TRAINING GUIDE

WOMEN AND CLIMATE-SMART AGRICULTURE:

A Programming Guide for Eastern and Southern Africa

Poverty-Environment Action
for Sustainable Development Goals

UN environment programme

UN WOMEN

01

East and Southern Africa Regional Office
UN Gigiri Complex, UN Avenue;
Block M, Ground Floor
P.O. Box 30218- 00100 Nairobi, Kenya
Tel: +254 20 762 4778
africa.unwomen.org
Email: esaro.publications@unwomen.org

unwomneafrica
unwomneafrica
unwomen
unwomneafrica

TRAINING GUIDE

WOMEN AND CLIMATE-SMART AGRICULTURE:

A Programming Guide for Eastern and Southern Africa

UN WOMEN EAST AND SOUTHERN AFRICA

Nairobi, November 2022

UNDP

Poverty-Environment Action
for Sustainable Development Goals

UN environment programme

UN WOMEN

TABLE OF CONTENTS

ACRONYMS 06

EXECUTIVE SUMMARY 07

1 INTRODUCTION 10

1.1 Gender, climate change and agriculture 10
1.2 Leveraging development co-benefits between gender equality and climate change management 11
1.3 CSA, sustainable agriculture and Agro ecology 12
1.4 The gender gap in agricultural productivity 12
1.5 Review of ICT programmes and platforms with gender considerations 14
1.6 Purpose of this guide 14

2. GENDER AND CLIMATE-SMART AGRICULTURE IN AGRICULTURAL SUBSECTORS 17

2.1 Gender and CSA in soil and water management 17
2.2 Gender and CSA in crop production 21
2.3 Gender and agricultural machinery and production technologies 22
2:4 Gender and CSA in forest management and agroforestry 27
2.5 Gender and CSA in fisheries and aquaculture management 30
2.6 Gender and CSA in post-harvest handling 34
2.7 Gender and CSA in value addition 37

3. ENABLING ENVIRONMENT FOR GENDER-RESPONSIVE CLIMATE-SMART AGRICULTURE PROGRAMMING 46

3.1 Strategic value of CSA to UN Women 46
3.2 Potential partners 47
3.3 Financing strategy 47
3.4 Programme planning and tools for delivery 48
3.5 Integrating gender equality principles 48
3.6 Measuring the cost of gender gap in agricultural productivity 49
3.7 Cost of Gender Gap Analysis in Agricultural Productivity 49
3.8 Policy Implications 49
3.9 Challenges and lessons learned 51

4 INFORMATION AND COMMUNICATIONS TECHNOLOGY FOR WOMEN'S ECONOMIC EMPOWERMENT 54

4.1 Women and ICT as a tool for the collective empowerment of women in CSA 54
4.2 Experience with and application of ICT in CSA: women's perspective 54
4.4 Addressing structural problems 59
4.5 Main feature overview (as of January 2021) 60
4.6 BfW Journey and Toolkit 61

ANNEXES **63**

Annex 1: Critiques of the climate-smart agriculture concept 64

Annex 2: Additional climate-smart agriculture practices and approaches

Annex 3: Best practices in climate-smart agriculture and information and communications technology 70

Annex 4: Good practices in designing gender-responsive climate-smart agriculture programmes 73

Annex 5: Actors and partnerships in climate-smart agriculture 74

Annex 6: Potential sources of funding for climate-smart agriculture 77

Annex 7: Key climate-smart agriculture practices in east africa 81

Annex 8: Women, agriculture and ict: solutions and barriers 82

Annex 9: Economic empowerment of women through climate-sensitive agriculture: two case studies 87

Annex 10: Recommendations for improving the buy from women platform 90

RECOMMENDATIONS FOR IMPROVING THE BUY FROM WOMEN PLATFORM **90**

REFERENCES **94**

ENDNOTES **101**

ACRONYMS

AKRSP	Aga Khan Rural Support Programme
AMCEN	African Ministerial Conference on the Environment
BfW	Buy from Women
CGIAR	Consultative Group on International Agricultural Research
CIF	Climate Investment Funds
CIFOR	Center for International Forestry Research
COMESA	Common Market for Eastern and Southern Africa
CSA	climate-smart agriculture
EAC	East Africa Community
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GHG	greenhouse gas
GPS	global positioning system
ICT	information and communications technology
IFAD	International Fund for Agricultural Development
IT	Information technology
LDCF	Least Developed Countries Fund
MDB	multilateral development bank
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental organization
REDD	Reducing emissions from deforestation and forest degradation
REDD+	Reduce emissions from deforestation and forest degradation, and foster conservation, sustainable management of forests and enhancement of forest carbon stocks
SADC	Southern African Development Community
SCCF	Special Climate Change Fund
SDG	Sustainable Development Goal
SFM	Sustainable forest management
SMS	Short message service
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-REDD	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation
WOUGNET	Women of Uganda Network

EXECUTIVE SUMMARY

Climate change, gender and climate-smart agriculture

In the face of climate change, addressing food insecurity and malnutrition is a major challenge that calls for an increase in agricultural production. Rain patterns are changing the amount of available water, mean temperatures are varying more, and extreme events are becoming more pronounced. In addition to rising sea levels and salinization, these changes will all have profound effects on agriculture, forestry and fisheries. Climate-smart agriculture (CSA) is one of UN Women's three flagship programme initiatives that aim to address all these challenges.

CSA is an approach that addresses food security and climate challenges jointly. The approach has three pillars:

- Sustainably increase agricultural productivity and incomes,
- Adapt and build resilience to climate change, and
- Reduce and/or remove greenhouse gas emissions where possible [1]

Climate-smart interventions in agriculture require substantial investments and innovative financing to support the transformational changes needed to maintain or increase agricultural productivity while using fewer resources and build the resilience of vulnerable farming communities to the impacts of climate change while also reducing or removing greenhouse gas emissions. CSA was identified as a strategic priority in the UN Women 2018–2021 Strategic Plan. It has the potential to address the gender gap and cost in agriculture, which can have transformational impact on women's lives and can unleash substantial development co-benefits between gender equality and climate action.

The strategic plan supports gender action under the United Nations Framework Convention on Climate Change (UNFCCC). Through this initiative and partnership, UN Women helps countries establish gender-responsive CSA programmes and strengthen resilience through an integrated approach that addresses the structural barriers women face within the context of changing climate. UN Women aims to ensure that gender is fully integrated into agricultural productivity, adaptation, and reduction and/or removal of greenhouse gas (GHG) emissions.

A very wide range of interventions are required to achieve tangible improvement in women's lives through CSA. Because of this UN Women has a strategy of establishing wide-ranging partnerships with governments and academic and research institutions – including the Food and Agriculture Organization of the United Nations, the World Food Programme, the International Fund for Agricultural Development, and other public and private organizations working in this area.

Gender-responsive approach in CSA

The UN Women framework prioritizes four outcome areas:

1. Gender-responsive climate-smart policies and increase women's land tenure security by building political will and addressing discriminatory social and customary norms.
2. Increase women farmers' access to climate-smart information by strengthening the capacity of agricultural extension workers and ensuring that climate information services are accessible, timely and user-friendly for women farmers.
3. Increase women farmers' access to finance so they can invest in CSA, by encouraging financial institutions to consider gender in their lending practices including through directed lending and credit enhancement mechanisms. A changing climate requires a shift in focus from borrowers' credit capacity and traditional loan guarantees towards risk management and sustainable financing.
4. Increase women farmers' access to higher-added value markets by supporting women farmers to form cooperatives and strengthening their capacity to participate meaningfully in the green value chain.

Using ICT to increase women's uptake of CSA

Across the CSA strategies, there are significant opportunities to leverage the role of ICT in all CSA subsectors. Technology tools including geographic information systems and remote sensing are used to improve soil and water management for the benefit of women and other smallholder farmers. Best practices also exist in multiple subsectors: For **crop management**, ICT facilitates efficient management of small farms and emerging ICT such as precision agriculture, handheld computers and mobile mapping can address agriculture-related challenges for small-scale farmers, facilitate market access to local and resilient varieties and sustainable production. ICT will support women engaged in livestock and rangeland production; for example by helping them find out the current or prevailing livestock prices. ICT can also promote forest governance and reduce emissions from deforestation and forest degradation. ICT also has potential to advance women's economic empowerment in **fisheries and aquaculture**, including by improving marketing and the use of mobile networks to provide daily fish prices. ICT also offers wireless sensors that can monitor oxygen, tidal current, temperature levels, fish behaviour and water conditions.

As seen in the examples above, ICT has enormous potential to enhance women's economic empowerment in CSA, but even with ICT's predominance in agriculture, women still systematically have less access than men to land, extension services, credit and technology. But ICT can help solve the numerous challenges that women face, including limited land rights, extension and research, technology and credit.

There is considerable evidence of ICT helping in the adoption of CSA and leading to women's economic empowerment, including its use in providing market information, as in the Ethiopian Commodity Exchange; the Mozambique agricultural marketing service; M-PESA, the KenCall Farmers Helpline and Mali Shambani in Kenya; MAKWACHA in Malawi, Cocoalink and Esoko and Radio Ada in Ghana. Other examples include the Kenyan Kilimo Salama (safe farming) microinsurance schemes, waterhole monitoring for livestock in north-eastern Kenya and southwestern Ethiopia, the Global Information and Early Warning System on Food and Agriculture, M-Farm in Kenya, the Reuters Market Light ICT Initiative in India and the WOUGNET in Uganda.

Even with these numerous platforms, not all forms of ICT are equitable. Men have more access than women, and a rural–urban divide exists. There is also a gender divide in access to and control and use of ICT tools, mainly because of cultural and social limitations, time and mobility constraints, finance and control, literacy and education, the high cost of ICT deployment, lack of basic infrastructure and unfamiliarity with ICT.

To overcome these barriers to women's access to and use of ICT and remove this gender divide, at least in the agricultural sector, it must be ensured that the content is adapted to the needs of men and women; the process of design is inclusive and ensures participation of men and women at all stages; gender is considered at the individual level, the organizational level and the enabling environment level; gender issues regarding partners' involvement in the initiative are analysed; there is the right mix of men and women as leaders; economic, social and environmental sustainability is ensured; a gender analysis is conducted to identify opportunities on how ICT can enhance current practices; direct relationships are developed with male and female farmers; ICT is used to complement existing information channels; and employment opportunities are provided for women as service suppliers in agricultural-related ICT services.

Buy from Women (BfW) platform

The UN Women BfW platform is an ICT innovation that offers opportunities to unlock the business potential of traditionally marginalized and isolated women by (i) providing easy, mobile-enabled access to CSA information and services, (ii) building a digital track record and credit profile to increase access to finance, and (iii) connecting farmers to national, regional and global supply chains to improve access to markets. The platform has been piloted in Rwanda, Mali and Senegal and aims to increase access to markets for women. Since its piloting in Rwanda, the platform has attracted interest from national governments, United Nations organizations, other development partners and UN Women country offices. It can be used in all UN Women CSA programming and at all country offices that are introducing CSA. Yet, whether for BfW or for any platform designed to empower

women economically, there are considerations when developing or planning an expansion, including designing with the user in mind; designing for scale; understanding the ecosystem; sustainability; data-driven; open-source, open standards and open innovation; ability to improve and reuse; addressing security and privacy and being collaborative.

BfW is a multilanguage, open-source platform that easily integrates with external applications and can be used in low-connectivity environments. It aims to support the implementation of UN Women's four programmatic CSA priorities and offer greater opportunities for women living in rural areas. The main BfW platform features have been developed to support the four CSA programme pillars:

- **Access to land:** The platform can map land plots, provide supporting documentation on the size and location of the land being farmed and calculate productivity and potential profits.
- **Access to finance:** The platform can be connected to partner institutions providing loans or microcredits to female farmers. Records from the platform can be used as supporting documentation for farmers needing to show evidence of the extent of their production and monthly or yearly profits. The platform can also be connected to mobile wallets that can provide farmers with digital banking services.
- **Access to information:** Female farmers can use the platform to access real-time information or training and capacity-building programmes to improve their knowledge of and skills in farming, extension services, markets, weather and other things.
- **Access to market:** The platform can help women with reaching new markets and buyers, replacing cash by using digital transactions and identifying new business opportunities.

The BfW platform aims to provide new tools to address the four structural barriers identified in the UN Women CSA programme and complement the more traditional interventions planned under that programme. In countries without a digital platform to provide similar services, the BfW platform aims to develop tailored ICT solutions for female farmers that cover multiple aspects of the agribusiness supply chain, are open-source and can use solutions from other BfW pilot countries.

1 INTRODUCTION

1.1 Gender, climate change and agriculture

In the face of climate change, addressing food insecurity and malnutrition is a major challenge for agricultural and food systems. Variability in the patterns, distribution and quantity of rainfall; increasing temperature; the increased frequency and intensity of extreme events; rising sea levels and salinization will all have profound effects on agriculture, forestry and fisheries (FAO, 2013a).[1]

Climate change has hit the agricultural sector hard. Current food systems,[1] approaches and practices contribute to greenhouse gas (GHG) emissions and addressing this must therefore be part of the effort to reduce global warming.[2]

Ongoing processes of climate change are likely to affect male and female farmers differently, and they may adopt different coping and adaptation strategies in response.

Changing land-use practices, soil degradation and climatic variability have reduced productivity. Although the agricultural sector can play an important role in climate change adaptation and mitigation, environmentally sustainable and climate-smart approaches to farming have not yet been adopted in most of the developing world. Frequent and prolonged dry periods may prompt farmers to stop growing traditional cash crops in favour of more drought-resistant, reliable and early-maturing food crops which are predominantly grown by women. Consequently, the sale of crops previously directed to household use can contribute to food insecurity. Moreover women, who often possess less knowledge, experience more climate-related challenges to productivity than men.[3] It is likely that men, through land ownership and control of resources, are better able to adapt to climate variation and natural disasters. Women and poor communities characteristically manage more fragile or marginalized land that is subject to floods, landslides, degradation and erosion at the same time, limited financial resources prevent them from acquiring high-quality soil-replenishing amendments.[4]

Because men have greater bargaining power, they are more likely than women to influence adaptation strategies in male-headed farming households.

The time available for agricultural food production has been affected by climate change in that men travel further to find pasture for livestock, and women walk for longer distances to fetch water and firewood.

Gender-differentiated farm activities and knowledge therefore contribute to the distinct nature of how women and men engage with the natural resources and in how they manage their environment.[5] As a result, climate change affects male and female farmers differently, and in response they may adopt different coping and adaptation strategies.

Because these constraints contribute to the gender gap in agricultural productivity, systematically addressing them is one of the most effective ways of increasing the climate resilience of households, communities and nations.[6] This would benefit both gender equality and climate change management. The following section outlines areas in which there are co-benefits between climate change and gender equality that can be exploited to ensure gender-responsive adaptation to and mitigation of climate change.

1 Food systems are the sum of actors and interactions along the food value chain – from input supply and production of crops, livestock, fish and other agricultural commodities to transportation, processing, retailing, wholesaling, preparation of foods to consumption and disposal. Food systems also include the enabling policy environments and cultural norms related to food. Ideal food systems would be nutrition, health and safety-driven, productive, and efficient (thus able to deliver affordable food), environmentally sustainable and climate-smart and inclusive (IFPRI,)

1.2 Leveraging development co-benefits between gender equality and climate change management

Mitigation and adaptation must be accelerated to increase agricultural productivity in the face of current climate change trends. But these responses should take into account socioeconomic development, food security and sustainable development. It is necessary to create synergies and development co-benefits between climate action (SDG 13) and gender equality (SDG 5). These are pre-conditions for the implementation of the Paris Agreement and the 2030 Agenda for Sustainable Development. Human rights require adherence to gender equality if development and women's economic empowerment are to take place. The co-benefits approach advances the view that actions to achieve the goal of a temperature rise of less than 1.5° C (climate mitigation) bring multiple benefits, including for gender equality and women's empowerment. Similarly, efforts to achieve gender equality and women's rights and empowerment contribute to more effective climate response and action. Synergies thus exist between climate change and gender equality, and they are found in a number of areas, as noted below.

1.2.2 Climate-related disasters

The link between climate change and gender equality can be seen in climate-related disasters where women and girls are normally more affected by climate-related disasters than men and boys due to gender inequalities and discrimination.[2] Economic disruptions following disasters tend to affect women more than men because women are normally employed in less secure environments.[7] Conversely, women also disproportionately play a greater role in building back after disasters that have impacted family and community levels.[8]

But women's contribution in disaster risk management is often marginalized and not acknowledged. Their role usually goes unmeasured, unnoticed and unsupported. Yet women play a big role as the first to respond and in building resilience in post-disaster situations. Often, they are responsible for attending to post-disaster needs.

2 https://www.unwomen.org/en/news-stories/explainer/2022/02/explainer-how-gender-inequality-and-climate-change-are-interconnected

Efforts to achieve gender equality and women's rights and empowerment contribute to more effective climate response and action.

1.2.3 Women's economic empowerment through climate-smart agriculture

Climate change in agriculture reinforces gender equality constraints that face female farmers. Globally, women make up 43 per cent of the workforce in agriculture and ensure food security in households and communities.[9] Closing the gender gap in access to these inputs and in agricultural productivity can reduce poverty and gender equality. Over a 10-year period approximately 238,000 people in Malawi, 119,000 people in Uganda and 80,000 people in Tanzania are likely to be pulled from poverty every year through closing the gender gap in agricultural productivity.[10] This may translate into substantial changes in the proportion of the population living below the poverty line.[11]

Female and male farmers' access to productive resources ensures food security, climate management and gender equality. "This supports the realization of SDGs"[12], yet the changing climate diminishes the window of' opportunity to act.[13]

Climate change worsens the existing disadvantage faced by female farmers in accessing inputs such as agricultural extension services and long-term affordable finance. Climate change also leads to water and fuel scarcity, which increases the burden on these women. The gendered effects of climate change have a massive impact on the women that are most reliant on land and natural resources for their livelihoods.

Climate-smart agriculture combines technologies and practices to meet food security goals while ensuring adaptation to and mitigation of climate change.

1.3 CSA, sustainable agriculture and Agro ecology

There are three objectives of CSA[3] that are critical to women and their relations with markets, men, and modes of production across the African continent:

- Increase sustainable agricultural productivity in support of equitable increases in food security, income and development
- Increase adaptation and build resilience to climate change from farm to national levels
- Provide options for the reduction of greenhouse gas emissions from agriculture.

CSA means having access to agricultural technologies, practices and approaches that respond to a constantly changing climate. CSA also deals with early warning systems, and insurance to reduce risk. It supports women in agriculture to deploy more effective tools, technologies and infrastructure; take part in decision-making to ensure suitable policy prescriptions; and enables institutions for ensuring resilience; and achieving sustainability in resource management in value chains.[14]

CSA was developed as a flagship initiative by UN Women to facilitate gender-responsive CSA work around the world – particularly in the developing countries. The aim is to support women's adaptation to climate change in terms of their food security and livelihoods. The **Global Flagship Initiative on Climate-Smart Agriculture** is premised on that fact that if female farmers have rights to land and secure land tenure; equal access to productive resources, services and technologies for sustainable farming; the financial capacity to invest and participate fully in green value chains and markets, they will be economically empowered and resilient in a changing climate because the root causes and drivers of gender gaps in agriculture will have been removed.

CSA aims to achieve:

1. Healthy people – secure, safe, affordable food and nutrition that meet the priorities of women as growers, producers, consumers, and care providers
2. Healthy governance structures and systems that provide for women's access to and responsibility for soils, land, natural capital, stewardship of biodiversity and habitat systems and shared co-benefits that are equitable and fair
3. Healthy planetary systems that support pro-environmental practices including low carbon food supply chains, circular economy and sustainable resource use
4. Healthy labour systems that promote inclusive policies for livelihoods and incomes, that protect assets of poor farm labourers and address the intersection of poverty and climate change
5. Healthy mixed farming systems that can deliver on the 2030 goals, reduce GHG and protect the public commons for future generations.

Natural assets	Social assets	Economic assets:
Water	Norms	Finance
Seeds	Networks	Technologies
Land	Clout	Insurance
Fuel	Governance	Markets

CSA supports stakeholders to incorporate climate change in planning and investment processes. It bridges the science and policymaking gap, facilitates action on climate change and supports financing mobilization.[15]

1.4 The gender gap in agricultural productivity

Beginning in 2015, the UN Women East and Southern Africa Regional Office, the Poverty-Environment Initiative of the United Nations Development Programme, United Nations Environment Programme and the World Bank sought to understand the reasons underlying the gender gap in productivity and to increase women's resilience in the face of climate change. To this end, a set of quantitative and qualitative studies was produced on the cost and causes of the gender gap in agricultural productivity in five African countries: Malawi, Ethiopia, Tanzania, Rwanda and Uganda[16]. In these studies, crucial common challenges causing the gender gap in agricultural productivity were identified and regional recommendations made. The main cause was identified as social and cultural norms and social institutions – i.e. social and cultural barriers.

3 FAO, 2013

Constraints related to social-cultural norms and social institutions: Labour is one of the most important functions of agricultural productivity. However, the basic human needs of shelter, food and water security must be met for successful production. For women farmers, the labour constraint is double-pronged, with competing reproductive unpaid work and limited access to male family labour support. Agricultural production is one of numerous crucial tasks they perform, as they are also responsible for unpaid reproductive social responsibilities, reinforcement of shelter, and provision of hygiene and sanitation. The terms and conditions under which this latter work takes place shapes women's capacity to work in economically productive employment (i.e. farming). Moreover, social norms and values that generate asymmetrical power relations between men and women result in gender-based differences in the use of on-farm labour, as well as access to, control of and use of cash income.

Cumulatively, the result is gender gaps in agricultural productivity and in agricultural incomes. These gaps in turn reinforce asymmetrical power relations between men and women. Economic production and productivity are themselves functions of reproductive social responsibilities which women perform and, in some cases, gender-based violence enforces.

These social norms and values create a major imbalance of power within male–female relationships. Not only do women have fewer hours in which to tend their farms, they also have less control over the use or misuse of household income and less access to improved farming practices and the tools required. Cash from women is prioritized for household expenditures and maintenance rather than the seeds, fertilizer, pesticides and CSA techniques needed to grow more crops. Thus, social norms and values limit the capacity of female members of a household to undertake economic production, which directly affects agricultural productivity and has important implications for gender equality and women's economic empowerment. Gender differences in access to critical farm inputs are a consequence of social norms and values.

Unpaid care and domestic work create an opportunity cost for women that directly affects their agricultural performance.

Access to male family labour is one of the largest contributors to the gender gap especially in Ethiopia, Malawi and Tanzania. Typically, women have less access to male family labour in cases of divorce, separation, widowhood and migration. Women are also subjected to social norms around gender that make it very difficult to hire male wage labour.

In addition to the social norms, or because of them, there are other factors responsible for the gender gap in agricultural productivity. These include the following:

- **Constraints related to impacts of climate change and mitigation and climate-smart agriculture techniques.**
- **Constraints related to land access and security of land tenure.** Insecure land tenure is considered one of the most important barriers preventing women from investing in climate-resilient agriculture-related activities. This is mainly because of their lack of control over natural resources (especially land), which denies them power to make decisions on land use and development. They also lack the ability to use the land as necessary collateral to access investment capital.
- **Constraints related to access to finance and other mechanism for financing.** Women often have limited ability to access finances they need to purchase improved inputs such as seeds, fertilizers and other technologies to increase productivity. Rural financial programmes are usually largely designed and implemented with a male head of household in mind and often fail to recognize that women have their own financial needs and constraints and are active, productive, engaged economic agents in their own right. Microfinance institutions geared towards women often have interest rates that deter or discourage women because of high risk.
- **Constraints related to access to extension services and hired male labour.** Women often miss out on extension training and capacity

development because of time-use conflicts with competing domestic activities. Extension training messages are normally biased towards smallholders and commercial farmers, the majority of whom are men. Moreover, modes of communication and the structure of extension service delivery are not favourable to women, who have lower literacy levels. Men also predominantly deliver extension services,[4] and although there are efforts to support the use of information and communications technology (ICT) to transmit information to farmers, these remain underdeveloped.

