaboration around ten research tools tested in three regions in Bangladesh, Uganda, and Kenya. The guide is targeted to agricultural development professionals who need better information on the ways in which men and women adapt to and mitigate climate change and how best to address their needs when supporting the development of climate-resilient rural communities. It focused on generating more understanding and research on the intersection of climate change, gender, and agricultural development through participatory approaches in gender-responsive and socially sensitive research that considers social and gender inequalities. Tools for gathering information on how men and women adapt to and mitigate climate change are outlined, as well as on the dynamics of different groups of people, their priorities, views and needs. They are also intended to help users identify how they can do this type of research more effectively (FAO & CCAFS, 2013).

The Gender and Inclusion Toolbox, published in 2014, builds on the FAO-CCAFS manual, integrating social learning processes conducted by CCAFS with partners during 2013-2014. CARE International, the World Agroforestry Centre (ICRAF), and CCAFS, along with practitioners, scientists, farmers, NGO professionals and academics, developed tools and concepts through workshops, field tests, and reflection sessions. It was developed as part of a larger social learning approach in CCAFS (Harvey et al, 2013) which emphasises self-reflexive, iterative and shared learning platforms that seek to integrate diverse actors and sources of knowledge. The Toolbox was presented as an alternative to expert-driven, often top-down approaches, to support the participation of those left out of policy and

programming on climate change and adaptation; as well as to understand the different options women and men farmers pursue to reduce climate vulnerability. The Toolbox did this by highlighting participatory research using qualitative tools to collect, synthesize and analyze data, including participatory tools for context analysis and information on perceptions of wealth, empowerment, and overall socio-economic dynamics in a community. Guidance on how to explore issues of access, use and control over climate services is also provided, how co-benefits of climate interventions are perceived, and how qualitative data can be organised and analysed (Jost et al., 2014).

Other gender toolkits and guidance developed by CCAFS include⁶:

- A Gender-responsive Approach to Climate-Smart Agriculture: Evidence and Guidance for Practitioners (Nelson & Huyer, 2016), developed with FAO and the Global Alliance for CSA (GACSA)
- Step-by-step Process to Mainstream Gender in Climate-smart Agricultural Initiatives in Guatemala (Acosta et al., 2020)
- Participatory Identification of Climate-smart agriculture Priorities (Duong et al., 2016)
- Developing Participatory Agro-Climate Advisories for Integrated Agroforestry Systems (Simelton et al., 2018)
- Inclusion of Gender Equality in Monitoring and Evaluation of Climate Services (Gumucio et al., 2018).
- Gender-Climate-Hotspot Mapping (Chanana and Agarwal, 2020; Khatri-Chhetri et al, 2020)
- Gender Empowerment Index – CSVs (Hariharan et al, 2020) to measure empowerment of women and men from participation in climate-smart villages.

⁶ See also Nelson and Forsythe, 2021, Gender and Climate Resilient Agriculture: a review of practical resources in support of gender transformative change.

Conclusion and moving forward

Climate change research in general shows glaring gaps in understanding the different adaptive strategies and capacities of men and women, as well as the technologies, practices, and enabling environments that will empower women (FAO & CCAFS, 2013). An external evaluation of CCAFS gender research in 2020 found that the GSI-supported research has advanced gender research in relation to CSA, in the form of: conceptual frameworks and better understanding of gender and climate-smart agriculture (CSA); monitoring and learning; research on new themes such as climate information services (CISs); sharing of CCAFS gender and CSA research with donors, government policies, and global investments; and synthesis of lessons learned on gender and climate change to build a research agenda (CAS Secretariat, 2020).

The critical priority now is to focus on how to promote gender equality and increase resilience, with a need for further exploration of the long-term interconnections between resilience and gender equality. What are the longer-term effects of decreased work burdens on resilience and agency? Research is also needed on promoting women's agency and voice in different contexts through collective action.

Power relations between women and men, within households, communities, and countries, as well as among different groups in a community condition climate adaptation and resilience (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 & Kelleher, 2005). More research is needed on the gendered impacts of climate change on men, their experience of and responses to climate change, as well as integration of men into climate adaptation programs targeted to women (Kantor et al., 2015).

Related to this is the need to understand existing socio-cultural norms. Social norms cut across multiple dimensions and have been highlighted as underlying factors affecting men and women's vulnerability (access to and control of resources, intersections with individual characteristics like age, marital status, landholding, etc.), CSA adoption barriers (literacy,

limited agency, limited technical resources etc.) and factors affecting differences in adoption by men and women (access to extension, institutions, asset ownership and access etc.). They are also responsible for how women benefit or not benefit from CSA. Addressing these is therefore essential for ensuring more gender-equitable outcomes of adaptation.

A major challenge is to identify the context-specific technologies and supporting measures that may be needed. Which trade-offs and co-benefits from different combinations of options will benefit women and promote the transformation of agriculture and rural development in ways that promote gender equality (Locatelli et al, 2015)? There is a need to better understand the processes or enabling mechanism of achieving gender equality through CSA adoption (for example role of group-based approaches, capacity building, training etc. In addition, understanding gender dynamics in terms of decision making on CSA adoption, implementation and distribution of benefits also needs more attention.

Several specific research areas are critical to the promotion of gender equality and women's agency and resilience in climate adaptation and mitigation:

- Use of CSA technologies and practices to reduce women's work burden.
- Access to agro-climatic information; and
- Increasing the participation of women and men in the formulation of climate policy as well as models for gender-responsive climate policy.
- What constitutes inclusive scaling: Who and what is it for? How do scaling strategies consider the capacities, priorities, and goals of all groups in society (Huyer, et al., 2021a; Huyer, et al., 2021b)?

Appendix

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