This is mainly because women are often involved in subsistence agriculture and sociocultural duties, and less integrated into value chains than men. Since they are less mobile, they also have less access to markets, and social norms limit their interaction with value chain actors.

- **Constraints related access in high-value inputs and agricultural equipment.** Female-controlled plots have relatively lower yields because important inputs such as inorganic fertilizer and pesticides are used mostly on male-controlled plots. Women are as productive and are technically efficient as men once they have access to inputs. Reallocating factors of production in a more efficient manner has the potential to increase output by 6 per cent. [17]
- **Limited access to high-value crops and markets.** Men typically farm high-value crops that include cash crops and exported crops, while women are more likely to plant subsistence crops due to inequitable access to cash crops. The gender differential in the high-value crops accounts for the highest proportion of the overall gender gap in agricultural productivity; it is as high as 28 per cent in Uganda. The gap is caused by cash and time constraints of unpaid care and domestic work, plot size and/or ownership, and social norms that create expectations that women work jointly on plots owned with their husbands. These norms reduce women's likelihood of investing in higher-value crops on their plots of land.
- **Gaps in agribusiness and challenges with marketing.** Rural female farmers tend to be at the bottom of the value chain, do not benefit from the full value of their production and are disadvantaged especially in the most financially rewarding stages of the value chain – processing and marketing

1.5 Review of ICT programmes and platforms with gender considerations

National and regional ICT initiatives have been developed to support smallholder agriculture players, especially women. Constraints posed by social and cultural gender roles and relationships are enormous and create obstacles that limit women's access to, use of and benefits from ICT. In recognition of this, regional organizations have formulated ICT initiatives linking farmers to the market. The guide also explores the Buy from Women (BfW) platform developed and piloted by UN Women.

This guide creates a single source for sectoral and programming information for UN Women's intervention in CSA.

1.6 Purpose of this guide

UN Women works to eliminate the conditions that create the gender division in sustainable development and poverty reduction. These gaps are reflected in agricultural productivity, and climate change has made them worse. Climate change affects men and women differently, and their responses also differ especially in safeguarding food security and livelihoods.[5] For example, women are important food producers and providers, though with limited access to and control of resources. GAdditionally, given their central role in agriculture, they women can be formidable agents of social change.

FAO estimates that more than 100 million people would be lifted out of poverty if women had the same access to and control of resources as men[18].

4 FAO estimates that only 15 per cent of extension personnel globally are women, and female farmers in many cultural contexts may not be comfortable interacting with male extension workers, or may even be prohibited from doing so.

5 https://ccafs.cgiar.org/sitesdefault/files/assets/docs/fao-ccafs-brief-gender-web.pdf

As such, gender should be considered in responses to climate change in agriculture. The World Bank contends that CSA won't be effective, equitable or transformative, unless they take gender into account. Together, climate change and gender-differentiated adaptation to climate change are important for poverty reduction in Africa because productivity-driven agricultural output growth has a strong effect on poverty reduction. Therefore, CSA strategies and investments and agricultural policies in Africa should consider differences in resources available to men and women and how they affect agricultural productivity, environmental sustainability, and community resilience to climate variability. [19] The adoption of CSA as an approach to eliminate these gaps is significant for gender equality and women's economic empowerment.

This guide targets project developers for UN Women and other partners. It creates a single source for sectoral and programming information for UN Women's intervention in CSA. It outlines how gaps in agricultural productivity between men and women can be closed by integrating gender mainstreaming into CSA. There is thus strong justification for UN Women's engagement in CSA alongside other specialized UN agencies such as FAO, the International Fund for Agricultural Development and the World Food Programme, and the IUCN, because UN Women works to reduce unpaid care and agriculture work and ensure decent work for all women to close the gender gap in agriculture productivity.

Consideration of gender in the design and implementation of effective CSA programmes is the main value addition to this strand of development. Also, given the importance of ICT in enabling effective CSA, its connection to gender-responsive productivity is explored in the guide. In particular, the UN Women's approach to mainstreaming the BfW platform into its overall CSA programming is elaborated in the guide.

Examples of how other ICT-based innovations have been integrated into other organizations' CSA programmes are also provided.

As stated, CSA has three pillars – productivity, adaptation and mitigation – each of which is addressed at different technological, organizational, institutional and political levels, with different entry points (enabling environments, systems approaches and practices). The manual guide considers how these three pillars apply to the different agricultural subsectors. It also delves into the contents of the UN Women's flagship programme initiatives and how the agency supports countries in developing their own national mitigation and adaptation plans.

The manual guide is organized as follows:

- **Chapter 1: Introduction.** This chapter presents background information, including a discussion of key concepts, and offers the rationale for this guide and its use.
- **Chapter 2: Gender and climate-smart agriculture in agricultural subsectors.** This chapter makes up the bulk of the manual. It reviews case studies, best practices, and emerging opportunities across a range of agricultural subsectors to showcase the potential of gender-responsive CSA. FAO, CCAFS and World Bank publications have established literature on different practices to be used in conjunction with this guide.
- **Chapter 3: Enabling environment for gender-responsive climate-smart agriculture programming.** This chapter establishes gender-responsiveness in CSA and UN Women's role in its development and implementation, and the critical preconditions that facilitate its development as a strategy for women's economic empowerment.
- **Chapter 4: Information and communications technology for women's economic empowerment.** ICT is discussed as a cross-cutting tool and central mechanism for ensuring that CSA is gender-responsive. The chapter ends with a discussion of the BfW platform.

The chapters are complemented and supplemented by several annexes, which further delineate best practices, partners, and funding opportunities in developing and implementing gender-responsive, ICT-enabled CSA.

END NOTES

Chapter 1

1. FAO 2013a.
2. Vermeulen, Campbell and Ingram 2012.
3. Nellemann, Verma and Hislop 2011.
4. Mary Robinson Foundation 2015.
5. UMFULA n.d..
6. Glemarec, Qayum and Olshanskaya 2016.
7. UNFCCC 2007.
8. Ibid.
9. SOFA Team and Doss 2011.
10. Sheahan and Barrett 2014.
11. UN Women, UNDP-UNEP PEI and World Bank 2015.
12. Glemarec, Qayum and Olshanskaya 2016.
13. UN Women 2016b.
14. El-Fattal 2012.
15. Saj et al. 2017.
16. Udry 1996.
17. The first of these covered Malawi, Tanzania and Uganda (UN Women, UNDP-UNEP PEI and World Bank, 2015). The most recent study in the series covered these three countries as well as Ethiopia and Rwanda (UN Women and UNDP-UNEP PEI, 2018).
18. FAO 2011.
19. African Development Bank 2016

2. GENDER AND CLIMATE-SMART AGRICULTURE IN AGRICULTURAL SUBSECTORS

Agriculture employs more than two -thirds of the population in sub-Saharan Africa and is the primary source of rural employment and income for women in Africa[6]. There is, however, inequality between women and men farmers in terms of land distribution, exploitative tenancy and labour relations, access to credit and markets. All these factors affect women's economic empowerment in the sector. In developing countries, an average of 43 per cent of the agricultural labour- force is made up of women, although in many countries this proportion may be higher.[7]

Recurring stresses and shocks caused by environmental degradation and climate change increasingly challenge the agricultural sector, hampering productivity and demanding innovative solutions. Numerous approaches and practices are used across the three climate-smart agriculture (CSA) pillars in the different agricultural subsectors – and women are involved in all of them, as outlined in the following sections. Additional CSA practices and approaches are outlined in Annex 2. Key CSA-related practices prevalent in East Africa are summarized in Annex 7.

2.1 Gender and CSA in soil and water management

Almost 70 per cent of all water withdrawals globally and up to 95 per cent of water use in developing countries is accounted for by agriculture, making it the biggest user of water. Water ensures food and nutrition security; reduces undernourishment, especially when people depend on local agriculture for food, services and income.[3] However, there is a gender difference in access to water. Because women have limited access to water, agricultural services, markets and, and employment opportunities, they face serious constraints in increasing production and productivity. Women are seldom involved in decision-making in water management and water for production[8].

Climate change effects on agriculture are changing the water cycle, and this is having an impact on women, who are often most affected by water stress because of their gender roles, as explained below. It is important, therefore, that the design of CSA strategies should be viewed through a 'water lens', as well as a gender lens'. Climate change has affected rain-fed and irrigated agriculture because of changes in the amount of rainfall, through increased crop evapotranspiration and, and variations in river run-off and groundwater recharge. These effects need to be considered in relation to other factors, including degradation of water quality, increased water demand from all sectors, and increased competition for water. There are several policies, investments, management, institutional and technical factors that increase adaptation to climate change in the water sector.

6 UN Women Report, 2015-2016

7 World Bank GroupUN Women 2012 (https://www.unwomen.org/en/news/in-focus/commission-on-the-status-of-women-2012/facts-and-figures)

8 Coulter, J.E. et al. 2019. Giving women a voice on decision-making about water: barriers and opportunities in Laikipia, Kenya

2.1.1 Soil and water management in CSA

Scarcity of water in agriculture is one of the most important constraints to productivity, and it also lead to tensions and competition for water.5 Increasing the flexibility and reliability of access to water for farmers, especially women, is of prime importance. Uncertainty about the availability of water is the cause of most of the wasteful behaviour on farms. Sound management of the interrelationships between soils, crops and water can increase soil's organic matter, improve the soil's ability to retain nutrients and water, and enhance soil biodiversity. Integrated management practices can create optimal physical and biological conditions and can lead to sustainable agricultural production (including food, fibre, fodder, bioenergy and tree crops, and livestock).

To minimize the effects of water stress, CSA practices such as harvesting techniques and storage of water while combining the use of groundwater and canal irrigation water, can increase irrigation water efficiency. Other practices, such as using drought-resistant, early maturing and high-yielding crop varieties with greater diversification in agricultural practices will reduce risk and increase the resilience of farming systems. However, in many cultural settings, some of these economic activities are the preserve of men, which disadvantages women.

In cropping systems, good management practices that consider women's unique vulnerabilities include the following.

- **Direct seeding (no tillage).** This entails use of farm machinery over crop residues (mulch) and cover crops. Women with minimal farm machinery may find this an unattractive option for practical soil management. However the alternative, burning crop residues, increases water loss through soil exposure to direct temperatures.
- **Integrated soil health management (inorganic and organic).** In intensified cropping systems, integrated soil health management is a strategy that uses organic matter such as mulch, compost, crop residues and green manure in combination with mineral fertilizers to improve on macro- and micronutrient deficiencies. Crop rotations with legumes, diverse cover crops and green manures can improve soil fertility. Retention of organic matter practice improves the soil's nutrients and water retention capacity. Women can use organic matter from domestic refuse, making this option attractive as they have limited resources to buy inorganic fertilizers.
- **Precise management of soil amendments.** In organic and low-external-input agriculture, this entails the use of manure and nitrogen-fixing plants to enhance soil quality and provide nutrients. Use of planting stations e.g., basins in Zambia and Zimbabwe or Zai systems in western Sahel where soil amendments are precisely added and concentrated, is a technique for climate change adaptation.
- **Soil land management practices.** Physical conservation structures to prevent soil erosion such as contour bunds, terraces and simple drainage can be physically difficult for women to construct. However, contour farming, strip cropping and buffer or grass strips barriers are methods that conserve soil.

Importance of climate-smart soil and water management and challenges for women

Enhancing women's participation in water management decision-making and supporting female farmers proactively increases productivity, and enables gender equity in soil management.[6]

Equitable input ownership is important in enhancing agricultural production and sharing the benefits of farmers' efforts. Women are as efficient irrigators as men, provided they have equal access to resources and human capital. Constraints on water access and control are often rooted in institutional and social structures.[7]

Land tenure differences are another reason for women's limited access to water and services.[8] Women usually have smaller land plots than men, and limited access to water resources. This often forces women to travel for long distances in search of water.[9] Land tenure insecurities may discourage women from making investments that increase water access, limiting their agricultural productivity[10] Women's participation in water users' and farmers' organizations in most rural areas

is also limited. In such cases, decision-making is limited. Male members often are not interested in improving women's access to resources and services or broadening their involvement in local organizations.[11] This reduces participatory and equitable decision-making on water resources at both local and national levels. There is also limited sex-disaggregated data, which increases the gap in women's participation in water management.

Possible interventions to improve climate-smart water and soil management for women

Governments and policymakers should address discriminatory institutional policies and practices that hinder social inclusion in water for women to ensure that rights for men and women are secured.12 Political and economic systems that restrict women or exclude poor farmers from gaining fair and affordable access to water as a resource and as an infrastructure service should be challenged, and data- collection should be improved. There is also a need for greater understanding of how these systems work. The Food and Agriculture Organization of the United Nations (FAO) recommends using fixed gender quotas and building leadership capacity for women so they can participate in policymaking and water organization leadership as approaches to ensure gender equality in water management. Such efforts promote women's socioeconomic empowerment by increasing women's control over the means of production, ensuring economic independence and that users are involved in decision-making at the local level.

To address the lack of sex-disaggregated data, statisticians and researchers need to incorporate and develop guidelines that take gender issues (such as cost, access etc.) into account in agricultural censuses and databases to support agricultural water management.[13] Other approaches to increasing women's access to water include women's civic training programmes related to water and land rights. Such training provides support to the rural poor, especially women, when it comes to their natural resource rights. It also increases capacity for women to invest in water access infrastructure and technologies, including labour- and water-saving technologies; and women's capacity to influence governance mechanisms. These technologies free up women's time and increase agricultural productivity. Another approach is networking, which promotes gender equality in the water sector by facilitating sharing of knowledge for all stakeholders involved in gender issues in the sector at national and regional level.[14]

Governments and civil society around the world face major challenges in advancing the goal of integrated, sustainable and equitable water resource management for the public good because of a lack of political will in resource management, particularly in developing countries.[15] However, the need to solve global water challenges is becoming more widely realized in the public and private sector.[16]

This awareness has led to an interest in undertaking collective and coordinated action, that takes advantage of the resources, technical strengths and ability of the public and private sectors to convene stakeholders – as well as academics, civil society, communities and, and others – to achieve sustainable water management.

To encourage the private sector to engage meaningfully in water management, the United Nations recommends awareness-raising in the business community about water-related challenges, promoting experience sharing and increasing independent stakeholder assessment of the effectiveness of corporate collaborations in order to reward good practices and discourage irresponsible practices. However, this private sector participation should not be allowed to hijack the water agenda with a profit-oriented motive and negate all the social (including gender) considerations that would increase women's participation.

Table 2.1 gives a summary of the challenges women face in soil and water management and possible intervention to address them.

2.1.2 Case studies of good climate-smart soil and water management

There are numerous examples of good soil and water management practices around the world with the potential to improve women's livelihoods). In India, the Aga Khan Rural Support Programme was able to achieve better results by mainstreaming gender into decision-making (Box 2.1). Soil erosion can present challenges to smallholder farmers,

many of whom are women. Agroforestry can alleviate most of these challenges, as the Nyando case in Kenya illustrates (Box 2.5). Community management systems for water that involve user groups and water management committees are instrumental in managing water resources. These committees tend to be more effective if the needs of both genders are considered.

TABLE 2.1
Challenges for women in climate-smart soil and water management and possible interventions

Challenge	Possible intervention
Insecure land tenure	Perform advocacy to change discriminatory land access policies
Limited participation in water users' organizations	Require gender quotas
	Develop women's leadership skills
Lack of sex-disaggregated data	Train statisticians and researchers
	Include gender guidelines in agricultural censuses and databases
Limited access to infrastructure and technologies	Support access to appropriate technologies

BOX 2.1
Mainstreaming gender in participatory irrigation management: THE India Aga Khan Rural Support Programme[17]

The Aga Khan Rural Support Programme (AKRSP) was established in 1983 as a non-profit organization. It works with rural and marginalized communities in three districts of Gujarat by organizing and empowering them by imparting natural resource management skills. It undertakes capacity-building through organizing both formal and informal village-level institutions geared mainly at facilitating participatory mechanisms of conflict resolution. AKRSP is now using these same methods to mainstream gender equity into participatory irrigation management, ensuring that gender sensitivity needs are considered at the beginning of every initiative. This has helped to challenge patriarchal perceptions that farming and irrigation are primarily male occupations. However, whereas women are often involved in the subsector, they normally have little say in decisions on how to manage water canals upon which they are dependent.

As AKRSP started the process of integrating these gender concerns in irrigation processes, they realized that it was very difficult to do this for existing projects – confirming that it is better done at the inception of the projects. AKRSP noted some gender division of labour where men are mainly concerned with collecting irrigation dues and saving money at the household level while women seem to be better as canal supervisors. Women appeared to be more effective in ensuring that water is not wasted, and that it is shared equitably.

The AKRSP case shows how diverse the needs women have for canal water are, including domestic use as well as for livestock. This therefore requires that these gendered needs are addressed in the design of irrigation systems and the adoption of rules governing access to water by participatory irrigation management societies. To make these efforts sustainable, gender concerns and in particular equity, especially for the landless and other stakeholders, need to be addressed. [Source: Vasavada, 2005]

2.2 Gender and CSA in crop production

Sustainable agricultural production and securing future food production will not be possible without designing and implementing appropriate mechanisms for mitigation and adaptation to climate change. This entails practices that manage agro-ecosystems and incorporate resilience as well as producing food, fuel and fodder while adapting and mitigating climate change for the production of enough safe and nutritious food for people and animals.[18]

Several agricultural practices and approaches are available that support the increase in crop production while ensuring environmental sustainability. Most have been practised for generations, but with gender-responsive CSA, there is a need for careful planning to ensure that trade-offs and synergies that arise from the three pillars (i.e., productivity, adaptation, and mitigation) are effectively managed. CSA will also need to ensure that production, climate change adaptation and climate change mitigation meet the needs of all groups, especially women.

CSA practices applied with a gender lens are a new approach to ensuring sustainable food security. Different agricultural practices such as integrated fertility management, conservation agriculture, crop diversification, small-scale irrigation and the introduction of drought-tolerant varieties can be adapted to all gender groups to be more effective. Social, institutional and policy support is essential in terms of options and opportunities to counter climate change effects on agricultural production systems and the livelihoods of the rural population.[19] Women are less likely to grow cash crops that men sell for higher income, and hence not able to afford quality inputs to improve production.

2.2.1 Crop production in CSA

Environmental stresses have a detrimental impact on crop production, and they need to be effectively managed. Because agricultural production generates income for most rural communities, ensuring that agriculture adapts favourably to climate change is important for improving livelihoods – especially for the rural poor – and ensuring food security. Common examples of such adaptation measures include integrated pest management, plant breeding and, and seed delivery methods. Capacity to undertake mitigation measures depends on available resources, and women are usually disadvantaged. CSA programmes need to undertake gender analysis before recommending mitigation measures to ensure they are favourable to women.

Box 2.2 presents practices and approaches in sustainable crop production that lead to climate change mitigation. These practices can provide options for location-specific contexts and should be adapted in a gender-responsive manner.

BOX 2.2
Crop production approaches and practices addressing climate change adaptation

- Integrated crop-livestock systems (regenerative agriculture)
- Conservation agriculture
- Mulch, residue retention and cover cropping
- Integrated nutrient and soil management e.g. precision agriculture
- Crop diversification
- Crop rotations
- Integrated pest management
- High-quality seeds, locally adapted varieties planting materials, and nutrient efficient varieties
- Water and irrigation management
- Integrated weed management
- Agroecology practices high in organic matter
- Landscape-level pollination management e.g. beekeeping, ornamental strip cropping etc.

Importance of climate-smart crop management and challenges for female farmers

Plots managed by women produce lower yields than those managed by men.[20] Yet there is no evidence to show that men are more efficient producers than women. The main problem is simply that women have lower inputs available to them than men. Given the same level of inputs women's plots would yield the same as those of men and overall agricultural production would increase. For instance, when women in Nandi hills, Kenya were allocated 50 trees of coffee there was a 250 per cent increase in coffee production compared to that of their husbands/ relatives.[9] Average cereal yields for countries with greater gender equality are usually higher than for those with less equality.[21]

Therefore, ensuring equitable access to inputs for women and men has the potential to increase yields on women's plots to a similar level achieved by men – which can lead to a 20–30 per cent increase in production.[22] [as above] This applies to other services and technologies including extension advice, finance and technologies, implying that removing this mismatch has the potential to unleash the productivity potential of women and increase output considerably (UN Women).[10]).

Possible interventions to improve climate-smart crop production for women

One possible intervention to close the gender gap in crop production is to advocate for change in discriminatory policies to improve land tenure for women. To ensure that women can save time so they can work effectively on their plots, strategies must be designed to increase access to labour-saving inputs.

Women must also be supported in engaging at high levels of value chains and in producing high-value crops that generate good returns. This can partly be achieved by increasing access to appropriate technology such as improved seeds and fertilizers. To eliminate the gender gap in access to finance, female-friendly financial solutions should be designed to ensure that women are not disadvantaged in securing financing. Purposely recruiting women extension personnel to train others to improve their skills is one way the gender gap in extension services could be closed. To increase the number of women producing cash crops, there is a need to improve women's control over marketed output so they can better take charge of the income they earn. This has the potential to shift the underlying conditions in which women farmers operate. Further strengthening women's groups and networks so that women can sell in larger quantities can go a long way in helping women reach markets and sell their produce at a lower cost.

Table 2.2. summarizes the challenges women face in crop production and possible interventions.

2.2.2 Case studies of good climate-smart crop production

There are many instances around the world where CSA practices have been used to enhance crop productivity, mainly by increasing the level of information available to smallholder rural farmers, especially women. (Box 2.3).

Conservation agriculture is very important for dry and arid areas due to the ability to maintain soil moisture, but it also can provide soil fertility benefits, as the case of using a ripper-furrower system e.g., inin Namibia, Zambia and Malawi. illustrates (Box 2.3).

Climate change impact is normally a communal problem, and solutions often would need to be collective for them to be effective. The case of the Hezekiah climate-smart village in the Gokwe North District of Zimbabwe illustrates the benefits accruing from such a village-wide intervention.

2.3 Gender and agricultural machinery and production technologies

Women's access to agricultural implements and machinery is significantly lower than that of men[23] Differences in use of implements and machinery explain the gender gap as women own fewer agricultural implements and machines, such as weighing machines, spraying pumps, machete knives, axes and, and irrigation equipment. The gender differential in the use of implements and machinery explains the gender gap in Malawi (18 per cent%), Uganda (8 per cent%) and Tanzania (8 per cent%). The main reason for this gender imbalance in

9 Women in Coffee https://fairtradeafrica.net/wp-content/uploads/2020

10 Cost of gender gap studies

TABLE 2.2

Challenges for women in climate-smart crop production management and possible interventions

Challenge	Possible intervention
Limited access to family male labour	Tackle constraints related to women's access to household male labour.
	Help women farmers access substitutes for household labour e.g. hired labour and labour-saving technologies e.g. cook stoves
Insecure land tenure	Advocacy to change land access discriminatory policies
	Advocate for control and access to larger farming plots
Market access for cash crop production	Strengthen women groups and networks for consolidation of products
	Improve women control over marketed output
Limited access to inputs	Increase access to non-labour inputs
	Help women produce high-value crops
Lack of sex-disaggregated data	Build the capacity of institutions to collect sex-disaggregated data
Limited access to finance	Support design of female-friendly financial solutions
Limited access to infrastructure and technology	Support access to appropriate technology
Limited access to extension services	Increase women's participation in extension services

access to equipment is women's lack of cash income given their responsibility for meeting household maintenance needs. In addition to this gender mechanization gap, women also use lower levels of advanced agricultural technologies, such as pesticide and inorganic fertilizer.

Possible interventions to improve on women's use of machinery

Cash vouchers or in-kind transfers may help women increase their use of machinery. However, women are unlikely to purchase and operate heavy machinery if it is inadequate for their needs or if it is deemed culturally or socially inappropriate [24]. Therefore, it will be critical to carefully understand women's machinery needs and, where appropriate, challenge the existing social norms (for example, via female-led tractor provision services). If the binding constraint for women farmers stems from the heavy upfront investment typically required to buy machinery, providing them with rental or leasing options is a policy alternative. In addition to promoting efficient and targeted use of pesticide and fertilizer use through voucher programmes, small nudges such as timeliness of delivery and smaller packages of fertilizer and seed more appropriately sized for women's smaller plots can potentially have a huge impact.[25]

Along with these short-term policy shifts, broader policy changes such as reforming land rights in favour of women have the potential to increase women's long-term agricultural investments, even if unrelated to machinery or fertilizer.[26] This may also help address the problem of small, fragmented farms that affects smallholder farmers of both sexes and that can render the use of agricultural machinery uneconomical.

2.3 Gender and CSA in livestock and rangeland management

In pastoral and agropastoral communities, livestock fulfil multiple economic, social and risk management functions and are important assets for poor people. Loss of livestock assets especially for poor people can make them fall back into poverty, with long-term effects on their livelihoods.[27] Livestock can make an important contribution to climate-smart food supply systems, but climate change is creating challenges for livestock production systems. The recent temperature increases, extreme weather events and poor rainfall distribution are expected to have adverse effects on livestock production and productivity around the world. These adverse effects may arise because of heat stress and scarcity of water. Indirect effects may be caused by poor

quality feed and fodder, the prevalence of livestock disease and a scarcity of resources to share with other sectors. [28]

It should also be noted, however, that the livestock sector is a major contributor to climate change through the generation of significant enteric carbon dioxide, methane and nitrous oxide emissions. Livestock also contribute indirectly to climate change (e.g., from feed production activities and conversion of forest into pasture).[29]

Nevertheless, livestock can offer substantial potential for climate change mitigation and adaptation and make a significant contribution to climate-smart food supply systems. [30] There are mitigation options along the entire supply chain often associated with enteric fermentation, feed production and manure management. Livestock can support organic matter and nutrient management (soil restoration) and income diversification. Livestock also contributes to food security, especially in marginal lands, where the animals represent a unique source of energy, protein and micronutrients. The contribution of the livestock sector to food security could be strengthened, particularly in areas where current levels of consumption of livestock products are low. There are several CSA practices that can be implemented, including grassland restoration and management, use of manure and its management and crop-livestock integration.[31]

2.3.1 Livestock and rangeland management in CSA

Most CSA practices that have been used in livestock and rangeland management – including grassland restoration and management (e.g. sylvopastoral systems), crop-livestock integration and manure management (e.g. recycling and biodigestion) – are not gender-neutral.

Good livestock and rangeland management practices cut across the three pillars of CSA (productivity, adaptation and mitigation). One of the guiding principles of CSA regarding productivity in livestock management is resource use efficiency. Due to the anticipated increase in demand for livestock products and the current and projected scarcity of resources, increasing efficiency in resource use will be essential to increase the sector's environmental sustainability. There is a need for more efficient use of natural resources in the livestock sector in the face of climate change. Emissions generated also depend on the level of productivity, such as eggs produced per unit.

Variables such as economic growth, population growth, increased urbanization, consumption of animal-based foods and greater commercialization are challenging the traditional production methods in the wake of climate changes. This has made it necessary to identify risk management strategies. The main CSA strategies are grouped under the dominant livestock production systems: land-based, mixed and landless[33, 34]

BOX 2.3

Conservation agriculture using ripper-furrower system in Namibia [32]

Women in the northern parts of Namibia are growing drought-resistant crops like maize, sorghum and millet as one of the practices in conservation agriculture. In order to open the hard soil pans occasioned by the drought conditions, they use tractor-drawn ripper-furrowers to a depth of 60 cm, which form furrows for harvesting rain in the fields. Manure and fertilizers are mixed in the rip lines where they can be taken up by the roots of the plants. Women establish the system in the first year by using tractors and in subsequent years they just use a direct seeder pulled by an animal to do the planting. The increased biomass the system produces provides both residue for soil cover and livestock feed. Crop rotation with legumes is encouraged. This practice has resulted in improved soil structure, improved fertility and moisture retention which supports the growing season. These practices have increased maize yields from an average of 300 kilograms to more than 1.5 tonnes per hectare.

Source: FAO (2013a).

Importance of climate-smart livestock and rangeland management and challenges for female farmers

The livestock sector is one of the most important sectors for women especially in managing poultry, dairy animals, small ruminants and in small-scale pig production where women dominate in some countries. As the sector becomes more commercialized women seem to be edged out because of technology advancement.

Starting a business is often more difficult for women and as businesses become more profitable, women tend to lose control over the profitable activities.[35] Two thirds of the 600 million poor livestock keepers are rural women.[36] However, not much research has been undertaken to explore the opportunities available, especially for rural women in this sector.

Optimal livestock production for women is constrained by a number of factors such as limited access to water, land, credit and other productive resources; market information and market prices access limitations; and limited participation in decision-making. These are often a result of unequal power relations within the household and the community. Women also often don't receive the training and extension services support available to men due partly to the small number of female extension workers and the gender-neutral approach generally taken by extension services that does not specifically address the needs of women.

The traditional pattern for gender roles in agricultural production in Africa has concentrated women in the subsistence production sector and men in the commercial production sector. As part of their reproductive roles, women often care (feed, water, milk and clean the environment) for cows. Once dairy production is commercialized, which is often accompanied by market formalization, men take over the control of milk and milk income from women, while women continue to care for the milk animals.[37] Men and women differ in the animal species they own. In many societies, men usually own cattle and larger animals while women own small animals, such as poultry and goats, which they look after near the house.

Generally, men tend to have more access to technology and training than women because they are the household heads and because of their greater opportunities to leave the farm.[38] Men also often dominate research and planning activities in the livestock sector, including handling, breeding, feeding and health care. Men are also likely to be the designers of extension programmes and educational materials, which consequently tend to be oriented towards men. When men dominate extension services, and women have little access to training, because of gender roles that are socio-culturally constructed, men may need to be persuaded of the benefit of training women.

Women are also a small minority in new commercial livestock sectors such as beekeeping, although that is changing, and these activities are a cheap and appropriate means of adding to household incomes. Beekeeping has traditionally been a male-dominated enterprise[39], yet with the advent of modern technology that makes its practice easier and safer, women are becoming increasingly involved in enterprise management as well as performing apiary cultural practices they had previously shunned. This should reduce the gender gap in beekeeping and enable this to become a climate-smart practice for women.

Possible interventions to improve climate-smart livestock and rangeland management for women

To realize the full socioeconomic potential of urban and rural communities, it would be necessary to allow more livestock-keeping women to control productive assets such a land and finances. Policy designs need to take into consideration the contribution of women to livestock management and how the subsector can empower the women. To cater for the specific needs of women, investments in livestock improvement and technologies need to be cognizant of the needs of women. This can only be achieved through a carefully planned gender approach. It is a prerequisite for designing and implementing successful training of women and men and achieving livestock production goals.[40]

Research and development of gender integration in livestock should consider how to improve the position of women and influence strategic gender relations – and not just use gender as an instrument to achieve project objectives or accommodate gender as a simple variable in a research project.[41] Research and development organizations need to sharpen how beneficiary groups are defined and targeted – moving away from the generic use of 'the poor', 'community', 'women' and 'men' – and

establish how to partner with transformative development programmes that enable women to benefit from agricultural innovations.

Because they bear much of the burden of domestic and agricultural work, women need access to productivity-improving and time-saving inputs and breeds. Supporting women to move up the livestock value chain can also increase their productivity and commercial benefit. Ensuring that research and development is responsive to the technology, financing and extension needs of women is critical in closing the gender gap in livestock production.

Table 2.3 summarizes the challenges that women face in livestock and rangeland management and possible interventions.

2.3.2 Case studies of good livestock and range-land management

Integrating indigenous breeds and climate-resilient measures in animal production have the potential to improve women's earnings while protecting the environment, as in the case of the climate-sensitive village in Nyando, Kenya, where resilient ruminants are kept (Box 2.5).

Mixed farming solutions are effective in deploying CSA practices that generate productivity, mitigation and, and adaptation benefits, as the case described in Box 2.4 of Zimbabwe livestock health management interventions shows.

TABLE 2.3

Challenges for women in climate-smart agriculture livestock and rangeland management and possible interventions

Challenge	Possible intervention
Limited access to inputs (land, water, credit)	Advocate for changes in discriminatory policies affecting input access
	Increase access to non-labour inputs
	Support design of women-friendly financial solutions
Limited access to market	Support women's integration at higher in the value chain
Limited presence in research and development	Increase women participation in research and development
Ownership of small, low-value animals	Support women's integration at higher in the value chain
Limited access to technology and training	Support access to appropriate technology

BOX 2.4

Livestock health management interventions in Zimbabwe[42]

In Zimbabwe, the's Department of Veterinary Services and Livestock Production undertakes the implementation of health management interventions aimed at preventing animal diseases (e.g., foot and mouth disease, Newcastle and African swine fever), including via targeted vaccination programmes. The department also undertakes herd- size and age- structure management all aimed at disease-free livestock production. Other interventions comprise the use of heat-tolerant indigenous breeds to increase heat tolerance. This has also been promoted in grazing livestock systems. In addition, the Department of Agricultural, Technical and Extension Services champions manure management practices It has been revealed that, if livestock waste is properly processed, it drastically reduces nitrous oxide emissions and helps improve crop or pasture productivity. Methods such as storing manure in liquid form or slurry to biodigest anaerobically lower methane emissions while producing useful energy. This can also be used to produce organic fertilizer in addition to reducing nitrous oxide emissions.

Source: CTCN (2017).

BOX 2.5

Breeding resilient ruminants in Nyando, Kenya [43]

Almost 90 per cent of farmers in Nyando keep small ruminants. Most keep local breeds of East African goats and fat-tailed sheep. However, most of these small ruminants have low productivity and poor adaptation to drought and disease. In Nyando, women and youth often have control over poultry, goats and sheep, which are generally less labour intensive as compared to larger livestock such as cattle. Key strategies that can transform productivity and support livelihoods of women and youth include improved breeds coupled with better livestock management practices.

Improved red Maasai sheep and Galla goat breeds were introduced between 2012 and mid-2013 that crossbred with the local ones that resulted in improved breeds. The improved breeds are more resistant to heat stress, have higher productivity and multiplication rates.

The Maasai sheep withstand heat stress and are diseases and parasites resistant as compared to the local fat-tailed sheep. This is important as warmer climate has led to an increase in diseases and parasites. The maturity period for the Ggalla goats is shorter and can be served at six months. They are higher milk producers and are with higher twinning rates than the local East African goats. They also fetch about three times more than local breeds in the market, with a mature Galla goat selling for USD 80–120 compared to USD 25–30 for a local goat.

More than 15,000 goats and 2,500 crossbred-bred sheep are being added to the small ruminants flock every year.

Source: Recha et al. (2017).

2:4 Gender and CSA in forest management and agroforestry

Forests and farms form part of a rural landscape that sustains rural households in smallholder farming systems. But people are invading these protected ecosystems, leading into disastrous climate change. The clearing of forestland to give way for settlement and agriculture often makes regeneration of woodlands more difficult. Climate change has interfered with the supply of goods and services from the forests and trees, endangering the food security and livelihoods of the rural poor in particular.

Agroforestry is a land-use management system where trees and shrubs have interactions with crop production systems and pasture and help address food security needs. It increases the adaptability of agricultural systems to climate change and contributes to climate change mitigation. The trees diversify production and reduce agricultural production risks while increasing farm incomes. Further, trees and shrubs limit the impact of extreme weather events, such as heavy rains, droughts and windstorms on farm systems. They also prevent soil erosion, increase water infiltration, enrich biodiversity and, and increase ecosystem stability. Organic matter from tree biomass is known to increase soil moisture and improve soil fertility.

Agroforestry systems are important sources of fuelwood and timber. Planting trees in agricultural lands is one of the most efficient and cost-effective mitigation measures, which provides co-benefits that enhance livelihoods and lead to climate change adaptation. Climate finance in agroforestry allows farmers to earn carbon credits[11], and has become one of the most effective incentives for tree planting. Several public and private organizations support such initiatives. Therefore, agroforestry is an important system in mitigation and adaptation to climate change. It reduces vulnerability, supports income sources diversification and, and improves livelihoods. But local customs, institutions and

11 https://www.worldbank.org/en/news/press-release/2014/01/21/kenyans-earn-first-ever-carbon-credits-from-sustainable-farming

national policies constrain agroforestry in many regions.

Rural communities' livelihoods are harmed by the destruction of forests that may lead to a tremendous decline in the productivity of ecosystems. Rural women are most affected by the diminishing levels of trees and shrubs as their source of energy and livestock feed. Therefore, given the prominent role played by women in the forestry sector, CSA approaches and practices for sustainable agroforestry and forestry management that are gender- sensitive have the greatest potential for success.

2.4.1 Sustainable forestry and agroforestry management in CSA

Targeted interventions in the forestry and agroforestry sector can contribute to CSA, increasing the resilience of forest systems, maintaining and enhancing the flow of the ecosystem's goods and services. This mitigates emissions from the sector by reducing deforestation and also reduces the climate change effects on forests.

Sustainable forest management is therefore important for climate change mitigation and adaptation, besides contributing to sustainable food security. Ensuring that climate change is mainstreamed into forest policy and practice will require identifying synergies and managing trade-offs with other forest management goals. With sustainable forest management forests can be integrated into strategies for poverty reduction, food security and development. CSA in the forest sector entails designing activities for adaptation focused on the most vulnerable communities and sectors of the population (e.g. the elderly, females, indigenous peoples) and forest systems (e.g. dryland, mountain, coastal). The focus should be on the most cost-effective and efficient mitigation measures, especially those with adaptation–mitigation synergies. Climate change mitigation responses are bringing changes to markets for forest products and leading to the substitution of forest products for more energy- or carbon-intensive products. This requires that forest planning and management is sensitive to such market changes.

Some of the agroforestry practices in CSA include alley cropping (trees planted in alleys with crops between the alleys), improved fallows (three- to four-year fallow with nitrogen-fixing trees and shrubs), taungya (plantation forestry allowing farmers to plant crops in young stands) and home gardens (multistorey structures such as gardens). CSA agroforestry can also entail boundary planting, growing multipurpose trees and shrubs in farmlands, orchards, farm woodlots, tree gardens, shelterbelts, tree plantations, windbreaks, fodder banks, conservation hedges, live fences, silvopastoral systems and, and apiculture with trees.

Importance of sustainable forestry and agroforestry management and challenges for female farmers

Forests are important for everyone, but especially the poor who often do not own land, such as women. Here forest resources are for subsistence, a sort of safety net from which modest incomes may also be generated. In developing countries, men and women play different roles in forestry and agroforestry systems.

Women are critical actors in the management of forest resources. [44] and are often disadvantaged due to economic, social, cultural and institutional factors – often deprived when it comes to the access and control over forest resources and in the economic opportunities available to them.[45] Women use forests for food, fuelwood fuel for domestic energy and income- generation. They process wood products such as medicinal plants, fodder for livestock, poles for fencing, and other non-timber forest products which become even more important during food crises and contribute value chains in forestry and agroforestry. Yet, policymakers and extension services tend not to adequately support women's roles in value chains. Moreover, women are normally absent when it comes to the formulation, planning and implementation of forest policies. Forests provide monetary and non-monetary benefits to men and women in forest communities around the world. Although forestry tends to be perceived as male- dominated, women in forest communities have the potential to generate more than half their income from forests, compared with approximately one -third for men.[46]

Women often have more knowledge of species diversity in trees and forests, management, conservation and use. This knowledge is usually linked to household use. Men on the other hand usually play a prominent role in extracting timber for commercial purposes. These roles are changing, however. While women generally focus on meeting the nutritional and subsistence needs of their households, they are also involved especially in collecting, processing and, and selling non-wood forest products. For example, women have long collected, processed and, and traded African shea and palm oil. Shea nuts and butter have been the main source of income for women in producing countries such as Benin, Burkina Faso and Ghana.[47] These forest products are processed, and value added for sale in local and export markets or domestic use that is well suited to women who combine income-earning activities with household chores. The income generated often makes a significant contribution to the well-being of the household. Further, important women's involvement in the forestry sector includes environmental stewardship in agroforestry, tree improvement, watershed management and forest protection. Globally, forest industries employ women in tree nursery industries, logging and wood processing.

Social norms, economic, legal and political factors can affect the rights of men and women to control forest resources and own land. Even when women own forest resources, they are often denied equal access to opportunities for forest-generated income. Forest priorities and preferences for gendered division of labour, different household responsibilities and priorities often influence what species of tree is planted. Men tend to engage in high-value activities to provide the household's main income and thus favour trees that offer greater commercial benefits.[48] Women, as the main caregivers and responsible for household cooking, provision of fuel and fodder, tend to select tree species based on relevance for their subsistence. Women prefer trees that provide fruits, firewood and fodder, and that increase soil fertility.[49]

Possible interventions to improve climate-smart agroforestry and forest management for women

When women participate fully in committee structures with power and voice, they are likely to get equal access, more equitable benefit-sharing and improved forest sustainability. However, achieving gender equality in the forest sector is a considerable challenge. Actions to incorporate gender concerns include collection of gender-disaggregated data to monitor gender roles and activities in the sector. Further actions include advocating for governance systems that provide secure forest tenure for women and men, research, and knowledge- building to explore and increase understanding of gender-specific roles while increasing understanding of cultural and social gender biases, applying gender analysis in projects and programmes, paying attention to gender in capacity-building initiatives, and disseminating information on gender in forestry.[50]

The lack of gender-disaggregated data hinders the development of women-friendly policy interventions to address agroforestry and climate-related forest management. Policies and practices that empower women in forest sector management can lead to improved nutrition and food security and sustainable management of forests. Another approach is to undertake gender-responsive capacity development for policymakers and planners and to ensure that biases in forestry research on gender roles are removed or relaxed. A summary of the challenges faced by women in forest management and agroforestry, and possible interventions, are shown in Table 2.4.

2.4.2 Case studies of gender-responsive CSA forest management and agroforestry practices

Agroforestry technologies have the potential to improve soil fertility but also generate economic benefits for smallholder farmers especially women (Box 2.6).

TABLE 2.4

Challenges for women in climate-smart forest management and agroforestry and possible interventions

Challenge	Possible intervention
Limited support from policymakers and extension services	Include gender analysis in projects and programmes Monitor gender roles and activities
Knowledge limited to household food consumption	Monitor gender roles and activities
Limited participation in formulation and implementation of forest policies	Gender-responsive capacity development
Inability of women to receive income from forests and trees even when they own them	Monitor gender roles and activities Research on gender roles and biases in the sector

BOX 2.6

Agroforestry technologies developed to enhance soil fertility in East and Southern Africa[51]

Farmers throughout East and Southern Africa cite soil fertility as a significant challenge. In response to the challenge, the World Agroforestry Centre and its partners have undertaken research into agroforestry-related options for soil fertility. Many agroforestry systems including improved fallows, which are natural fallows enriched with trees, were tested.

Trees are planted into an existing crop such as in Kenya or in uncultivated fields such as *Faidherbia albida* spp. in Zambia. In Zambia, fallows are mainly used in maize, while in Kenya they are used in maize and beans. The tree fallows are cut and the leaves incorporated into the soil during land preparation in both countries.

In Kenya, trees or shrubs are grown along boundaries or contours on farms – or are collected off the farm, such as by the roadside. This is what is known as biomass transfer, with the leaves of the trees or shrubs applied as manure.

Source: Place et al. (2002)

2.5 Gender and CSA in fisheries and aquaculture management

Over 600 million people in developing countries are directly or indirectly dependent on fisheries and aquaculture for their livelihoods. Approximately 4.5 billion people consume 87 per cent of global aquatic foods produced, which contributes to 17 per cent of the animal protein and essential minerals [52], reaching 23 per cent in lower-middle-income countries and more than 50 per cent in parts of Asia and Africa. Aquaculture is the world's fastest-growing food production system, growing at 7 per cent annually[53]. However, aquaculture growth has often occurred at the expense of the environment. Sustainable aquaculture development remains critical to supply the growing demand for aquatic foods. Overfishing, poor management and other practices are exacting a high price on fish resources, but the impact is becoming bigger with the increasing impacts of climate change[54]. Hence, the important role of fisheries and aquaculture in providing essential nutrition and national development is being challenged in the face of climate change.

With increased fish and other aquatic foods demand globally at a rate of 3.0 per cent, the impacts of climate change including ocean acidification are going to make this problem even worse[55]. Most community members, especially fishers, will also be more likely to lose their assets and even lives. Therefore climate-smart and sustainable management approaches that increase fisheries and aquaculture productivity

including the selection of suitable stock will become increasingly important. Other approaches include undertaking aquaculture as part of a broader farming, such as using sludge produced during treatment of aquaculture wastewater or pond sediments as manure in agricultural production. Moreover, seaweed can be used for feed for livestock and in food products and possibly biofuel production. As traditional species decline and the need to catch novel species grows, more climate-smart approaches will have to be deployed by the private sector.

2.5.1 Fisheries and aquaculture management in CSA

Approaches in climate-smart fisheries and aquaculture will entail efficient production of fish and other aquatic foods to ensure that production systems are resilient so that there is sustainable livelihood for those that depend on the sector and are likely to be harmed by climate change[56]. Climate-smart fishery and aquaculture practices can be grouped into three categories: (i) those that relate to sustainable intensification for food security and output expansion without excessive pressure placed on fishery resources, (ii) those that build resilience in the wake of increased vulnerability resulting from climate change, and (iii) those that contribute to processes which mitigate the effect of greenhouse gases. GHG mitigation processes.

Sustainable increase in fish productivity means that capacity and fish effort is used efficiently. Reducing time and effort requires improved fisheries management and maintenance of healthy, productive stocks and systems, especially for capture fish.[12] There are a number of aspects to climate-related vulnerability in the fisheries and aquaculture sector, ranging from specific concerns of individual households and communities to more strategic efforts to sustain industry performance and national food supplies. There is already social and economic vulnerability in fishing communities especially for small-scale producers. For those involved in commercial fish production, uncertainties in supplies due to reduced stocks and their distribution are causing concern, and production risks add to financial vulnerability along the fish value chains. Gender analysis is important to understand who feels the effects more. Analysis should be done even within each gender, because women are not homogeneous, and neither are men. Therefore, the resilience and mitigation strategies should be for both genders but would defer for each. They should also be reviewed regularly because of the dynamic nature of the process. Therefore, when households are analysed, it is also important to conduct intra-household and gender-disaggregated analyses on how the effect is felt and the coping mechanisms of the different members of the household. Currently there are insufficient sector-disaggregated data to calculate the exact share of fishery-dependent people within the total populations affected by climate change.

- **CSA measures to understand and reduce vulnerability.** Productive, political and social dimensions are all impacted by climate change. All these depend on timing and location of these changes. For example, location and form-specific effects (e.g., a storm can affect a small fish village) or broader effects (e.g., effects of a shift in temperature shifts and fresh water balances can affect a whole river delta and surroundings). Different risks affect different people and communities with varying adaptation capacities.
- **Building resilience.** Increasing household, community and national resilience can entail targeting specific vulnerabilities as long as these vulnerabilities are not selectively or partially addressed, because the remaining vulnerabilities may reverse the positive impact of the approach. For example, fisheries and aquaculture emit GHG gases such as carbon dioxide, methane and nitrous oxide as by-products of production. Through the natural sequestration of carbon in the management of the aquatic ecosystem these GHG gases could be reduced from the atmosphere. Aquatic biofuel production in the fisheries and aquaculture sector is an option that can be approached using a gender lens, and there may be interactions with mitigation efforts for GHG with other areas in the energy sector such as hydropower generation.

12 Capture fisheries is exploitation of aquatic organisms without stocking the seed. Recruitment of the species occurs naturally. This is carried out in the sea, rivers, reservoirs, etc. Fish yield decreases gradually in capture fisheries due to indiscriminate catching of fish including brooders and juveniles.

- **The role of the fisheries and aquaculture sector in naturally removing emissions.** Approximately 93 per cent of carbon around the globe is aquatic with 30 per cent sequestrated in aquatic environments[57]. There is a need to halt the destruction of fisheries systems and to expand mangroves and floodplain forests to enable this carbon sequestration[58].

Importance of fisheries and aquaculture management and challenges for female farmers

Climate change has led to changes in distribution, species composition and habitats, so that fishing practices and aquaculture operations need to be modified. Aquaculture is increasingly becoming an option given climate change effects, declining fish stocks and growing pressure on land. Women play leading roles in expanding aquaculture, and it is considered greatly beneficial to women in smallholder agriculture because the activities can be performed near homesteads and require only a low investment. Therefore, aquaculture plays a significant role in addressing food insecurity and nutrition in poor households. However, aquaculture is capital intensive (e.g. fish cage farming), so economically disadvantaged women (and men) may need economic assistance for them to be effective and competitive. On the other hand, marine capture fishery activities that include deep-sea fishing and nocturnal fishing are generally male activities although women are involved in capture and commercial fisheries' value chain activities[59].

The fishing industry is male- dominated but female intensive in that women fill 90 per cent of land-based jobs at fisheries that include managing fish farms, working in sea food processing plants, marketing products while collecting by-catch[13] that feed communities[60]. Yet, their substantial roles, contribution and participation in fisheries are generally invisible because of a lack of sex-disaggregated data and in-depth gender analysis, and the prioritization of the production sphere which is dominated by men. Further, they are engaged directly in onshore fishing, small boats and canoe fishing and serving as crews or in fish processing on boats.

13 By-catch is the unwanted fish and other marine creatures trapped by commercial fishing nets during fishing for a different species.

In Africa, rural women fish inland in rivers and ponds while in Asia, where fish and seafood are a major resource, women are active in artisanal and commercial fisheries and heavily involved in small-scale fishing[61]. In some countries, women are increasingly playing a central role as entrepreneurs in fish processing, as wage labourers in large-scale processing operations, although they are constrained by lack of appropriate technology, economic inefficiencies, education, leadership capacity, social and cultural constraints.

Women's role in fisheries is often regarded as small-scale and home-based; the unseen backbone of fisheries and therefore often excluded from the mainstream planning of the sector[62]. The sexual harassment and gender-based violence that affects women along the whole value chain, and normally increases at the time of disasters such as climate change events, often reinforces these constraints[63]. Unfortunately, women are rarely chosen for leadership or managerial roles in seafood supply chains, meaning that they often do not have a voice in decisions, including working conditions (temporary and unsalaried), and fair compensation. Systemic discrimination and lack of representation and recognition makes women more vulnerable to abuse.

The UNDP resource guide[64] gives a number of reasons why women's roles in fisheries are poorly documented. These include that production goals continue to dominate national policy agendas, which means that research attention continues to be focused on the catching sector (male-dominated) rather than the processing and marketing sector (female dominated). Research is often 'gender-blind' – researchers are often unable to include women in interviews and discussions for cultural reasons. Fisheries data are often aggregated with data from the agriculture sector and not disaggregated by sex, making it difficult to extract information pertinent to the fisheries sector in general and to gender in particular. When disaggregated data are collected, they are often limited to direct harvesting activities, whereas women are mainly involved in pre- and post-harvest activities globally[65]. Research on women's engagement in fisheries has largely focused on small-scale fisheries in the development context. Unsafe use of agrochemicals in aquaculture is another concern for men, women

and children engaged in aquaculture, although women and children may often not be aware that the chemicals are dangerous and are less likely to have protective clothing or gloves.

Possible interventions to improve climate-smart fisheries and aquaculture management for women

To tackle the gender inequalities in fish value chains, measures may include the enactment and implementation of enabling polices and legislation and adequate investment budgets geared to gender equity. Review of fisheries policies and legislation to ensure access to resources and elimination of gender discrimination is important[66]. Other strategies include ensuring that international and regional instruments on fisheries (voluntary guidelines, codes of conduct and conventions) and in trade agreements such as those of the World Trade Organization incorporate gender issues. There is also a need to ensure that these strategies are implemented to make sure that women have the production resources, inputs and markets to succeed. There is also a need to ensure that women use these resources more effectively (e.g., by providing them with improved technologies, extension, credit and, and forming marketing cooperatives). Another strategy entails building knowledge and statistical systems for harnessing data disaggregated by gender to support decision-making that is gender- sensitive.

There is a relationship between efficiency, gender equity and women's empowerment and it is important to always bear this in mind.

Freeing up women's time is also an effective approach to increasing women's participation in fishing. Providing labour-saving technologies to facilitate domestic and fishing work can save time for women and allow them time for fishing. Such technologies may include ovens for fish processing, domestic stoves, and more efficient processing and storage equipment. Better infrastructure (roads, electricity, water, markets, and landing sites) and services (e.g., health, transportation, extension, credit education, credit) can facilitate women's effective engagement in fisheries. The promotion of equity in sharing domestic work between genders and the provision of childcare facilities in fishing communities can help free up women's time for fishing activities[67]. Measures to reduce sexual harassment and improve privacy, such as separate women's toilets and washing facilities, can increase the safety and efficiency of women fishers. To stem the sexual violence that hampers women's participation in fishing, policies should be designed to sanction the perpetrators of practices that discriminate against women and girls in the sector. At the same time, stakeholders that implement and propagate gender-responsive practices should be rewarded. Another approach to improve women's participation in fisheries is to strengthen collective fishery organizations and women's leadership roles in them. There is an urgent need in all developing countries to strengthen collective organizations in the fisheries sector, including those for producers, traders, workers and employers to enable economies of scale in production, processing and marketing processes. Required measures include fisheries and aquaculture management and provision of equipment such as cold storage, ice facilities refrigerated trucks and other processing machines; improving input and output markets; enhancing prices for small actors through negotiation of better prices with bigger players; ensuring sustainable fisheries resource management; and ensuring labour rights for workers[68]. To achieve this, a deliberate effort is needed to build the confidence and assertiveness of the women and girls in the sector. A summary of the challenges that women face in fisheries management and aquaculture and possible interventions are presented in Table 2.5.

2.5.2 Case studies of good fisheries and aquaculture management

Sociocultural considerations are important in the fishing industry and determine the location of females in the value chain. In cases where females are confined to only the low-value stages, their welfare would be affected (Box 2.7).

Given the prospects of losing livelihoods when fishing activities are disrupted, the adoption of sustainable harvesting practices to maintain a safe ecosystem for the fish resources is an important element of the overall CS fishing especially for women who are mostly at risk of these disruptions (Box 2.8).

2.6 Gender and CSA in post-harvest handling

Post-harvest loss (PHL) is defined as measurable losses in edible food mass (quantity) or nutritional value (quality) of food intended for human consumption (FAO), and seed viability loss and commercial loss. PHLs are multidimensional and can be measured in different ways, both quantitatively (physical loss, theft) and qualitatively (for example, increased physical or biological damage, decay, breakage, contamination with toxins, lack of harvest and post-harvest handling knowledge, reduced seed viability and deterioration in the nutrient content or economic value of a product). In considering the system as a whole, losses can occur: (i) at harvest; (ii) during preliminary processing; (iii) at handling; (iv) during transportation and distribution; (v) at storage due to pests, spillage, spoilage, and contaminations; (vi) during processing due to inefficient technologies; (vii) during commercialization and finally at consumer level.

For the purposes of this guide, we use the FAO description of PHL in terms of food loss and waste. Food loss is the decrease in the quantity or quality of food resulting from decisions and actions by food suppliers in the chain, excluding retail, food service providers and consumers. Food waste, on the other hand, is the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food services and consumers.

The causes of food waste at the retail level are linked to limited shelf life, the need for food products to meet aesthetic standards in terms of colour, shape and size, and variability in demand.

Using food loss and waste reduction as a means of reaching the environmental objectives enshrined in the SDGs will require an understanding of where in the food supply chain (see Annex 12A.2.4) the loss or waste is incurred; which commodities are involved; which environmental footprints are affected; and what the costs are of intervening to reduce the loss or waste. Incorrect post-harvest handling techniques, inadequate infrastructure for transportation and cooling facilities result in spoilage[69]. Other factors include spillage, contamination and degradation due to poor handling during transport and storage. Loss or waste due to inadequate post-harvest handling results from poorly equipped slaughtering facilities and the condition of animals, and processing practices which include the improper cleaning, skinning, cutting, and canning or smoking of fish[70]. Others are inadequate preservation of products, trimming, and picking products that do not have the right weight, shape, size, and appearance.

FAO estimates that one- third of global food produced (1.3 billion tonnes) meant for human consumption is lost during post-harvest operations per year. The scarcity of solid data on how much food loss and waste occurs, and where, is an obstacle to effective policymaking. The lack of data is particularly acute for food waste at the consumer level because of both methodological challenges and the measurement costs involved. Availability of data on losses varies considerably across countries and commodities, and along the food supply chain. Foods commonly lost and wasted are the highly perishable fresh fruits and vegetables.

There are CSA practices and approaches that can reduce or eliminate these losses, but gender and other social barriers limit their uptake. These especially affect women because of their limited financial means to adopt these practices, and to manage the needed investments in storage and handling facilities, and social barriers that limit their access to these adaptation and mitigation measures.

2.6.1 Post-harvest handling in CSA

Reducing food loss and waste is seen as a way to lower production costs, improve food security and nutrition, and contribute towards environmental sustainability, notably by easing the pressure on natural resources and decreasing greenhouse gas (GHG) emissions. Three major types of environmental footprints of food loss and waste are generally quantifiable: GHG emissions (carbon footprint), pressures on land (land footprint) and pressures on water resources (water footprint). These can in turn also affect biodiversity. Using food loss and waste reduction as a means of reaching the environmental objectives will require an understanding of where in the food supply chain the loss or waste is incurred; which commodities are involved; which environmental footprints are affected; and what are the costs of intervening to reduce the loss or waste.

Both private and public interventions can be used to reduce food loss and waste and offer possible guiding principles. Clarity about the objectives being pursued is essential for identifying the most appropriate policies and entry points for reducing food loss and waste. If the focus is on economic efficiency, an attractive option is to enable the business case for food loss and waste reduction, wherever it may present itself along the supply chain or geographically. A focus on food security will tend to favour interventions early in the food supply chain, where positive food security impacts will be felt throughout the rest of the supply chain. To reach environmental objectives, food loss and waste reductions need to take place downstream in the supply chain relative to where the environmental impact occurs. Finally, location matters when pursuing food security and nutrition or environmental objectives, the only exception being a fall in GHG emissions, which has the same impact on climate change wherever it occurs. Developing countries will likely focus on improving food security and nutrition, in addition to the sustainable management of land and water resources. This calls for a focus on reducing food loss and waste early in the supply chain, including at farm level, where impacts will be the strongest and losses tend to be the largest. Opportunities for post-harvest agricultural adaptation to climate change are described in detail in Annex 3.

TABLE 2.5

Challenges for women in climate-smart fisheries management and aquaculture and possible interventions

Challenge	Possible intervention
Participation and contribution invisible A comparison of the loss in quantity or quality for the different interventions can provide an overview of their efficacy	Analyse and disseminate sex-disaggregated data
Policy ignores processing and marketing	Enabling polices and legislation
Lack of education and leadership capacity	Leadership training
Social and cultural norms	Enabling polices and legislation
Limited access to technology	Increase access to labour-saving technology
Gender-blind research	Mainstream gender development and management
Limited participation in organizations	Build women's confidence

BOX 2.7

Ideologies affect women's roles in fishing[71]

In Trivandrum, Kerala, Christian men do the fishing while women are responsible for the processing and marketing of the catch. In Muslim communities, women generally never do fish marketing but work in related activities such as making of nets. The religious and cultural ideologies partially explain the significantly greater success of Catholic fisherwomen in Gao than their Hindu counterparts.

Source: FAO (2013d)

BOX 2.8

The TRY Oyster Women's Association in the Gambia[72,73]

In 2007 in Gambia, a community organization known as TRY Oyster Women's Association, was established to bring together female cockle and oyster harvesters operating in Tanbi National Park and the periphery. The association was geared at raising the living standards of women involved in oyster and cockles harvesting. There were 500 women in 15 communities in the association. In the wake of the overexploitation that was happening, women adopted sustainable harvesting methods to ensure sustainability. One of the measures entailed the closure of harvesting grounds and enforcing closed seasons to increase productivity, income and ecosystem-system preservation. Other measures included use of more efficient and effective methods of harvesting. Increased income has allowed the harvesters to engage in other iIncome- generating activities such as soap and batik making. Theat reduced pressure on oyster stocks provided a more diversified source of livelihood for the community.

Source: Interview with TRY Oyster Women's Association; UNCTAD (2014)

Possible climate-smart interventions to improve post-harvest handling for women

Post-harvest losses and waste, and how they are dealt with, are not gender-neutral. "Cleaning, drying and storage of food products have always been considered domestic chores and therefore not acknowledged"[74]. In the design and implementation of PHL reduction programmes, gender issues need to be considered. FAO emphasizes the importance of gender-sensitive approaches to food reduction, stating that "interventions to improve women's standing and decision-making power in the consumption and sale of household production may help reduce food losses"[75]. Working with women as active participants in groups, empowering them as trainers and in extension, using gender targets or incentives to enhance women's representation and leadership within male-dominated groups, while concentrating on the segments of the value chain where women are most active (e.g., processing as opposed to transport), are a few of potential approaches that can increase gender equity. Where practical, adopt gender-transformative approaches to integrate interactive behavioural change in communication on gender equity for decision-making and the use of resources. Such practices would help shift underlying gender norms and better empower women by improving their decision-making power on matters related to PHL reduction. Women need to be included across all intervention types as active participants to shape the approaches to service delivery. Similarly, teams should develop careful protocols for selection of participants or hosts for on-farm demonstrations and experiments. This will require gender-responsive technology advocacy to ensure that post-harvest handling technology research and development is gender-responsive. Ensuring that women have the finances they need to purchase appropriate and labour-saving post-harvest handling equipment may also improve productivity through a reduction of produce losses. A summary of the issues that women face in post-harvest handling and the possible intervention is presented in Table 2.6. In selecting and recommending technologies to reduce post-harvest losses, the needs of men and women should be considered; teams that introduce new post-harvest technologies should ensure careful, balanced selection of women and men who participate in on-station observation of experiments. Both men and women need to be educated on how to calculate household food requirements, so as to save enough.

Further, PHL reduction interventions must take into account factors of gender norms and social biases, mobility limitations, lower education levels and capital access, lack of or limited access to improved technology, lack of decision-making power and limited time due to competing domestic roles. Increasing the adoption and effectiveness of PHL reduction strategies will likely depend partly on ensuring that the voices of women – who represent a large share of the actors in agricultural value chains – are taken into account in the design of interventions and approaches for implementing

them. Finally, to achieve long-lasting food loss and waste results, policy interventions must be designed and implemented in a way that accounts for gender. To ensure this happens, policymakers should: consider the results and recommendations of gender-sensitive maps and analyses of food supply chains; identify the gender constraints that actors face at critical loss points in the food supply chain; duly consider the differences in needs, constraints and preferences between women and men active in the food supply chain; and assess the gender and social implications of any proposed solutions. Questions to consider in gender-responsive planning include: Do the suggested solutions worsen gender inequalities? Are they appropriate in the cultural and social context of the supply chain and can they be adopted widely to have a long-term impact on losses or waste?

2.6.2 Case studies of good post-harvest handling with a gender focus

Reducing the workload for females in fish processing has the potential to improve their welfare and to save them time to engage in other household activities. Solar fish driers have been one of the best innovations that have saved time and effort and led to improved welfare of females involved in fish marketing (Box 2.9).

Post-harvest losses are a big problem for smallholder farmers such as females who cannot afford the equipment and technology for proper post-harvest handling. Supporting females with appropriate technologies to undertake post-harvest handling has the potential to improve their welfare, as the case of mango farmers in Kenya shows (Box 2.10).

2.7 Gender and CSA in value addition

It is important that food systems are economically, socially and environmentally efficient[76]. This section examines how food chains can be made inclusive and sustainable and how that contributes to CSA. It also provides information on possible interventions, practices and technologies that can be deployed along the value chain to ensure sustainability and inclusivity of food chains through value addition to agricultural produce.

2.7.1 Value addition in CSA

To address food security and climate change challenges, the agricultural sector, which includes fisheries and forestry, crop and livestock production, should transform to become more climate-smart. One characteristic of a sustainable gender-responsive climate-smart value chain is its inclusiveness of poor people and both genders (Box 2.11). The value of a product is determined at the end of the chain.

The value can be added through processing and packaging.

There are three dimensions to sustainable food value chains:

- **Economic dimension** – this entails ensuring that value chains are profitable and commercially viable.
- **Social dimension** – refers to socially accepting the differences and diversity in others in the distribution of chain benefits and costs (.... gender foot printing)
- **Environmental dimension** – ensures that chain natural inputs and resources are sustainably used. It also considers the effects of biodiversity, GHG emitted by the chain and the carbon sequestration and GHG reduction through the value chain.

TABLE 2.6

Challenges for women in climate-smart post-harvest handling and possible interventions

Challenge	Possible intervention
Limited knowledge of post-harvest handling technology A comparison of the loss in quantity or quality for the different interventions can provide an overview of their efficacy	Gender-responsive technology advocacy
Work on post-harvest handling not acknowledged	Participation in high levels of the value chain
Limited knowledge [limited what?] in processing and	Gender-responsive post-harvest handling research and
marketing	development
Social norms	Gender-responsive post-harvest handling policies and community awareness-raising efforts on gender roles and social norms
Lack of finance to buy post-harvest handling equipment and materials	Access to finance for post-harvest handling
Limited participation in collective organizations	Participation in high levels of the value chain

BOX 2.9

Low-cost solar fish dryer[77]

Open sun drying has traditionally been the most used and common food preservation and processing method for fish. The method involves removal of moisture from the fish so that it can be stored for longer at ambient temperatures. However, one disadvantage of the method is that it can expose the fish to contamination and rehydration if not stored properly. Depending on current weather conditions, the sun may take longer to dry because it does not generate enough and constant temperature for drying. Longer drying time produces a poor final quality. Solar drying is considered an improved sun drying practice.

Solar dryers can be made from a wooden frame table that is covered with locally available material such as glass or plastic. The material is usually painted black to enable absorption of the heat of the sun and with two openings one at the top and another at the bottom to allow airflow and to decrease the moisture content of the fish. Such dryers are now common in various countries around the world. These dryers not only protect food produce from direct sun exposure but also reduce contamination. Solar driers generate low humidity and hot air temperatures which results in faster drying hence reducing chances of contamination and improving on end product quality and less loss than with traditional sun drying techniques. The use of a low-cost solar dryer has various benefits and includes taking 15 to 16 per cent less time drying the product and better product colour and texture than open sun drying. It is estimated that low-cost solar dryers can enable the fishers to recover their investment in the purchase of these dryers in 2.3 months. Solar drying also reduces GHG emissions.

Source: FAO (2013a)

Importance of value addition and challenges for women

The main reason for developing inclusive, equitable, climate-smart value chains is to safeguard the interests of smallholder farmers, especially women, who otherwise are at risk of profiting the least from agricultural value chain development. The critical mechanism for achieving this inclusive, equitable development is improving the ability of smallholder producers to increase productivity in a sustainable manner. It also involves easy access to markets leading to increased income. A sustainable and inclusive food value chain approach can help transform the agricultural sector so it can better address food security and climate-smart challenges.

The word 'chain' puts emphasis on the fact that there is a sequence of interlinked actors and activities in the production of commodities. When women or men are locked out at any stage of the chain their contribution and associated benefits are lost. For example, women engage more at the levels where there is low- value addition and low returns. The lost income means they have less capacity to afford agricultural inputs that would increase their productivity. For example, in the grain value chain, women are usually concentrated in harvesting, threshing and sorting. When it comes to transport, processing and marketing their numbers diminish drastically.

BOX 2.10

Mango farmers in Kenya get access to new technology to counter post-harvest losses[78]

During the mango season in Meru and Makueni counties in eastern Kenya, trees are usually heavy with fruit. Mango farmers often lose 40 to 45 per cent of their crop mainly due to lack of improved harvesting practices, post-harvest handling (PHL) and packaging techniques; and pest and diseases. UN Women conducted farmers training in PHL and fruit processing techniques using a new multi-food processing machine. The machine can process 7.8 tons of mangoes every six hours and can be used to process other fruits as well.

The training was done in collaboration with Jomo Kenyatta University of Agriculture and Technology, Stockholm Environment Institute and Techno Serve, with funding from the Rockefeller Foundation. More than 100 farmers, half of them women from Meru, Makueni and Tana River counties, were trained in fruit processing, packaging and branding. The project convened 30 farmers' groups in Meru for a vigorous competition and awarded a multi-food processing machine to the Chaaria Group. Representation of women in the group and its leadership, availability of water and electricity to operate the machine and proof of registration of their collective were among the criteria used to select the winner.

For many of the female farmers, learning how to process, preserve and market various products made from fresh mangoes was an eye-opener. Stella Musyoka, a 48-year-old farmer from Kyeni Kya Yathonza Group in Makueni said, "Through this training, I have learned how to make jams and juices. It will be easier for me to introduce yogurt since I have both the mangoes and cows that produce milk for my family. I will be able to get the required capital through the table banking initiative available in our group".

"Table banking" refers to a group funding strategy that small savings and loans groups commonly use, whereby the group contributes its savings to a common pool of funds that can then be used to give small loans to fund specific projects. "Kenya has a significant proportion of women engaged in agriculture. While they work as hard as any male farmer, they often lack access to financial and technological resources that can improve their livelihoods. This is why UN Women has partnered with the universities to make technology accessible for women farmers", said Fatmata Sessay, UN Women Regional Policy Adviseor on Climate-Smart Agriculture. As Kenya's mango production in Kenya continues to grow, access to existing and new technology is critical to maintain and improve productivity. UN Women is fostering collaboration with universities, research institutions and private sector partners in Kenya to make sure that female farmers are not left behind as technology evolves.

Source: UN Women (2018)

Few women own butcheries, for example. They only work at the farm level, looking after the animals but rarely taking them to the market or participating in value addition. This low concentration of women in the downstream nodes of the value chain occurs in many commodity value chains. Women often have no choice in this because of competing domestic responsibilities and as farm labourers.

Possible interventions to improve CSA value addition for women

Mainstreaming gender does not mean just integrating women and men into existing value chains; it also means transforming the chain to better cater for the needs of women and men. It entails knowing the relationships, differences, preferences and interaction and supporting their incorporation into the chain. If, for instance, women's preferences are not to be at the farm and neither are they concerned with food security, they may then need to be supported to undertake more downstream commercialized value chain actions. With the spread of information technology, women's value chain participation could be achieved by giving them more information on markets, commodities, inputs, exporters and importers. Appropriate information and communications technology ICT tools such as Buy from Women facilitate not only their involvement, but also their performance along the whole value chain. Technology can commercialize formerly subsistence production and make it more attractive for men. In turn this would prompt men to produce more and in the end the household will be more food secure. Another approach is to advocate for change in value addition gender-blind policies to ensure that they support women in integrating at higher levels of the value chains. Female entrepreneurs seeking to engage in value addition can also be supported through enterprise incubation. Research and development should support value addition that is gender-responsive. Design for women-friendly value addition financial solutions is another strategy that can support women's participation in climate-smart value addition. A summary of the challenges that women face in value addition, and possible interventions, is presented in Table 2.7.

2.8 Gender and CSA in energy management

Sustainable and renewable energy is an important enabler for development and pertinent for the achievement of the Sustainable Development Goals[79]. However, there is a growing gap between needs and energy access in the face of the growing demand for food[80]. There is concern over conventional, non-renewable energy that is known for intense GHG emissions, uncertain availability due to volatile economic conditions, and association with a dependence on foreign energy supply[81]. Both developed and developing nations depend on an assortment of primary energy sources to produce electricity, like coal, natural gas, biomass, oil and renewables. In developing countries, biomass, hydroelectric power, geothermal, wind and photovoltaic are becoming more attractive because of their low- carbon impact, indefinite supply, price stability in the energy market and economic benefits. However, initial high costs of renewable sources, and an intermittent energy supply, hinder uptake. Over 70 per cent of the rural population in developing nations use biomass as the primary energy for cooking, which has both environmental and human health disadvantages.

2.8.1 Women and energy

Greater access to affordable and modern sources of energy in developing countries, especially for women, is a prerequisite for improved productivity, increased income, and economic and social development for vulnerable individuals. Inequalities in access to these services are a major limitation for women's economic empowerment and the livelihoods of communities[82]. With limited access to modern energy services, rural women, and girls in particular, spend long hours in time-consuming and physically draining tasks such as collecting biomass fuels. This often makes it difficult for them to obtain educational opportunities, decent wage employment, and livelihood-enhancing options, and limits their options for social and political interaction outside the household[83]. Each year, approximately 7 million people – mainly women and children – are killed by indoor and outdoor air pollution and approximately 600,000 across Africa suffering ill health accounting for about an eighth of global death[84]. Strengthening resilience in the face of climate change and variability is another

objective for CSA practices. Climate change has affected income from the farming practices of smallholders, especially women. Taking advantage of local energy sources expands diversity of energy sources and can increase incomes, especially for women. This increases resilience to climate change and improves the life and economic situation of women and girls. For example, the use of biogas for cooking, lighting, energy for small farm equipment and the by-product (bioslurry) as fertilizer can bring household energy self-reliance, and reduce the cost of using wood fuel and chemical fertilizers. It also reduces the time women and girls spend gathering firewood. Lighting may also extend or add flexibility to working hours, which may increase available time for especially women to engage in income-generating activities. At the same time, access to energy-based technologies, such as for agricultural production and post-production, low-cost domestic appliances, power water wells and drip irrigation systems, and labour-saving technologies such as grinding and milling help farmers to save time for other farm and non-farm activities while enhancing labour productivity.

2.8.2 Energy management in CSA

It is estimated that globally, about 1.3 billion people do not have access to electricity, and 2.6 billion lack modern cooking facilities. More than 95 per cent of these people are in sub-Saharan Africa or Asia, and 84 per cent are in rural areas[85]. The dependence

TABLE 2.7

Challenges for women in climate-smart agriculture value addition and possible interventions

Challenge	Possible intervention
Limited access to value addition technology	Advocacy to change value addition in gender-blind policies
Participation mainly upstream of value chains	Support women to integrate at higher levels of chain
Social barriers such as sexual violence that limit	Advocacy to change value addition in gender-blind policies
women access to value addition opportunities	Support women to integrate at higher levels of chain
Limited presence in value addition research and development	Value addition enterprise incubation
	Participation in value addition research and development
Limited voice in value addition policy discourse	Advocacy to change value addition in gender-blind policies
Subsistence orientation	Support women to integrate at higher levels of chain
Limited access to value addition financing	Design of female-friendly value addition financial solutions
	Value addition enterprise incubation

BOX 2.11

Afghan Pride Association: A women-owned food processing company[86]

The Afghan Pride Association in Kabul Afghanistan is a women-owned processing centreer that adds value to dried fruits and nuts, including raisins and almonds. There are about 200 women members who work as processors or supervisors at the centreer. The association sells mainly to hotels, through two exporter unions and at their two retail shops. In 2009 it earned USD42, 000 from sales. They also purchase produce directly from women producers in the villages. Most of the produce is processed and packaged at the centre and the association is willing to pay a premium of 50 to 100 per cent to producers who supply cleaned raisins; and shelled, cleaned, and sorted almonds.

Solar dryers are being set up and tested at local collection and drying centres to produce raisins with no dust and dirt. The association cooperates with women's associations with grass rootsroots networks such as the Afghanistan Women's Business Council, which provide some assistance in marketing produce in local and national markets.

Source: World Bank (2011a)

of agrifood systems on non-renewable energy is a major threat to food security and is partly responsible for climate change. The challenge of reducing dependency on 'dirty fuel' may call for the up-scaling of energy-smart food systems, increasing renewable energy production and use, improving energy efficiency, and increasing the use of modern energy services in agrifood systems. A number of agricultural practices are not only energy-smart but can also reduce vulnerabilities to climate change. To promote energy-smart food, there should be a balance between increased access to energy sources, the efficiency of energy use and the proportion of the energy that is renewable. When designing and recommending new or improved energy technologies, the cultural factors and economic trade-offs between the options and local conditions must be considered.

For example, for women to adopt new improved stoves, there is need for their participation to include cultural and social considerations and small loans for affordability. The use of more efficient biomass cookstoves, compared with open fires, can halve the demand for traditional fuelwood, but women may prefer to cook some types of foods such as beans and plantains with fuelwood[87]. In the face of climate change, high and volatile non-renewable fuel prices, many farmers are shifting to on-farm energy generation. Because of women's traditional roles in cooking food, energy-smart food systems, entailing increased access to and diversity of modern energy services, contribute to energy security, especially for women[88].

Importance of energy management and challenges for women

Access to modern energy is critical for women's empowerment (SDG 5) as it impacts the health with respiratory associated diseases with smoke, musculoskeletal discomfort, and disability from carrying heavy loads, and general well-being of rural women and girls.[89] As the primary household energy managers, a lack of modern energy sources also contributes to women's time poverty that reduces the time available for learning other skills such as literacy (formal education).[90] In households that cook with solid fuels, for example, girls spend about 18 hours a week, on average, gathering fuel. Time poverty, especially in rural areas, may contribute to lower participation by women in Science, Technology, Engineering and Mathematics (STEM) education and STEM-specific jobs. Typically, the energy devices are designed, tested, implemented, and monitored by men. Additionally, despite energy companies having non-discrimination and anti-harassment policies and gender committees, flexible work options are generally not available (which might contribute to the low percentages of women working in senior or supervisory positions instead of in the field) and childcare options are limited.

Women are also largely sidelined in employment in the industries that produce modern sources of renewable energy. Practices that would help to sustainably increase productivity and income can only be effective if they are gen-der sensitive or benefit women [91].

Therefore, technologies that reduce women's time burden can help reduce poverty but designing appropriate programmes to integrate women's concerns in energy access have been few and difficult to design. Most women's economic contributions to the energy sector, such as fuel collection, are unpaid, unrecognized, and undervalued. The use of locally available renewable energy sources for productive work, among other energy solutions, can provide opportunities for women's entrepreneurship, to deliver reliable energy services based on renewable energy technologies. Consequently, patterns of women's energy production and consumption are often not accurately reflected in national statistics. As a result, energy planners fail to accurately capture women's energy demands, and less attention is paid to technology development and investments aimed at improving women's than men's work.[92, 93]

Possible interventions to improve how women manage energy

Practices that lead to climate change mitigation with implications for women include agroforestry for provision of firewood, biogas digesters to produce energy for both domestic and small farm equipment and bioslurry (efficient ready-to-use organic fertilizer). From the standpoint of consumption, the design, production, distribution and sales of sustainable energy technologies (e.g., clean cookstoves and lighting devices) would benefit from having women contribute to shaping the clean energy value chain [94]. Suggested technologies that

can be part of energy-smart food systems include solar collectors; power generators; windmills; photovoltaic panels; biogas production units; fermentation and distillation facilities for ethanol production; equipment for bio-oil extraction and purification; wind- or bioenergy-operated water pumps; pyrolysis units; hydrothermal conversion equipment; solar, renewable energy-powered vehicles; ICT; monitoring systems; cookstoves and equipment for water supply, distribution and purification [95].

Use of efficient energy systems at the household level (e.g., special cookstoves and ovens) can lower emissions while reducing time poverty [96].

In many countries, there are many highly fuel-intensive small- and medium-scale enterprises and home industries, such as processing food, baking, brewing beer and making soap and shea butter products in which rural and urban women are engaged. Therefore, allowing women access to more efficient fuels and equipment would increase the profitability and productivity of these activities and move into other types of business enterprises while reducing GHG emissions and other air pollutants. [97] Further, there are legal and social restrictions on women's rights, including rights to own assets such as land, borrow money and make their own economic decisions, that make women ineligible for financing for new equipment that can increase the productivity of their labour. [98] There is a need to address legal and regulatory frameworks that prevent women from accessing credit and other financial services, as well as electricity (grid and off-grid) to stimulate income-generating activities through access to modern, affordable energy services. It is also important to recognize the role of women in the energy sector to ensure that services are designed for men and women, which requires awareness-raising and collecting and using sex-disaggregated data to facilitate the process. Another important prerequisite is political will and public sector leadership and government significant investments in the energy sector. The challenges that women face in climate-smart energy management and the possible intervention are presented in Table 2.8.

2.8.2 Case studies of energy management

Gender-blind energy policies worsen energy access constraints for women; deliberate gender mainstreaming measures are needed in such policies to benefit rural women (Box 2.11).

Solar technologies not only have the potential to relieve the energy burden but can also provide a business opportunity for women, as the case of the Solar Sisters initiative in sub-Saharan Africa and the Solar market gardens (Solar Electric Light Fund [SELF]) in Benin show (Box 2.13).

TABLE 2.8:
Challenges for women in climate-smart energy management and possible interventions

Challenge	Possible intervention
Limited access to energy technology	Advocacy to change energy gender-blind policies
Social barriers to energy sources	Advocacy to change energy gender-blind policies
Limited access to equipment	Increase access to labour-saving energy equipment
Limited presence in research and development	Participation in energy research and development
Lack of voice in energy policy discourse	Advocate for women's participation in energy related decision-making processes and policy formulation and implementation
Food security focus	Efficient food preparation technology
Limited access to energy financing	Design of female-friendly energy financial solutions

BOX: 2.12

Gender-blind energy policy in Botswana[99]

In 2002, the Botswana Ministry of Energy reviewed the Botswana energy policy. The Ministry undertook a participatory approach of consultations with individual actors and mini workshops to identify policy issues. More than 35 energy sector actors were consulted, 50 per cent of whom were representatives from government, 25 per cent from parastatal organizations and another 25 per cent from private sector entities. The majority of participants were male. There was no mention of gender in any of the mini workshops. The Botswana Women's Affairs Department did not participate, not even in the review of the output of the consultative process. None of the 34 men that attended the workshop were planners or social scientists, only engineers and administrators. Of the only five women who attended, four were from government and one was from the private sector. Not surprisingly, gender was not addressed in the recommendations for the revised energy policy.

BOX 2.13

Solar market gardens Solar Electric Light Fund in Benin[100]

For the first time, women farmers can grow crops during the six months dry season. Farmers in this remote arid region, use solar-powered drip irrigation systems to achieve higher productivity with lower water and labour input through the initiative of Solar Market Gardens (SMG) project. In addition, the initiative helps to reduce GHGs while allowing female farmers to increase their income and food security (access and nutrition) for their families. The income has been used to pay for such things as school fees and medical treatment.

2.8.3 Sustainable energy

Without a set mandatory global carbon pricing structure or budget, a policy environment that encourages low-carbon, climate-resilient investment should be established which could potentially be deployed at scale on a commercial basis[101].

However, some of the analyses and policy instruments used to unlock barriers to this investment are gender-blind – despite the fact that female entrepreneurs often face gender-differentiated barriers and risks that are rarely gender-neutral. Such structural barriers result in unequal access to productive resources such as land, labour, finance, technology, markets, justice and information.

Reducing investment risk to accelerate universal energy access and decentralize renewable energy development helps to reduce poverty. But this potential for energy transition is vastly untapped, and women are underrepresented in the sustainable energy sector. Support forto female entrepreneurs needs to address capacity, policy, and financing barriers and promote energy use sustainability. This would result in productive roles that generate income.

END NOTES

1. SOFA Team and Doss 2011.
2. FAO 2017.
3. FAO 2016c.
4. World Bank, FAO and IFAD 2009a.
5. FAO 2013a.
6. de Haan and Sugden 2015.
7. UN Women, UNDP-UNEP PEI and World Bank 2015.
8. Wambu, Openda and Kinuthia 2016.
9. SOFA Team and Doss 2011; Doss et al. 2013.
10. FAO 2013a.
11. FAO 2016c.
12. de Haan and Sugden 2015.
13. UNDP and Gender and Water Alliance 2006.
14. Ibid.
15. Morrison 2013.
16. Ibid.
17. Vasavada 2005.
18. FAO 2013a.
19. Ibid.
20. UN Women, UNDP-UNEP PEI and World Bank 2015.
21. FAO 2011.
22. Ibid.
23. Doss et al., 2016.
24. Njuki et al. 2014.
25. Duflo, Kremer and, and Robinson 2009.
26. Ali, Deininger and Goldstein 2014.
27. FAO 2013a.
28. Parvatha Reddy 2015.
29. FAO 2013a.
30. Ibid.
31. Ibid.
32. Ibid.
33. This material draws on FAO 2013a.
34. FAO's CSA sourcebook 2013.
35. FAO 2011.
36. Njuki and Sanginga 2013.
37. Ibid. Njuki et al. 2013.
38. Shafiq 2008.
39. Mujuni, Natukunda and Kugonza 2012.
40. Njuki et al. 2013.
41. Njuki et al.
42. CTCN 2017
43. Recha et al. 2017.
44. Mwangi, Meinzen-Dick and Sun 2009.
45. FAO 2013b.
46. FAO 2013a.
47. FAO 2016b.
48. Kiptot 2015.
49. Beaujon Marin and Kuriakose 2017.
50. Nelleman et al. 2009.
51. Place et al. 2002.
52. FAO 2022.
53. Ibid.
54. Ibid.
55. Cochrane et al. 2009.
56. FAO 2022.
57. Kiptot 2015.
58. FAO 2013a.
59. FAO 2013c.
60. FAO 2022.
61. FAO 2022.
62. FAO 2013c.
63. FAO 2019.
64. UNDP and Gender and Water Alliance 2006.
65. FAO 2016.
66. FAO 2013d.
67. FAO 2013d.
68. FAO 2013d.
69. Gatere et al. 2020.
70. FAO 2003a.
71. FAO 2013d.
72. Source: Interview with TRY Oyster Women's Association.
73. UNCTAD 2014.
74. Sidhu 2007.
75. FAO 2019.
76. FAO 2013a.
77. Ibid.
78. UN Women 2018.
79. UNDP 2016.
80. FAO 2013a.
81. Hidayatullah et al. 2011.
82. FAO 2013a.
83. UNIDO and UN Women.
84. UN Environment 2017.
85. Danielsen 2012.
86. World Bank 2011a.
87. FAO 2013a.
88. Ibid.
89. UNDP 2016.
90. Ibid.
91. USAID/IUCN 2014.
92. ENERGIA 2007.
93. Cecelski 2000.
94. UNDP 2016.
95. FAO 2013a.
96. GTZ 2010.
97. Karlsson and Rojas,2011.
98. Clancy et al. 2011.
99. Ministry of Energy Mozambique 2012.
100. Solar Electric Light Fund 2008.
101. UNFCCC 2007.

3. ENABLING ENVIRONMENT FOR GENDER-RESPONSIVE CLIMATE-SMART AGRICULTURE PROGRAMMING

Overview

Climate-smart agriculture (CSA) is a relatively new area for UN Women and a natural fit for the organization, given its global orientation and institutional framework that prioritizes climate change considerations and seeks to improve the livelihoods of women. The various global goals and strategies on sustainable and equitable development that UN Women spearheads underpin its adoption of CSA and the information and communications technology (ICT) that supports this.

Key messages

- Understand the need for cost of gender gap analysis for inclusion in agricultural productivity.
- Institutional synergies and networks for knowledge exchange are key to establishing, maintaining, and scaling up CSA initiatives.

3.1 Strategic value of CSA to UN Women

There is a big gap between the productivity of male and female farmers in sub-Saharan Africa. Eliminating this gap will bring meaningful reductions in poverty, as well as improvements in nutritional outcomes and in the overall macroeconomy. As the country cases studied by UN Women and its partners demonstrate[1] – and as cross-country evidence in numerous other published studies supports – gender equality in access to land, labour, technology and agricultural inputs is crucial in increasing productivity in food production. Understanding the existing gender inequality gives a better picture of the barriers that prevent women from having full access to agricultural resources and inputs.

Closing the gender gap in agriculture can have a transformational effect on women's lives and can unleash substantial development co-benefits between gender equality and climate action. Although agriculture is one of the most important areas of women's work globally, most agricultural policies and investments do not take into consideration the differences in men's and women's access to resources, their roles and labour burdens, and the constraints they face.

UN Women has a strong justification for engaging in CSA alongside other specialized United Nations agencies such as the Food and Agriculture

Organization (FAO), the International Fund for Agricultural Development (IFAD) and the World Food Programme (WFP), as the following points illustrate:

- Although women make up most of the agricultural labour force, recent studies by UN Women in collaboration with other agencies has revealed a persistent gender gap in agricultural productivity. One of the underlying reasons for the gender gap in agriculture – unequal access to resources – falls squarely within UN Women's mandate.
- Reproductive roles related to childbearing bearing dutiess limit women's agricultural engagement and productivity. Also, women's work in agriculture is often unpaid. UN Women works to bring about gender transformation in agricultural work and ensure decent employment for all women to close the gender gap in agricultural productivity.
- UN Women's interventions link women's economic empowerment to other areas affecting gender equality (e.g., linkages between economic empowerment and gender-based violence, safe working environments, leadership, and decision-making opportunities for women), creating opportunities for women.

Given these justifications, UN Women has identified five priority outcome areas:

- Gender-responsive climate-smart policies, securing women's land tenure and addressing discriminatory social and customary norms by building political will. This will facilitate reform of statutory and customary laws, policies and practices to address gender-specific barriers, including those related to increasing women's access to land.
- Increasing female farmers' access to climate-smart information. This entails building the capacity of agricultural extension workers and ensuring that climate information services are accessible, timely and user-friendly for female farmers.
- Increasing female farmers' access to finance to invest in CSA by factoring gender into private and public financial institutions' lending practices, including through directed lending and credit enhancement mechanisms. A changing climate requires a shift from focusing on borrowers' credit capacity and traditional loan guarantees towards risk management and sustainable financing.
- Increasing female farmers' access to higher added-value markets. This will entail supporting farmers to form cooperatives and increasing their capacity to participate meaningfully in green value chains. Women-run cooperatives can be offered preferential access through quotas; targets and tax exemptions may be required. Investments will be needed in local infrastructure, including post-harvest storage and processing facilities.
- Reducing the gender productivity gap by providing access to labour-saving mechanisms for women; adopting technologies that free up time and policies that enable women to access hired labour. Prevalent cultural norms may prevent women from hiring male labour, especially if women and men carry out specific agricultural tasks separately.[4] Hence, policies involving both women and men, such as awareness and sensitization campaigns, may be needed to reform existing structures.

3.2 Potential partners

UN Women is aware of the distinct expertise of other United Nations agencies in agricultural practices and has strived to nurture partnerships with these agencies in implementing women's economic empowerment through CSA in various countries in Africa. The scope of the interventions required to achieve tangible improvement in rural women's lives is considerable, so UN Women seeks partnerships with other international agencies to this end. To deliver on CSA programmes, UN Women would need collaborative efforts with public, private, local, national and international institutions. Partnerships will be sought with networks, research and academic institutions, non-governmental organizations, private organizations and, and philanthropic organizations; specific entities are listed in Annex 5.

3.3 Financing strategy

Innovation, cooperative action and political will are some of the ways of meeting the financing challenge for CSA to address current and projected funding shortfalls for climate change adaptation

and mitigation. Examples of funding sources, existing and new, are given in Annex 6.

3.4 Programme planning and tools for delivery

Mainstreaming gender in climate change projects can be done through a three-pronged approach in a gendered project cycle[2]:

- **Gender analysis –**analysis that helps to determine the social, economic and, and political factors that underlie climate change – gender inequality's contribution to climate change impact and how women and men contribute to societal changes through building resilience to and addressing climate change (see Box 3.1).
- **Gendered actions –** methods and tools to promote gender equality and reduce gender disparities in climate action.
- **Gender-sensitive monitoring and evaluation –** measuring the outcomes and effects of project activities on women's and men's resilience to climate change through gender-responsive monitoring and evaluation.

3.5 Integrating gender equality principles

The main value addition and comparative advantage for UN Women in CSA programme support is the integration of gender equality principles into the pillars of CSA. The gender-responsive approach adopted by UN Women will lead to more effective and equitable outcomes. It will also reduce project risks and risks relating to climate change because it will lessen effects of the gender gap in agricultural outcomes. Importantly, it will also better reflect the lives and experiences of agricultural communities. The following discussion explains why gender equality as reflected in this gender-responsive approach is relevant to all three pillars of CSA. Annex 4 presents a summary of good practices and examples of gender-responsive CSA.

- **Pillar 1: Sustainably increase agricultural productivity and incomes.** In CSA programme formulation and implementation, it is important to examine how gender differences, shaped by social norms and intra-household decision-making, may affect men and women's participation in sustainable agricultural practices and the consequent benefits. An awareness of the importance of gender equality in improving productivity in the agricultural sector is also needed.

- **Pillar 2: Adapt to and build resilience to climate change.** As noted earlier, the effects of climate change and related adaptive strategies are not gender-neutral because socioeconomic factors, livelihoods, capacity, and access to knowledge, information, services and, and support often determine the level of vulnerability to climate change. In addition, men and women may have different coping strategies. Women also often have less access to climate information, such as weather forecasts through short message service (SMS) or radio than men. When women have access to information on CSA, they are often just as likely as men, if not more so, to adopt CSA practices. For resilience-enhancing practices and approaches to be developed, it is critical that information be made available and accessible to men, women, boys and girls and that any potential increase in workload be minimized.

- **Pillar 3: Reduce or eliminate greenhouse gas emissions, where possible.** Gender inequalities can affect the ability to adopt CSA practices that reduce greenhouse gas emissions. When pursuing practices that contribute to climate change mitigation, women and men often have different outlooks based on their experience. For example, some technologies, such as improved cook stoves, biomass for energy and biogas, may be more attractive to women because of their labour-saving features. Proposed mitigation actions should therefore harness the experiences, expertise and realities of women and men alike.

  The UN Women CSA flagship programme initiative supports country projects by developing methodologies to assess the gender gap and improve data- collection, providing technical assistance, building global and regional partnerships, convening communities of practice, and ensuring knowledge management. ICT is leveraged to facilitate the implementation and expansion of all interventions. A mobile-based enterprise platform, Buy from Women (BfW), helps link female farmers to customers, suppliers and financiers and build their economic identity

while enabling a rigorous assessment of the value for money of the programme. Some countries, such as Rwanda, have also developed training manuals to help mainstream gender in the CSA programme supplementing UN Women's own manual on gender and economics. Monitoring and evaluation for CSA programmes is to be based on indicators developed in the UN Women Strategic Plan 2018–2021 Integrated Results and Resources Framework.

3.6 Measuring the cost of gender gap in agricultural productivity

For this guide, agricultural productivity is defined as the value of output per hectare. The difference in this measure between male and female farm plot managers constitutes the **unconditional gender gap,** while the **conditional gender gap** is calculated from plot area and agroecological conditions.

The study treats the plot of land, with the identification of the gender of the plot manager or decision maker, as the unit of analysis.

Using gender-disaggregated plot-level data allows us to capture differences in agricultural productivity even among women and men who belong to the same household but cultivate different plots. The main advantage of this level of analysis is that it explicitly measures the productivity of women farmers, who are frequently neglected in analytical work that only looks at the gender of the household head.

For example, a **lack of access** to adequate labour, soil and plant protection technologies has been identified as a major contributor to the gender gap in Ethiopia.

If the aim of development policy is to ensure that women become more productive and are lifted out of poverty, then policymakers should carefully consider if women act because of choices that they make voluntarily, or because of the constraints that they face.

Since there can be a thin line between the two, agricultural gender policy should be cognizant of how women farmers make their agricultural decisions. Various policy instruments affect women's constraints and choices differently.

3.7 Cost of Gender Gap Analysis in Agricultural Productivity

The five countries included in the study of cost of gender gap were selected for various reasons that included their potential for valuable policy lessons for the region as well as the availability of high-quality, nationally representative household survey data with information on household characteristics and on agricultural inputs and output. Further, in these countries agriculture contributes over 40 per cent of gross domestic product (GDP).

The quantitative studies provide estimates of the monetary value of the gender gap in agricultural productivity for each country and then calculate the costs associated with gender gaps in access to individual agricultural inputs. These gender gaps in agricultural productivity are calculated as the unconditional values of the male–female differential in the value of agricultural output per hectare of cultivated land. Further calculations on conditional gender gaps take into account gender differences in plot size and regional variations in agro-climatic conditions. The conditional gaps tend to be larger than the unconditional gaps because, on average, women work on smaller plots than men and are subject to more variable climate conditions.

The utility of CSA is that it not only traces the linkages between unpaid care and domestic work and productivity, but it also shows how the performance of unpaid care and domestic work directly affects growth in the agricultural economy and beyond. Unpaid care and domestic work thus create an opportunity cost for women that directly affects their agricultural performance, reducing production and cash income – income that might be spent on productivity-enhancing inputs such as better seeds, fertilizer, pesticides and herbicides. The loss of cash income affects the larger economy by reducing disposable income that might be expended on goods and services, thereby reducing economic growth generally.

3.8 Policy Implications

Good policies are built upon redefined problems, and introducing policies that take advantage of female-specific farm knowledge to foster innovations would enhance productivity.

Investing in carefully diagnosing and refining the scope of problems can significantly reduce implementation costs and ensure that policies are cost-effective. Lessons can be learned from experiments and research in other development efforts.

I. **Designing policies that directly reduce inequality in access to male farm labour can take two avenues.** One option is to tackle constraints that limit women's access to male labour from outside the household. This requires policies to reshape social norms around the sensitivities associated with the hiring of men's labour by women plot operators, through education and awareness campaigns. Another option is to think about policies to increase the ability of women plot operators to access and use rural labour markets. In the context of pervasive rural underemployment, increasing women's ability to hire men (and women) farm workers that could substitute for absent household labour could greatly enhance their farm crop productivity.

II. **Policies on expansion of government-funded cost-effective rural social protection measures targeted at women plot operators.** The most important policy implication from women's lack of access to size-appropriate affordable farm inputs is that it is women's limited or lack of income and wealth that precludes them from allocating discretionary income to the purchase of soil and plant protection technologies. Women's productivity is constrained by a lesser use of adequate soil and plant protection technologies because of their poverty. In this regard, an expansion of government-funded cost-effective rural social protection measures targeted at women plot operators has the potential to offset gender- based differences in household income and wealth and create the preconditions for increasing access to affordable and size-appropriate soil and plant protection technologies.

III. **Adopting labour-saving technologies and time poverty for women.** It is possible to increase women's labour productivity by enabling them to adopt labour-saving technologies on farm or by freeing up their time within the household by the adoption of labour-saving technologies such as the use of energy-efficient and environmentally friendly improved cooking stoves, solar cookers and, and biogas. Training targeting local women's groups with credit or finance may increase adoption. Further, a significant expansion of publicly financed gender-responsive irrigation or rainwater harvesting using locally produced storage is inexpensive. In addition to aiding agricultural production, rainwater harvesting contributes to reducing unpaid care and domestic work by women.

    This is an example of a small-scale, appropriate, environmentally responsive mechanization that would drive an increase in agricultural productivity.

IV. **Policies on civic education for women.** The majority of women in rural areas belong to village women's groups that could be strengthened to allow private discussion on gender violence, inform women of their civil and political rights and educate them on livelihood options. Policies to reduce the unpaid care and domestic work required by households with more dependents, by providing substitutes for some activities through public infrastructure provision, particularly in the form of water and energy, will allow women to give more time to their plots and make up for some of the shortfalls in the labour requirements that they face.

V. **Policies that facilitate diversification into higher-value crops and markets.** These crops can be used for household food security and sold for premium prices when surplus is generated.

VI **Revision of land rights including marriage act to provide legal recognition of gender equality in asset ownership.** Enforcement of joint asset ownership by man and wife will enhance the legal position of women and allow them to assert control of land especially in situations of polygamy or the death of a husband.

VII. **Promote gender-responsive climate-smart agricultural extension systems.**

Box 3.1: [3]

Gender analysis is at the core of mainstreaming gender considerations in the project cycle. Gender analysis helps reveal the significance of existing gender inequalities and gaps in relation to climate change, and the potential contributions of women and men to climate action. It should inform project design, and therefore should either precede or be conducted in parallel with preparing a funding proposal.

To conduct gender analysis, it is vital to gather relevant data and information, including through stakeholder analysis. Gender analysis entails the following:

- Identifying and analysing gender issues relevant to the project
- Reporting findings of country/regional gender diagnostics or undertaking project-specific analysis
- Reflecting the results of consultations on the project objectives or components with relevant stakeholders including women, girls, men and boys in the project area; gender advocates and women's civil society organizations; and local and national authorities.

Questions are asked to explore the gender aspects of CSA projects. Sample questions to facilitate this process may include the following: What is the context for the proposed project intervention, including climate risks and impacts? Who has what in terms of project area, land, resources, income, assets? Who does what in the project area (gendered roles and responsibilities)? Who makes decisions in the household and the community? Finally, who will benefit from project activities and interventions?

Source: UN Women and GCF (2017)

3.9 Challenges and lessons learned

Although several CSA programmes and projects have been implemented, adoption remains low especially in the developing nations. This is partly because of the number of challenges facing these efforts, as outlined in Table 3.1.

TABLE 3.1
Challenges and lessons learned on women and CSA project implementation and possible actions

Challenge/lesson learned	Possible action
Women find it harder to adopt CSA because is not adequately incorporated into national agricultural extension training and manuals	Formulate training manuals for CSA practitioners such as extension staff to enable them to understand how to integrate CSA into their programming
Lack of quality CSA inputs (e.g., farm implements and equipment, agrochemicals, seeds, tree seedlings) especially for rural communities and especially for women	Put mechanisms in place to increase women's access to these inputs
Limited awareness and knowledge of CSA by farmers, policymakers, the media and the public, especially women	Build capacity for stakeholders on CSA practices
CSA programmes and projects are implemented in a fragmented manner, threatening their sustainability and effect	Harmonize an approach for promotion of CSA and strengthen CSA coordination mechanism between partners
Local context and farmers' knowledge and preferences not usually considered in sharing best practices in technology transfer	In partnership with farmers develop, test and share climate-smart technologies to enhance adoption and sustainability
CSA is inadequate unless research on context and location context is undertaken	Conduct action- and field-based research, with a more practical orientation rather than academic
Most projects on CSA are funded for only a short period (2–5 years)	Provide long-term (10–20 year) CSA financial support to allow farmers to grasp concepts fully and realize the benefits of practices
In most developing countries, there is limited budgetary allocation and investments in CSA technologies such as water harvesting and irrigation	Seek public and private financial support
There is a wide gender gap in in access to productive resources and decision-making over land	Remove barriers to equitable distribution of productive resources
Women find it difficult to access the global carbon market because they often either do not own land or own very small land holdings	Modify carbon market to the advantage of women
Farmers that are food insecure find it costly to invest in CSA practices such as better land and agricultural management systems	Integrate food security concerns into recommended CSA technologies and practices

END NOTES

Chapter 3

1. UN Women, UNDP-UNEP PEI and World Bank 2015.
2. Taylor 2018 outlines the sustainability gaps in the three pillars of CSA and gives suggestions on how they can be bridged.
3. UN Women and GCF 2017.
4. Fafchamps 2001.

4 INFORMATION AND COMMUNICATIONS TECHNOLOGY FOR WOMEN'S ECONOMIC EMPOWERMENT

ICT plays an integral part in the success of CSA. ICT has great potential to promote gender equality and empower women, by addressing inequalities between women and men before they become worse. Considering access and use of ICT through a gender lens can promote women's economic, political, and social empowerment through CSA.

There is an unequal distribution of access and opportunities provided by ICT among users, which creates asymmetries that only appropriate policies can address. The price of access to ICT, inadequate ICT infrastructure, or a complete lack of such infrastructure in some remote areas and persistent inequalities hinder access for women. Gender inequalities in ICT use are a serious challenge in agriculture, which plays an important role in rural and national development as women make up the majority of farmers. ICT may give women the opportunity to be agents of their own development.

4.1 Women and ICT as a tool for the collective empowerment of women in CSA

Women's ability to build social capital and their higher sense of community means they have great potential as agents of change and rural development; however, women tend to use less technology than men for reasons such as socioeconomic disadvantage, affordability, time poverty to learn new skills and lack of human resources to teach digital tools. Even when women have access and know about technological tools, a lack of technological skills and confidence may keep women at the margins of digital revolution. Such technophobia is a result of concurrent factors such as lack of education, employment status and income level. It is claimed that women possess less computer self-efficacy and higher computer anxiety. Individuals with lower self-efficacy have less motivation to engage in a task than those with higher self-efficacy.

On the other hand, many women are aware of the importance of information and the power that these technologies hold in terms of breaking out of systematic discrimination and lack of power in resource allocation for effective participation in CSA.

4.2 Experience with and application of ICT in CSA: women's perspective

Women farmers, just like men, can use ICT tools to help manage small farms more efficiently. As owners of ICT-based businesses, ICT can create employment for women as managers and employees of ICT-accessed projects. ICT can create an environment, including through training, where women can be facilitated to feel comfortable participating in community development activities such as cooperatives. ICT facilitates advocacy for women's needs and priorities by facilitating training, access to market and trading information services and e-commerce initiatives in CSA.

Information dissemination: Modes of communication such as video, radio, the Internet, television, and mobile and media services play an important role in agricultural production. These

powerful tools allow farmers to access timely information on climate and agricultural production. They facilitate exchange of advice, experience and knowledge among farmers and other stakeholders, helping with decision-making. These tools also support local, national, regional and international agriculture networks where different stakeholders exchange information across geographic boundaries. ICT has a variety of applications (see Figure 4.1) that have implications for the livelihoods of women involved in CSA. ICT in agriculture can offer many solutions for farmers and extension services. According to a study in rural India where 100,000 rural farmers were provided with a phone line and asked questions on agriculture, their profits increased between 25 and 150 per cent[2]. Such applications have huge potential to be used in agricultural extension and marketing. Such ICT-based agricultural extension programmes can empower farmers.

ICT in local languages connects people and improves information flow, even in rural areas, meaning that illiteracy in farming communities is no longer a barrier in offering extension services.

In Tanzania, mobile phones are used as listening devices, recording tools, and for supporting income-generation. Community radio stations are also incorporating mobile technology into programming, and it is being used for advisory services in agriculture. Mobile phones are being used in Ghana to obtain production and marketing information in a programme known as Cocoalink. It has helped farmers to improve farming practices, and also to improve farm safety, crop disease prevention, post-harvest production and crop marketing. It is a free service where farmers are given answers to their questions through voice and SMS messages in their local language or English.

Others are the banana information line, a text-to-speech telephone service in Kenya that gives farmers information on how to plant, grow and harvest bananas in English or Kiswahili. There is also the national farmers information service, which sends timely news and information on agriculture, weather patterns and other related matters to farmers' mobile phones.[3]

Production: Accurate information on inputs use and on yield facilitates decision-making on what to plant the following year. Moreover, by using simple software, women can undertake effective farm management that helps in economic sustainability. Through local collection and analysis of data, ICT can be used to monitor change.

Soil management: ICT is used for precision agriculture in nutrient management, and soil conservation measures that include brown water harvesting. The Nutrient Manager for Rice Mobile programme by the International Rice Research Institute (IRRI) provides information on optimal inputs via mobile phones (for example, advising rice farmers in the Philippines on the optimal use of fertilizers, which enables them to maximize profit and reduce waste). There is a toll-free number that farmers and extension workers can dial to get a voice instruction to answer 12 to 15 question about their rice crop on a keypad in their preferred language. The farmer is then given a recommendation by text for the fertilizer to use[4]. On-farm and near real-time soil diagnostic tools such as the SoilDoc system, or AgroCares use technology for soil nutrient analysis and management where results are disseminated via SMS. These tools are now widely used on smallholder farmers.

Integrated animal health: Mobile phones are being used to deliver animal health services, helping to reduce transaction costs and increase the efficiency of animal care. Through the iCow project, animal health workers in the community purchase veterinary drug kits and mobile phone at a subsidized price and give mobile phones to animal health assistants and veterinarians. The system permits the sharing of information, allowing animal health-care providers to update one another, share information and provide referrals. There are mobile apps that have been developed to help farmers in the field identify pest and diseases, e.g. Plantwise, PlantVillage.

- Growing and/or storing crops and varieties which are less susceptible to post-harvest pest attack;
- Prompt harvesting;
- Adequate and protected drying;
- Maintenance of the physical storage structures;
- Careful store cleaning and hygiene;
- Accurate estimation of food stock requirements;
- Protection and monitoring of grain to be stored for more than three months;
- Use of low GHG emission food preparation methods;
- Understanding and application of basic food safety principles;
- Increasing farmer access to market information and transport options;
- Use of early warning seasonal forecasts to project how the climatic conditions might impact on food storage or marketing strategies;
- Use of more water, energy and resource efficient processing, packaging and transport operations;
- Ensuring plant breeders evaluate post-harvest as well as pre-harvest crop characteristics; and
- Helping farmers to learn from others' and their own experiments.

Knowledge on early warning signs (EWS): Emerging ICT tools such as geographic information systems, handheld computers and mobile mapping can address the challenges that smallholders face. EWS that include rainfall distribution intensity and duration help farmers make informed decisions on crop and livestock production management. Texas A&M University has developed an application for an early warning waterhole-monitoring system for livestock, which was implemented in north-eastern Kenya and south-western Ethiopia, by using multi-source satellite data and hydrologic modelling. In these pastoral areas, shortage of water means these resources are crucially important for survival, often leading to conflicts between rival communities in the region. Satellite technology products developed by the US National Aeronautics and Space Administration (NASA) are also used for operating waterhole identification and monitoring for precipitation, and watershed delineation with estimates available daily for free.

Markets: ICT improves the prospects for market access for crops and animal products and increases women's bargaining power by providing current price information. Information and knowledge can bring economic development. Similarly, tools that provide market information can allow farmers to bargain for better prices that increase income allowing them to seize market opportunities. Market information also helps farmers adjust production plans, better allocate production resources, and make better marketing choices.

Decision-making on income- generation: Women tend to make farming decisions based on family food security, which gives them the advantage of being decision makers on the use of agricultural income. Empowering women to use ICT solutions can help prevent intrahousehold conflicts and power struggles over household income management and decision-making because women would also be informed of the total income earned from agricultural production on a family farm.

Supply and value chain management: ICT tools encompass supply chain management from production to market (farm-to-fork). They increase traceability, efficiency and predictability while reducing post-harvest loss (e.g., recording movements along the value chain; responding to quality standard requirements; helping bulk buyers track, manage, pay and reward small producers). These ICT-based initiatives facilitate CSA productivity for all farmers and include initiatives such as M-PESA, Kilimo Salama, and Mali Shambani (in Kenya); E-soko (East Africa); Cocoalink and Radio Ada (in Ghana) and MAKWACHA (in Malawi). Mali Shambani in Kenya is a weekly hour-long radio programme featuring topics such as market prices and trends, weather and seasonal topics, farming techniques, financing opportunities, inputs, land-use and quality standards. Each programme also has an interactive call-in component when farmers can ask a panel of experts agricultural questions over the phone or SMS. In addition, Farmer Voice

Radio is a radio extension service in Kenya, Malawi, Tanzania, Mali, Ghana and Zambia that targets smallholder farmers. Extension agents of Farmer Voice Radio provide regular, on-site extension support to a small group of preselected farmers that is then documented and broadcast over the radio[5].

Agricultural insurance: Agricultural insurance products can be provided to farmers via mobile phone, another innovative service being offered in many countries. In Kenya, for example, farmers have used Kilimo Salama, a product developed by UAP Insurance that is 'pay as you plant' type insurance. It enables farmers, especially smallholders, to buy insurance for agriculture inputs against adverse weather conditions such as drought and excessive rain. The insurance cover entails farmers paying an extra 5 per cent for a bag of seed, fertilizer or other inputs.

Finance and credit facilities: E-banking and mobile banking is also available in Kenya, Uganda, Malawi and elsewhere; an ICT-based service that connects rural farmers in ways that have had a tremendous effect on the socioeconomic status of farmers. The smart-card based MAKWACHA system in Malawi allows rural farmers to receive payments and buy farm inputs electronically. The card can be used at any of the company's automatic teller machines at merchant stores in rural trading centres throughout the country. Dairy cooperatives are affiliated with savings and credit cooperatives societies (SACCOs) such as Githunguri and Wakulima Dairy cooperatives and incorporate ICT for communications, financial transactions and extension services.

FIGURE 4.1
Some ICT4Ag platforms on the market in the agricultural sector

Application	Purpose	URL
AquaManager	Aquaculture	http://www.aqua-manager.com/
[illegible] Tracker	Bee Keeping	http://www.africanbeekeepers.co.ke/index.php/
KenCall Farmers' Information Service	Extension and support	http://www.kencall.org/national-farmers-information-service/
Green Dreams – Mkulima Fiti and iCow	Extension and support (livestock & crops)	http://www.[illegible].org/[illegible]-best-practices/now-green-dreams-agriculture-information-service-to-help-kenyan-farmers-enhance-their-productivity-.html
RiceAdvice	Extension and support (rice)	http://www.africarice.org/riceadvice
Farm-App Ug	Extension and support, Market Links	http://farmappug.com/about-us/
Cocoalink	Extension and weather services	https://play.google.com/store/apps/details?id=co.farmerline.cocoalink&hl=en&gl=US
Women of Uganda Network (WOUGNET)	Extension services, support	http://www.wougnet.org/
Radio stations (local languages)	Extension services, support	Various
1920 Agri Extension (also known as Govi Sahana Sarana)	Extension, support	http://gic.gov.lk/gic/index.php/component/info/?id=1341&catid=47&task=info
Hello Tractor	Farm implements (tractor) share	http://hellotractor.com/
Kilimo Salama	Farm inputs and excess rain insurance	https://kilimosalama.files.wordpress.com/2010/02/kilimo-salama-fact-sheet-final11.pdf
Ushahidi	Governance, political matters	http://www.ushahidi.com/about-us/our-story
TXT CSC	Governance, political matters	[illegible]
Acre Africa	Insurance (climatic data)	http://acreafrica.com/
Mali Shambani	Interactive farm to farm radio station	http://www.comminit.com/africa/content/mali-shambani
Nuru	Integrated Pest Management (IPM)	http://news.un.org/en/story/2018/06/1012952
Plantwise	Integrated Pest Management (IPM)	http://www.plantwise.org/
Kazi560	Labour migration, human development	
[illegible]	Labour migration, human development	http://www.[illegible].com/[illegible]-banking/mobile-banking/
[illegible]	Livestock, extension, support	http://www.[illegible].com/
Icow	Livestock Health & Management	http://icow.co.ke/
Vet Africa	Livestock Health & Management	http://www.cojengo.com/
Livestock Information Network and Knowledge System (LINKS)	Livestock market info	http://[illegible]/livestock-information-network-knowledge-system-for-enhanced-pastoral-livelihoods-in-east-africa/
e-Dairy	Livestock, extension, support	http://e-dairy.training.modules.africa/
Dream E-dairy	Livestock, extension, support	http://www.[illegible].com/[illegible]-dairyman-ventures-[illegible]/dream-e-dairy/
Digicow	Livestock, extension, support	http://digicow.co.ke/
BuyfromWomen	Market links	http://www.buyfromwomen.org/
M-Farm	Market links	http://www.mfarm.co.ke/
Esoko	Market links	http://esoko.com/
Virtual City	Market links, distribution, logistics, traceability	http://www.virtualcity.co.ke/
iShamba	Market links, extension, support	http://ishamba.com/
Kilimo Salama	Market links, rural finance infrastructure, information technology	http://[illegible].org/2013/05/kilimo-salama-index-based-agriculture-insurance/
MobileAgent	Poverty alleviation	http://mobileafrica.net/mobile-agent/
Kenya Agricultural Commodity Exchange	Price information, market links	http://www.[illegible]/kenya-agricultural-commodity-exchange-ltd
DrumNet	Price information, market links	http://www.poverty-action.org/project/[illegible]drumnet
[illegible]AgriPriceNews.com	Price information, market links	http://www.crunchbase.com/organization/[illegible]-com
Dialog Tradenet	Price information, market links	http://www.e-global.org/[illegible]dialog-tradenet/
TruTrade	Price information, market links	http://www.trutradeafrica.net/
Farmradar	Production (expected harvest, soil type, inputs	http://agris.fao.org/agris-search/search.do?recordID=GB2015004722
Grameen [illegible]	Resource management	
[illegible]	Rural banking network	http://www.techno-associates.co.ke/[illegible].html
SoilDoc	Soil diagnostic tool	http://agriculture.columbia.edu/projects/agriculture/soildoc/
Agrocares	Soil diagnostic tool	http://www.agrocares.com/
Nutrient Manager IRRI	Soil nutrient management	http://www.irri.org/crop-manager
Hach	Soil diagnostic tool	http://www.hach.com/soil-fertility-test-kit-model-sfk-1/product?id=7640217313
Digital Green	Technology integration	http://www.digitalgreen.org/
Reuters Market	Weather, Market prices	http://www.reuters.com/[illegible]/

than 3,200 farmers from 12 cooperatives in the maize value chain were registered on the platform during the pilot, which laid a good foundation for the BfW system and rich lessons were learned. Based on Rwanda's case, a refined version was developed and tested in Haiti, on the cocoa value chain in collaboration with a local social enterprise to mobilize farmers and organize their activities.

Full-fledged BfW value chains have been implemented in four countries: Costa Rica (Haiti, Mali and South Africa. Côte d'Ivoire, Liberia, Rwanda and Senegal are in the process of implementing BfW. UN Women is also expanding the platform to other countries with CSA programmes.

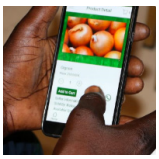
4.4 Addressing structural problems

The main BfW platform features have been developed to support the four CSA programme pillars:

- **Access to land.** The platform can map land plots, provide supporting documentation on the size and location of the land being farmed and calculate productivity and potential profits.
- **Access to finance.** The platform can be connected to partner institutions providing loans or microcredits to female farmers. Records from the platform are used as supporting documentation for farmers needing to show evidence on the extent of their production and monthly or yearly profits. The platform also can connect to mobile wallets that can provide access to digital banking services.
- **Access to information.** Female farmers can use the platform to access real-time information or training and capacity-building programmes to improve their knowledge and skills on such things as farming, extension services, markets and weather.
- **Access to market.** The platform can help women in reaching new markets and buyers, replacing cash with digital transactions, and identifying business opportunities.

The goal of the BfW platform is to provide new tools to address the four structural barriers identified in the CSA programme and complement the more traditional interventions planned under that programme. In countries where there is no digital platform that can provide similar services, the BfW platform develops tailored ICT solutions for female farmers that cover multiple aspects of the agribusiness supply chain. The platform is open-source and is customized based on solutions and lessons from other BfW countries.

FIGURE 4.2



Sample of Buy from Women features for UN Women climate-smart agriculture programme

The BfW project is grounded in the vision that, if more small-scale female farmers have access to long-term, affordable finance and the capacity to invest in climate-smart, labour-saving equipment and technologies, the following outcomes could be achieved:

- Increase in productivity, which increases local food security (access and nutrition) and national export capacity
- Increase in revenue and economic empowerment for female farmers, which increases savings and investments in farming, health and education, thereby breaking poverty cycles and gender inequalities
- Improvement in climate-smart agricultural practices, which reduces the trade-offs between food security and carbon sequestration

As an integral part of the CSA programme, it is anticipated that BfW will facilitate a revenue increase for female farmers in three major ways: 1) reduce post-harvest loss through the availability of a digital production record, provide weather information and clearer inventory management that would help farmers in smarter post-harvest handling and management; 2) provide easier access to finance through the digital record provided by BfW which establishes credit profile for farmers, an essential element for eligibility for financial loans; 3) expanding the market: BfW gives farmers access to more online buyers, provides better branding of their products, and offers an easier way to manage customer relationships.

4.5 Main feature overview (as of January 2021)

Snapshot of farmer's personal page and business page on Buy from Women web (Annex 11)

Mobile application

- Sign-up feature for farmers, buyers, cooperatives, suppliers and food processors
- Global positioning system (GPS)-based land area calculation
- Farmer can record land details and quantity produced for each product
- Marketplace to sell and buy products
- Crop information notification to provide basic education on how to grow agriculture products
- Mobile payment option available upon country's agreement with mobile wallet partner
- Voice message option available upon country's identification with third-party partner
- Multi-language

FIGURE 4.3

Snapshot of Buy from Women application for Haiti (Annex 11)

- **Land mapping.** A free satellite imagery service enables mapping of current land features on the application. By clicking on the screen, dots can be connected to draw the boundary of a plot, and the system automatically captures the size and GPS coordinates, which has greatly improved female farmers' management of their land and production.
- **Reduce manual errors in data entry.** The system is designed to eliminate human errors as much as possible. For example, set up fixed data entry format control across the system, like fixed numeric inputs, using choice menus rather than text boxes, to reduce potential human error; 2) integrate with third-party applications to eliminate data error. For example, land mapping is done via GPS, integration of mobile money payment and wallet will prevent the potential inconsistency of system record and actual cash payment amount; 3) Set up unique identifier for user profile, e.g. national ID in Mali and unique log in ID for Haiti, so that no confusion even if names are misspelled or when multiple people share a same phone number.
- **New additions to BfW.** Each country is encouraged to develop and test new features based on the programmatic needs assessments conducted with potential beneficiaries. Pilot countries have identified two additional features that could be added in the coming months:
- **Traceability.** Buyers of organic products and exporters have -expressed an interest in using BfW to improve traceability and allow registration and tracking of products from the farm to the final customer. These features could be tested in Côte d'Ivoire, for example, where the UN Women country office has obtained organic certification for shea butter and cassava that female farmers produce.
- **Disaster risk reduction.** In Haiti, where female farmers are particularly vulnerable to adverse weather incidents, a disaster risk reduction component could be developed to include such things as weather index insurance.

In addition to these two features, and based on country-specific needs, UN Women could also explore new features in relation to such things as land registration, microloans and manufactured products. In Rwanda, an off-farm female entrepreneurship database and information management has been added to the platform.will be added.

More work on data analytics, usability tests and adjustments, and business sustainability studies are underway for other countries.

- **Value addition.** Unlike various agri-digital tools that companies have developed to monitor their suppliers, BfW is a user-driven, female farmer centric tool. Beneficiary needs rather than buyers (companies that are the owners of many existing platforms) directly define the design of the system. In Rwanda for example, the new interface was designed with active consultations and participation of all actors: female farmers, buyers and financial institutions. Building on the lessons learned from the pilot phase, each stakeholder expressed what worked and what could be improved on the digital platform. The local developer company is basing its work not only on the terms of reference that UN Women produces, but also on feedback received from all users. It is an enterprise resource planning system that belongs to farmers and farmer organizations, covers multiple functions and is very flexible in integrating third-party applications. BfW is developed on open-source technology, which means it is easily adaptable to different country contexts and business processes and there are minimum costs for long-term use (unlike with proprietary software). All functions of BfW are free for all countries to share. In addition, the data collected through BfW can be analysed to benefit various stakeholders, from individual farmers to government agencies. **Data privacy.** For the pilot phase in each country, UN Women hosts the platform, with full compliance with corporate data security policy (including European Union General Data Protection Regulation 2016/679). Depending on the discussion between each country office and local government agencies, local agencies could host the platform after the pilot stage. UN Women aims to hand over the whole system to local stakeholders, limited with public sectors, which will take full control and operation of the platform. The data will never be 'sold' to third parties. There are also plans to develop a progressive (step by step) sustainability and localization strategy.
- Estimate technology cost, communication materials, programme documents, market assessments, recruitment terms of reference and all other relevant product documents are stored in a shared drive, that colleagues can access.

There is still room for improvement of the current version of the platform, and recommendations for improvement are outlined in Annex 10

4.6 BfW Journey and Toolkit

Based on lessons learned from Haiti, Mali and Rwanda (see case studies from the latter two countries in Annex 9), UN Women has developed a checklist for new countries that plan to use BfW in their CSA programme. This checklist (Annex 11) covers a range of considerations for introducing BfW and increasing the success rate of technology use. It is highly recommended that countries check each section, learn previous lessons, avoid pitfalls and refine their planning and project documents.

Some major considerations are:

- **Design stage.** Identification of value chain, identification of beneficiaries, vetting of solutions, determination of user requirements
- **Development stage.** Clear roles and responsibilities, technical specifications and sprint development partnerships with implementation partners, telecommunications companies
- **Implementation stage.** User training, monitoring and evaluation protocol sustainability plan

The evolving BfW can be considered as a collaborative design process, which means that each new country can leverage what has been built in previous countries while remaining free to try new features that meet their particular needs. In return, the new feature developed, once proved successful, will be accessible to all other countries implementing the BfW initiative. UN Women signed a long-term

agreement with a global credited golden partner of the Odoo system for development of BfW. It is anticipated that this partner will provide design, development, upgrade and maintenance services across countries, so the institutional knowledge also exists with the technology partner.

Several other tools have been developed to facilitate the project.

- A general workplan to enable multi-units collaboration link
- A monitoring and evaluation framework to evaluate the effect of BfW
- **Access to land:** The platform can map land plots, provide supporting documentation on the size and location of the land being farmed and calculate productivity and potential profits.
- **Access to finance:** The platform can be connected to partner institutions providing loans or microcredits to female farmers. Records from the platform can be used as supporting documentation for farmers needing to show evidence of the extent of their production and monthly or yearly profits. The platform can also be connected to mobile wallets that can provide farmers with digital banking services.
- **Access to information:** Female farmers can use the platform to access real-time information or training and capacity-building programmes to improve their knowledge of and skills in farming, extension services, markets, weather and other things.
- **Access to market:** The platform can help women with reaching new markets and buyers, replacing cash by using digital transactions and identifying new business opportunities.

The BfW platform aims to provide new tools to address the four structural barriers identified in the UN Women CSA programme and complement the more traditional interventions planned under that programme. In countries without a digital platform to provide similar services, the BfW platform aims to develop tailored ICT solutions for female farmers that cover multiple aspects of the agribusiness supply chain, are open-source and can use solutions from other BfW pilot countries.

END NOTES

Chapter 4

1. FAO 2013a.
2. Unwin 2009.
3. Forum for Agricultural Research in Africa 2008.
4. USAID 2012.
5. Okyere and Mekonnen 2012.

ANNEXES

ANNEX 1

CRITIQUES OF THE CLIMATE-SMART AGRICULTURE CONCEPT

Climate-smart agriculture (CSA) is facing conceptual misunderstandings within the research community and growing criticism from civil society.[1]

Critics contend that CSA would gain clarity and credibility if its proponents were to formally favour agroecological-ecological options in their initiatives – or at least discard some acknowledged unsustainable agricultural practices. They note that, although CSA is often presented as a triple win in terms of productivity, sustainability and emissions reduction, the impact that the pursuit of these goals has on agro-ecology and sustainable agriculture is often ignored.

For example, the first goal requires continual productivity gains so production can keep up with consumption. In this pursuit, critics note, sustainability is neglected, leading to resource degradation mainly as a result of poor land and water management practices. For CSA to be sustainable, links are needed between CSA, sustainable development and agro-ecology. And for agriculture to be sustainable, the concept of productivity needs to be re-envisioned, as it cuts to the heart of what an agricultural system does and who it benefits.[2] Agriculture arguably produces far more than an immediate yield of food, fuel, or fibre. In fact, agro-ecosystems may contribute to or impede renewable natural resource management, landscape and biodiversity conservation, and the socioeconomic viability of rural areas. It has been suggested that productivity should be examined holistically to consider the multifunctionality of agriculture or in agro- ecological terms.[3] Agroecological-ecological farming avoids the simplified cropping patterns of input-intensive agriculture which CSA emphasizes, but seeks to intensify agriculture by harnessing localized biological processes based on the interaction of different types of crops and other organisms in the immediate environment. The aim is to use biological processes to regulate such things as nutrient cycles, biomass production, pest control and water cycling with limited external inputs. This model of farming is knowledge-

intensive, and a holistic understanding of the multifunctionality of an agroecosystem-ecosystem is pivotal to its success.

Resilience issues are also related to sustainability. In broad terms, resilience designates the ability of a system to withstand external shocks such as climatic shifts. The level at which resilience is considered – crop, farm, landscape, bioregion, global – is significant.[4] In many agrarian regions, the resilience of an agricultural system depends on the ability of relatively privileged actors to push the costs of maintaining stability on to subordinate groups. In southern India, for example, the resilience of farms in times of water scarcity often relies on the ability of male farmers to increase the labour burdens of female household workers. There are good reasons for thinking that the goals of resilience and productivity are not congruent, as the CSA presumes in its triple win formula.

Concerns with the third goal of CSA relate to emissions control, along with increased production. Contrary to the thesis pushed by international organizations that the use of synthetic inputs and machinery in agriculture to raise yields does not increase emissions in some sectors, there is always a trade-off between increased yields and increased greenhouse gas emissions. The goal of agricultural modernization implies an increase in emissions

connected to agriculture – a process which would have to be compensated for in other ways to maintain climate smartness.

Despite these shortcomings, CSA continues to spread, and international and national frameworks are being formulated and resources distributed following the approach. In recent years, the concept of 'climate-wise' agriculture has been introduced, which takes into account equity and sustainability concerns.5 Its introduction stems from recognition of the trade-offs and conflicts between the goals of productivity, sustainability and emissions reduction underlying CSA's triple win claims. The framework of a climate-wise food system could emphasize four points that are well represented in the literature on food sovereignty and agro-ecology:

- Access to sufficient nutritious food (food distribution)
- Shifts in consumption patterns
- Building on strong preferences for ecological intensification, in which biological processes and human labour underscore productivity advances, rather than external, energy-intensive inputs.
- Participatory climate-wise approaches which challenge the politics of knowledge production in which the concentrated power of agro-corporations – stemming from an increasingly oligarchic hold over agricultural research, and input and output markets – disproportionately influence political debates on agrarian futures in favour of the status quo.

ANNEX 2

ADDITIONAL CLIMATE-SMART AGRICULTURE PRACTICES AND APPROACHES[1]

A2.1 Livestock and rangeland management

A2.1.1 Land-based systems

The main mitigation options for land-based grazing systems are reductions in enteric methane emissions and carbon dioxide removal through soil carbon sequestration. Grazing management (balancing and relieving grazing pressures on land) can lead to increased grassland productivity and deliver other mitigation and adaptation benefits. Rotational grazing is one of the main strategies that can increase the efficiency of grazing management. It can be adjusted through frequency and timing of the livestock's grazing needs and better meet these needs with available pasture resources.

Rotational grazing. Rotational grazing allows forage to grown early in the growth stage, helping to enhance its quality and digestibility, which increases system productivity. This is an important sustainable grazing practice. Increasing livestock mobility, which has traditionally been done by nomadic and transhumant herders in many parts of Africa, helps to match animal production needs with changing rangeland resources thereby increasing the resilience of these livestock systems to climate change. Rotational grazing may allow farmers, especially women, to combine different economic activities on small plots of land.

Pasture management and nutrition. Sustainable pasture management practices include sowing improved varieties of fodder, by replacing native grasses with higher-yielding and more digestible forage using perennial fodder, grasses, and legumes. To enhance productivity, soil carbon, pasture quality and animal performance pasture production intensification measures such as fertilization, cutting regimes and irrigation can be used. Growing fodder has been important for women because it enables them to raise one or two animals on 'zero grazing'; this increases their income, given land access constraints.

Animal breeding. Another strategy that can enhance productivity and reduce methane emissions is animal breeding in that more productive animals are selected. For example, cross-breeding has been shown to deliver simultaneous advantages for adaptation, food security and mitigation benefits. In the face of climate change, cross-breeding strategies will need to make use of locally adapted breeds that are tolerant to heat, poor nutrition, parasites and diseases. Adapting and adding livestock species is another adaptation practice. For instance in northern Kenya, the Samburu are traditionally cattle herders who adopted camels as part of their social livelihood strategy 1. In the face of threats from drought, cattle raiding and animal diseases, the Samburu embraced camels as a mitigation strategy to counteract the environmental shocks that were driving the decline in their cattle-based economy.

Vaccines. Vaccines against methanogens (microorganisms that produce methane as a metabolic by-product in low-oxygen conditions) in

the rumen are a potentially useful mitigation option for ruminants in land-based grazing systems because of their wide applicability, even for very low-input extensive systems with little human intervention.

Early warning systems and insurance. The use of weather information helps rural communities manage the risks associated with rainfall variability, which is potentially effective in climate change adaptation. In situations where risks are unacceptably high for the private sector, recently developed public–private partnership approaches to index-based livestock insurance have been useful because the public sector underwrites a significant share of these risks. In several areas of drought-prone northern Kenya indexed insurance schemes based on satellite imagery are being piloted.

Agroforestry practices. Agroforestry as a mitigation practice is important because it leads to carbon sequestration, improved feed and consequently reduced enteric methane. By using trees to intensify and diversify production and buffer farming systems against hazards, agroforestry improves the resilience of agricultural production in the face of climate variability. Shade trees also help to reduce heat stress on animals and increase productivity. In addition to the other benefits of trees, agroforestry also provides smallholder farmers, especially women, with access to fuelwood.

A2.1.2 Mixed systems

Mixed livestock systems can be one of the most important adaptation mechanisms for climate change and for mitigating the contribution of crop and livestock production to greenhouse gas (GHG) emissions. A number of agronomic techniques and livestock management practices have proven effective in delivering multiple benefits (food security, climate change mitigation and adaptation). The options below are for integrated mixed systems but focus on livestock-related interventions for climate-smart agriculture (CSA).

Integrated soil, crop and water management. Integrating soil and water management increases efficiency in the use of resources, adaptation to and mitigation of climate change, and thus sustains productivity. Examples of integrated soil and water adaptation practices include erosion control, minimum or zero tillage, use of crop residues to conserve soil moisture, and improved soil cover through cover crops. Other mixed-system practices that increase productivity and adaptation to climate change include mulching, green manure, conservation tillage and conservation agriculture, since they increase water infiltration, reduce evaporation, and increase storage of rainwater in soils. They can therefore help land users in areas projected to receive lower levels of precipitation adapt to climate change. Another mitigation practice entails the capture of carbon in the soil. This can be achieved through the use of soil management practices that limit soil compaction, reduce tillage, and retain crop residues.

Water use efficiency and management. Increasing the productivity of water use (crop output per unit of water) is another way to improve climate change adaptation. Examples of practices that can achieve this include irrigation techniques that maximize water use, supplementary irrigation in rain-fed systems and water-efficient technologies to harvest water, cultivation of crop varieties with resistance to extreme conditions, and modification of cropping calendars (timing or location).

Sustainable soil management. Using residues as mulch in combination with no-till farming and integrated nutrient management (appropriate application of synthetic and organic fertilizer) can help create a positive carbon budget in soils and ecosystems and is one of the climate-smart strategies in this area. Soil carbon sequestration improves soil quality and offers other ecosystem services. An increase in soil organic carbon pools can restore degraded soils and improves production, which fosters food security and improves nutrition. It also increases efficiency in the use of nitrogen and potassium.

Feed management. Feed resources are usually not easily digested and are deficient in crude protein, minerals and vitamins which limits productivity and increases methane emissions. Improving the quality of crop residues or supplementing diets with concentrates increases the digestibility of feed rations and reduces methane emissions. There are other helpful feed management practices in mixed farming systems, including the use of improved grass species and forage legumes.

A2.2 Diversification to climate-resilient agricultural production systems

An example of a farm-level adaptation option is a change in the mix of farm products (e.g., proportion of crops to pastures) This might entail farmers reassessing the crops and varieties they grow and shifting from growing crops to raising livestock – which can serve as marketable insurance in times of drought. Introduction of heat-tolerant breeds that are more resistant to drought is another example. However, before these benefits are achieved, in the short term with respect to emissions, some trade-offs need to be made as regards to productivity and food security. Poor subsistence farmers, including women, may not be willing or able to accept the short-term losses associated with some of these practices despite the long-term benefits.

Improved feed conversion. Feed efficiency or the reduction of the amount of feed required per unit of output has the potential to reduce GHG emissions and increase farm profits. Measures to ensure feed efficiency may include the development of breeds that grow faster, are hardier, gain weight more quickly or produce more milk. It can also be achieved through herd health, better veterinary services, preventive health programmes and improved water quality.

Sourcing low-emission feed. Use of feeds with a low- carbon footprint is another way to reduce emissions. This is especially relevant for concentrated pig and poultry production systems. Such low-emission feeds may include feed crops that have been grown in cropping areas that have not been recently extended into forested land or natural pastures or have been produced through conservation agriculture practices. Crop by-products and co-products from the agrifood industry are other examples of low-emission feeds.

Improving energy use efficiency. Improving energy use efficiency can help lower production costs as well as emissions. There is a need to reduce energy used for the milking process, cooling and storing milk, heating water, lighting, and ventilation. For example refrigeration systems are usually energy intensive. Replacements could be heat exchangers cooled using well water, variable-speed drives on milk pumps, refrigeration heat recovery units and scroll compressors to conserve energy.

These technologies can also reduce GHG emissions; the energy sector is particularly emission intensive.

A2.3 Sustainable forestry and agroforestry management

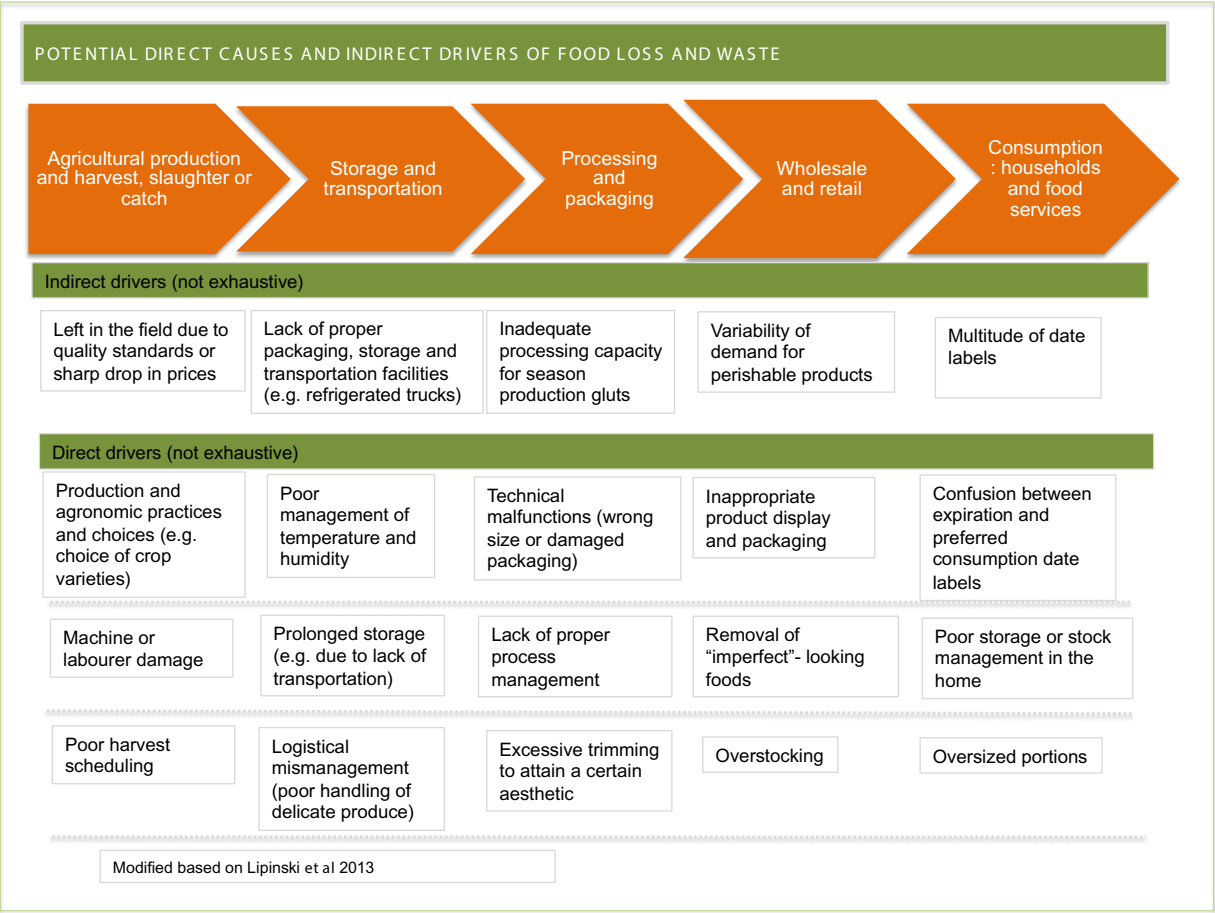
These practices apply to all three CSA pillars.

Mitigation. Trees planted in fields as windbreaks, live fences, fodder banks, alley cropping, woodlots or improved fallows can sequester carbon in biomass and soil. They also supply poles, fuelwood, and other forest-based products, preventing destruction of natural forests.1 Such actions include increasing tree cover (afforestation, agroforestry, reforestation), and reducing deforestation and degradation (slows land degradation), thereby increasing carbon sequestration in biomass and soil. This helps women gain access to the fuel they need for cooking, giving them more time for productive work.

Adaptation. Tree canopies reduce soil temperature for crops planted underneath and reduce run-off velocities caused by heavy rainfall. They also and increase resilience to natural hazards. Trees on farms act as shelterbelts or windbreaks and help protect against landslides and floods. They are used to stabilize riverbanks and to mitigate soil erosion. Agroforestry can help to restore and protect the ecosystem related to soils and watersheds through improved management systems and better management of biomass, including crop residues.

Such measures can increase and maintain the productivity of farming systems. Forests facilitate provision of ecosystem goods, such as non-timber forest products, food and fuel, primary production, nutrient cycling, and soil formation. Therefore, for forest activities to support CSA, adaptation actions targeted particularly at the most vulnerable communities and sectors of the population (e.g., women, children, elderly adults, indigenous populations) and forested ecosystems (e.g., woodlands, mountains, wetlands) are required to focus on the most efficient and cost-effective adaptation options. They also need to capitalize on adaptation-mitigation synergies. These options should focus on sustainable forest management and agroforestry.

A2.4. Drivers of post-harvestharvest loss



ANNEX 3

BEST PRACTICES IN CLIMATE-SMART AGRICULTURE AND INFORMATION AND COMMUNICATIONS TECHNOLOGY

A3.1 Soil and water management

Several case studies showcase positive gender-responsive climate-smart soil and water management practices that have strengthened women's economic empowerment: waterhole monitoring for livestock in north-eastern Kenya and southwestern Ethiopia; Grundfos Life link in Kenya, which uses the M-PESA payment system to recharge pump keys, allowing water drawing rights to be managed via mobile phones; the Kenyan's Kilimo Salama (safe farming) microinsurance-insurance scheme; and the use of Landsat satellites to assess irrigation systems in Mali.

A3.2 Crop production

Proven gender-responsive approaches and practices include cover cropping, mulching and integrated pest management to ensure adaptation; and growing of cover crops, intercropping and agroforestry to ensure mitigation. For crop management, information and communications technology (ICT) offers an opportunity to manage small farms more efficiently, and emerging ICT tools such as geographic information systems, precision agriculture, mobile mapping and handheld computers have great potential in addressing the challenges small-scale farmers face. They can also facilitate market access to traditional crops and local varieties, and support the adoption of resilient seed varieties and good practices for sustainable production. There are many successful case studies in this area, including conservation agriculture with ripper-furrower systems in Namibia.

A3.3 Livestock and rangeland management

Mitigation options include feed production, enteric fermentation and manure management; adaptation practices include management of organic matter and nutrients and income diversification. Specific practices for land-based systems include rotational grazing, pasture management and nutrition, animal breeding, vaccines, early warning systems, insurance and agroforestry practices. Those for use in mixed systems include integrated soil, crop and water management; water use efficiency and management; sustainable soil management; feed management; and diversification to climate-resilient agricultural production systems. ICT holds strong potential to enhance livestock and rangeland productivity, especially for women, because it can help farmers find out livestock prices and supply

information from the major livestock markets, including the Livestock Information Network Knowledge System (LINKS) Texas A&M University has implemented in Ethiopia, Kenya, and Tanzania; and the Namibian Livestock Identification and Traceability System (NamLITS). Among the many successful case studies of livestock management are the climate-sensitive village in Nyando, Kenya, which is breeding resilient ruminants (Box 2.5); Zimbabwe livestock health management interventions (Box 2.4)

A3.4 Sustainable agroforestry

Climate-smart agriculture (CSA) best practices in this subsector include improved fallows, alley cropping, home gardens, growing multipurpose trees and shrubs in farmlands, boundary planting, farm woodlots, orchards and tree gardens, tree plantations, shelterbelts, windbreaks, conservation hedges, fodder banks, live fences, silvopastoral systems and apiculture with trees for agroforestry. ICT can play an important role in conserving forests and in agroforestry – for example, in reducing emissions from deforestation and forest degradation, promoting forest governance as in the use of a management information system in the Vietnamese forestry sector, and the Global Forest Information System. Case studies of good gender-responsive CSA forest management and agroforestry practices include preserving the agroforestry system on Mount Kilimanjaro and conserving soil and water through agroforestry by intercropping fruit trees in Hoima, Uganda.

A3.5 Fisheries and aquaculture

Climate-smart fisheries and aquaculture practices that empower women may pertain to the reduction of excess capacity, which is linked to improved fisheries management and the maintenance of healthy, productive stocks and systems, especially for capture fish. ICT can play a role, including by improving marketing, as in Senegal, with the Manobi-developed platform; in Kerala, India, with a mobile network that provides daily fish prices; and wireless sensors that can monitor oxygen, tidal current, temperature levels, fish behaviours and water conditions. Successful case studies include fish farming promotion in Mutasa District, Zimbabwe; and the introduction of a fuelwood-saving fish-processing technology by the Food and Agriculture Organization of the United Nations in Liberia.

A3.6 Post-harvest management and value addition

Gender-responsive CSA practices can lead to sustainable, inclusive, equitable value chains. Such practices can improve the performance of CSA value chains for the benefit of women at all levels of the chain, including the food production stage, which may entail proper management and housing, milking hygiene, adequate feed and water, and animal health through vaccinations and drugs – that help to minimize and avoid food losses and waste. At the food distribution, marketing and retail stages, the condition of the transport infrastructure needs to be improved, ensuring suitable modes of transportation, refrigeration, good market facilities, and bulking, packaging, and proper labelling schemes. Opportunities for ICT – and the Buy from Women platform – to facilitate women's participation in CSA value chains include solutions to improve the management and efficiency of farmer organization operations and internal organizational processes; to increase access to local expert knowledge and advice on production methods and agricultural good practices; and to increase the financial inclusion of smallholders.

A3.6.1 Climate-smart post-harvest agricultural adaptation opportunities

- Growing and/or storing crops and varieties which are less susceptible to post-harvest pest attack;
- Prompt harvesting;
- Adequate and protected drying;
- Maintenance of the physical storage structures;
- Careful store cleaning and hygiene;
- Accurate estimation of food stock requirements;
- Protection and monitoring of grain to be stored for more than three months;
- Use of low GHG emission food preparation methods;
- Understanding and application of basic food safety principles;
- Increasing farmer access to market information and transport options;
- Use of early warning seasonal forecasts to project how the climatic conditions might impact on food storage or marketing strategies;
- Use of more water, energy and resource efficient processing, packaging and transport operations;
- Ensuring plant breeders evaluate post-harvest as well as pre-harvest crop characteristics; and
- Helping farmers to learn from others' and their own experiments.

A3.7 Energy

Smart practices for CSA with opportunities for women's economic empowerment include use of improved designs for domestic stoves, use of biogas cookstoves, and efficient use of fertilizer that lowers carbon dioxide and nitrous oxide emissions and reduces consumption of fossil fuels. Potential applications of ICT and the Buy from Women platform in climate-smart energy management include reduction of waste and increase in the usable volume of wood from harvest. Examples of successful case studies include the integration of clean energy (biogas) into CSA systems in Goromonzi District, Zimbabwe, and the integrated food-energy system in Colombia.

ANNEX 4

GOOD PRACTICES IN DESIGNING GENDER-RESPONSIVE CLIMATE-SMART AGRICULTURE PROGRAMMES

Analyse gender and social and political norms, along with different vulnerabilities to climate risks that affect increased adaptation and productivity for men, women, and vulnerable groups

Resources: Access to and control of resources and information	
Access to information and extension services	Facilitate equitable access to agriculture and climate information for all smallholder farmers; ensure that information and services address women's and girls' tasks and priorities
Access to inputs and Technology	Facilitate equitable access to agricultural inputs and technology that is sensitive to the priorities and constraints of female and young smallholder farmers
Access to natural Resources	Promote equitable access to natural resources by developing policies and approaches that facilitate equal access to land, water, and forest resources by male and female smallholder farmers
Access to markets and finance	Promote access to market opportunities and to equitable credit and finance for smallholder farmers
Knowledge, information and capacity-building	Use innovative, farmer-led, community-based approaches (including traditional and indigenous knowledge) for capacity-building
Power: Understanding power dynamics	
Planning and decision-making processes	Promote anticipatory, flexible, inclusive, forward-looking adaptation planning and decision-making processes
Equal voices and Representation	Promote equal representation in communities, especially of women, youth and marginalized groups, in decision-making at household, community and national levels; establish institutional arrangements and linkages that facilitate multi-stakeholder engagement
Monitoring, evaluation and learning	Integrate consultative learning, capacity-building, monitoring and knowledge management processes
Investing in programme Capacity	Conduct gender analysis to guide programme implementation and invest in staff capacity to mainstream gender-transformative approaches during programme implementation

Source: IFAD (2018)

ANNEX 5

ACTORS AND PARTNERSHIPS IN CLIMATE-SMART AGRICULTURE

A5.1 National governments and relevant ministries and agencies

The national ministries that are central in the implementation of climate-smart agriculture (CSA) programmes include agriculture, water and environment and lands and the national environment authorities.

A5.2 United NationsN agencies

A number of United NationsN agencies and funds are involved in CSA.

The **United Nations Environment Programme (UNEP)** focuses on adoption of CSA through ecological approaches to increasing food productivity in agriculturally dominated landscapes, while maintaining important services produced by natural habitats such as forests, wetlands and rangelands.

The **Food and Agriculture Organization of the United Nations (FAO)** manages works to increase agricultural productivity and adaptation to climate change. FAO uses tools, approaches, and information to support the adoption of CSA and development of appropriate policy frameworks and supports countries in their application. CSA is a major area of work under FAO's current strategic programme. In Africa, FAO supports national and regional agricultural investment programmes and NEPAD's Comprehensive African Agricultural Development Programme.

The **World Bank Group** supports countries in translating their nationally determined contributions (NDCs) into climate policies and investment plans into actions, and in mainstreaming climate considerations into policies and budgets through advisory services, public expenditure reviews and development policy operations. The World Bank Group works with regulators, creates green banking champions, provides climate credit lines, and promotes the growth and development of the green bond market. It helps countries gain access to concessional climate finance and supports research programmes such as the Consultative Group on International Agricultural Research (CGIAR), which develops climate-smart technologies and management methods, risk insurance early warning systems, and other innovations that promote resilience and combat climate change.

The **International Fund for Agricultural Development's (IFAD's)** Adaptation of Smallholder Agriculture Programme (ASAP) funnels climate change funding to farmers while helping countries achieve their greenhouse gas emissions reduction commitments. IFAD is also involved in the Platform for Agricultural Risk Management (PARM), working with national governments to assess risks and – with local stakeholders – identify, test, and implement solutions. IFAD also supports research in CSA; this includes, for example, salinity-resistant forage plants developed by the International Center for Biosaline Agriculture, which are helping farmers in many arid and semi-arid nations. Through the Green Climate Fund (GCF), IFAD is working to expand index insurance availability throughout Africa.

A5.3 Partnership networks

The **Africa Climate-Smart Agriculture Alliance**, also known as the AU-NEPAD INGO CSA Alliance (African Union–NEPAD–International Non-governmental Organization CSA Alliance), was announced in June 2014 at the African Union summit in Malabo. The Aalliance seeks to expand CSA to six million farming households across Africa through collaborative efforts and practical, on-the-ground experience of Alliance members in agricultural research and implementation.

The **Global Mechanism of the United Nations Convention to Combat Desertification (UNCCD)** designs financing strategies in member states. It facilitates partnerships in support of the Initiative for the adaptation of African agriculture to climate change. It works with the Secretariat of the African Ministerial Conference on the Environment (AMCEN), to strengthen the engagement of the Common Market for Eastern and Southern Africa (COMESA) with the AMCEN to prepare for the African High-level Panel on Climate Change and other meetings to position the issues of carbon finance in key negotiations leading to the United Nations Framework Convention on Climate Change (UNFCCC) meeting in Copenhagen.

The **Center for International Forestry Research (CIFOR)** works with the tripartite regional economic communities – i.e., COMESA, the East Africa Community (EAC) and the Southern African Development Community (SADC) – to develop strategies on forestry development and the concept of payment for ecosystem services. This partnership helps farmers and communities gain from forest resources to support member states to pilot mitigation measures in their countries.

The **African Conservation Tillage (ACT) Network** supports sharing best practices and information on CSA, while promoting and adopting conservation agriculture on the continent. It generates conservation agriculture awareness materials. It is the leading implementing agency of a number of initiatives promoting conservation agricultural technologies in Africa, including the Conservation Agriculture for Sustainable Agriculture and Rural Development (CASARD) project, which the German Trust Fund finances and in which Kenya and Tanzania participate. It implements the IFAD-financed Smallholder Conservation Agriculture Promotion (SCAP) project in Burkina Faso, Guinea and Niger.

A5.4 Research and academic institutions

The CGIAR research programme on **Climate Change, Agriculture and Food Security (CCAFS)**, led by the International Center for Tropical Agriculture, is a collaboration among all 15 CGIAR research centres and brings together researchers in the agricultural, climate, environmental and social sciences to identify and address the most important interactions, synergies and trade-offs between climate change and agriculture. The programme addresses the increasing effects of global warming and declining food security on agricultural practices, policies, and measures through a strategic collaboration between CGIAR and Future Earth.

The **International Maize and Wheat Improvement Center (Centro Internacional de Mejoramiento de Maíz y Trigo – CIMMYT)** implements the Sustainable Intensification of Maize-Legume Systems for Food Security in Eastern and Southern Africa (SIMLESA). The programme's aim is to increase food security and productivity at the farm through the development of more resilient, profitable, sustainable farming systems.

The **International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)** undertakes projects aimed at promoting local production of nitrogenous fertilizers by converting atmospheric nitrogen gas into chemical fertilizers.

The **World Agroforestry Centre (ICRAF)** conducts research in agroforestry, which is the practice of integrating trees into agricultural landscapes for economic and ecological benefits. It is one of the 15 research centres that constitute CGIAR. The centre conducts research in partnership with national agricultural research centres and advanced research institutes with a view to developing sustainable, productive land- use.

The **Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN)** supports regional and continental civil society organizations that work to reduce emissions from deforestation and forest degradation in agriculture, forestry, and other land- use (REDD-AFOLU).

Also at the continental level, **COMESA** supported the Pan African Climate Justice Alliance, an Africa-wide civil society organization network. The goal of the network is to act as an effective African platform for sharing information, advocating for environmental sustainability in development programmes. It coordinates engagement with African governments and advocating for fairness and justice in United Nations Framework Convention on Climate Change negotiation process to protect the climate system while safeguarding development.

A5.5 Non-governmental organizations

World Vision is a Christian advocacy, relief and development organization working with children, families and communities living in poverty and injustice. It has worked in community development in Africa for a long time and has a strong legacy of community-based forestry programmes.

Sasakawa Global has been involved in the introduction and promotion of conservation agriculture in East Africa.

The **Canadian Food Grains Bank** is a partnership of 15 Canadian churches and church-based agencies that work together to end global hunger. It has with programmes in Ethiopia, Kenya, and Tanzania. The partnership has supported the adoption of conservation agriculture and improved soil health, the profitability of farmers and overall system resilience. The partnership is well known for delivering an extensive large-scale conservation agriculture programme in sub-Saharan Africa.

CARE International implements a climate-smart initiative that builds on the Ethiopian's Productive Safety Net Programme and Household Asset Building Programme.

The **Alliance for a Green Revolution in Africa** works in agroforestry in many African countries.

Farm Africa is a charity that works directly with communities in East Africa – including Ethiopia, Kenya, South Sudan, Tanzania and Uganda.

ANNEX 6

POTENTIAL SOURCES OF FUNDING FOR CLIMATE-SMART AGRICULTURE

Meeting the financing challenges for climate-smart agriculture (CSA) requires innovation, cooperative action and the use of multiple funding sources, new and existing mechanisms, and better ways of connecting action to financing. The World Bank estimates that the annual costs of adaptation in the agricultural sector in developing countries will be US$2.5–2.6 billion a year between 2010 and 20502: "By 2030 developing countries will require US$2.8–6.7 billion in funds to enable adaptation to climate change."

A6.1 Financing mechanisms directly under the UNFCCC

The largest source of CSA financing is directly connected to the UNFCCC. One major mechanism under UNFCC is the **Global Environment Facility (GEF) .**The GEF Trust Fund funds activities that create global environmental benefits such as climate change **mitigation**.

Climate change **adaptation** activities are supported by the GEF-managed **Least Developed Countries Fund (LDCF)** and **Special Climate Change Fund (SCCF)**. These funds were established in 2001 and have developed into the main sources of global financing for climate change adaptation activities. The LDCF was originally mandated to fully finance least developed countries for the formulation of national adaptation programmes of action. The fund has shifted its focus towards support for implementing projects that respond to national adaptation programmes of action priorities. LDCF funding is only open for least developed countries. Other developing countries only get funding through SCCF, which funds almost all aspects of climate change adaptation and mitigation.

Funding from other GEF focal areas such as biodiversity and land degradation might be an option for some CSA initiatives.The GEF also provides funding for sustainable forest management (SFM) through its **SFM/REDD+** program5.

The UNFCCC also created a fund to address the adaptation needs of those countries not eligible for any of the GEF-administered funding sources. The **Adaptation Fund** was established in 2001 under the Kyoto Protocol and began operations in 2007.

A6.2 UN agencies and programmes

UN agencies and programmes are one of the main implementing agencies for activities financed through the UNFCCC funding.They also have multi-donor trust funds that provide climate financing directly financed

by member states. The United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation (UN-REDD Programme) and the Rural Energy Enterprise Development (REED) Programme are two prominent examples of this type of international climate finance.

In addition to GEF funding, **UN-REDD Programme**, a collaborative initiative of the United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP), and the

Food and Agriculture Organization of the United Nations (FAO) financed by Denmark, Japan, Norway and Spain is another major source of financial support for SFM activities. The programme primarily prepares countries for REDD+ activities, creating prerequisites such as monitoring, reporting and verification systems, enhanced policy and legal frameworks, monitoring systems, stakeholder awareness and management accountability. Activities under the UN-REDD Programme are coordinated with those of the Forest Carbon Partnership Facility of the World Bank.

The **Rural Energy Enterprise Development Programme** implemented by UNEP is another example of CSA-relevant funding options administered directly through United NationsN agencies and programmes. The programme invests in small and mid-sized enterprises that are providing clean energy solutions in rural areas; giving them seed funds as opposed to the more conventional grant approach. Relevant funding areas covered by the programme are clean technology applications that play an integral role in CSA activities, such as solar crop drying and wind- water irrigation.

A6.3 Multilateral development banks

Agriculture is a primary target sector for multilateral development bank (MDB) loans, which account for a [sizeable?] share of agricultural official development assistance. Among the MDBs, one of the most important and the largest lender as regards climate financing is the European Investment Bank. Grant-based climate finance provided through the MDBs is the **Climate Investment Funds (CIF)**, a joint initiative of the World Bank and the regional development

banks that support developing and emerging economies to shift to low-carbon and climate-resilient development by delivering climate-smart investment to scale. The CIF comprises two separate funds: the Clean Technology Fund and the Strategic Climate Fund. The CIF's Pilot Program for Climate Resilience provides the most direct financing option for CSA activities, but financing under it is earmarked for climate adaptation activities.

MDBs also administer their own climate change financing mechanisms. Among these is the **Forest Carbon Partnership Facility** of the World Bank, which complements the UN-REDD Programme and takes the lead in economic analysis of REDD strategies, including pilots on performance-based incentive payment systems. The African Development Bank's **Congo Basin Forest Fund** is an example of one of the regional banks' climate finance mechanisms which addresses deforestation in the Congo Basin. Another is the Asian Development Bank's **Clean Energy Financing Partnership Facility**, which targets policy, regulatory and institutional reform addressing clean energy development.

A6.4 Bilateral public financing channels

Bilateral financial institutions play a central role in climate finance as intermediaries disbursing funding to developing countries. The **French Development Agency** (Agence française de development – AFD), the **German Development Bank** (KfW) and the **Japan International Cooperation Agency** all support climate change activities. In addition, levels of South–South bilateral climate finance are increasing, including those provided by the **Brazilian Development Bank** (BNDES), the **China Development Bank** (CDB), the **Indian Renewable Energy Development Agency** (IREDA) and the **Overseas Private Investment Corporation** (OPIC). From a CSA perspective, an important programme for member states of the European Union (EU) is the **Global Climate Change Alliance** (GCCA), launched in 2007 as a European Union initiative coordinated by the European Commission. The **African, Caribbean and Pacific Group of States–European Commission Energy Facility**, which promotes access to sustainable energy services for poor rural populations in

sub-Saharan Africa, the Caribbean and the Pacific, is another major programme with potential links to CSA activities that the EU has funded. In addition to these initiatives the EU, through the European Commission budget, provides support individual climate change projects, including agricultural activities. Most of the individual EU member states provide funds bilaterally at the national level and these are often partially linked to the bilateral finance institutions listed above, providing climate financing to developing countries.

BOX A6.1

Gender dimensions of public climate finance

A budget is the most comprehensive statement of a government's social and economic plans and priorities. In tracking where money comes from and where it goes, budgets determine how public funds are raised, how they are used and who benefits from them. Therefore, implementing commitments to gender equality or climate finance requires intentional measures to incorporate these objectives into planning and budgeting frameworks. Various communities have made efforts to consider gender when drawing up domestic budgets and to incorporate climate considerations into public investments.

A6.5 Compliance and voluntary carbon markets

Some voluntary carbon market standards, such as the **Verified Carbon Standard** and the **American Carbon Registry** allow for carbon credits from CSA activities. However, most of the climate change mitigation credits derive from REDD activities, with carbon reductions from CSA playing a limited role. The **Panda Standard** is one of the most important emerging voluntary carbon markets in China, based on its first domestic carbon standard. It explicitly promotes reductions in greenhouse gas emissions from agriculture, forestry and other land uses.

A broad spectrum of certification methodologies for CSA credits has been developed under these various standards, including for agroforestry, integrated

farm energy systems, nutrient management, rice system management, tillage and residue management, and watershed restoration. For example, the Agricultural Carbon Project in Kenya, implemented by the Swedish NGO Vi Agroforestry, produces carbon credits from CSA activities that the World Bank's **Biocarbon Fund** will buy. The Biocarbon Fund is a public–private trust fund and part of a larger set of carbon funds that the World Bank's Carbon Finance Unit manages and administers. The Biocarbon Fund provides carbon finance for projects that create greenhouse gas reductions in forest, agro- and other ecosystems.

Box A6.2

Gender equality considerations in carbon markets

Despite a recent decrease in the size of its operations, the **Clean Development Mechanism** (CDM), one of the flexibility mechanisms defined in the Kyoto Protocol for voluntary certified emission reductions, continues to exist and offers valuable opportunities for integrating gender dimensions into climate change mitigation projects. Many carbon buyers are seeking to enhance their corporate social responsibility image by paying a premium for projects that not only offset their carbon footprint, but also bring co-benefits to local communities. The most promising practices involve certification schemes with links to voluntary carbon markets. For example, the most popular, gold standard certification, enables projects to earn certifications and increase purchase prices by meeting additional sustainability criteria – which include promoting livelihoods and educational opportunities for women. In the same vein, the **Women Organizing for Change in Agriculture and Natural Resource Management** introduced a standard that uses women's empowerment screening tools to certify projects for premium credits.

A6.6 Private sector actors and philanthropy

Most financing for agriculture in developing countries is from **domestic sources**, through national budgets or private sources. These investments come in a variety of forms – informal or personal family loans and formal trade credits, commercial lending and contract farming. Approximately 70 per cent of current investment in the Comprehensive Africa Agriculture Development Programme is private, mainly domestic.

Foreign direct investment in African agricultural land has risen significantly in recent years. Investors are a heterogeneous group, including private agribusiness and sovereign wealth funds. For example, Coca-Cola has a presence in almost all sub-Saharan African countries. These companies also have considerable

resources available to invest in food production and the agricultural value chain as a whole.

Private sources of capital can be classified as tied to regulated carbon markets, specifically the Clean Development Mechanism, or to voluntary carbon markets. Private companies may also invest in projects that could be considered low carbon carbon through their corporate social responsibility programmes or supply chain sustainability efforts.

A growing cohort of private foundations and international NGOs, such as the Rockefeller Foundation, CARE, Oxfam and Conservation International, are joining with national NGOs and farmer organizations to invest **philanthropic funding** in CSA. For example, the Rockefeller Foundation supports climate resilience for smallholder farmers through its Developing Climate Change Resilience initiative. The Howard G. Buffett Foundation supports conservation agriculture projects – with adaptation and mitigation benefits – in Burundi, Sierra Leone, Sudan and Tanzania through a partnership with CARE.

BOX A6.3

Women and private climate investment

Women's roles in driving and benefiting from private climate investment have been limited, but they are gaining momentum as part of a broader field of **gender lens investing**. Much of the work in gender lens investing is directed towards making finance smarter by incorporating a gender analysis into the financial analysis. This approach hypothesizes that the financial return on gender-responsive investment is likely to be higher because it better reflects gender-differentiated risks and opportunities and leverages the voice and agency of women.[1]

Green bonds could offer a new avenue for increasing women's roles in climate finance and maximizing development co-benefits between gender and climate action. Green bonds enhance an issuer's reputation, because their use helps showcase commitment to sustainable development and provides issuers with access to a specific set of global investors who invest only in green or social ventures. As a result, green bonds are substantially helping to reduce the cost of capital for project proponents.

A major factor for the continued growth of the market is the credibility of green labelling. Standards, assurance and certification are essential to improve confidence and transparency. An avenue to leverage co-benefits between gender and climate action would be to require that, to designate an issue of a corporate bond as a green bond, the issuer would have to disclose information on the gender-differentiated effect of the use of the proceeds. Alternatively, co-benefits between gender equality and climate action could be intentionally built into a new generation of green bonds to increase the development effect, improve the risk–reward profiles of the supported investments and lower financing costs for entrepreneurs.

1. For more about gender lens investing, see Criterion Institute (2015).

ANNEX 7

KEY CLIMATE-SMART AGRICULTURE PRACTICES IN EAST AFRICA

CSA practice	Components	How it is climate-smart
Conservation Agriculture	• Reduced tillage • Crop rotation and intercropping with cereals and Legumes • Crop residue management – mulching, intercropping	• Sequesters carbon • Reduces emissions • Is resistant to dry and hot spells
Integrated soil fertility Management	• Efficient fertilizer application techniques (time, • Compost and manure management including green Manuring	• Reduces emission of nitrous oxide and methane • Increases soil productivity
Small-scale irrigation	• Efficient water use • Year-round cropping	• Creates carbon sinks • Increases yields and food security
Agroforestry	• Practised traditionally and as improved practice (e.g., farmer-managed natural regeneration)	• Sequesters carbon • Increases resilience and productivity of agriculture • Increases food security
Crop diversification	• Pest resistance, high yielding, tolerant to drought, short season • Popularization of new crops and crop varieties	• Increases resilience • Increases incomes
Improved livestock feed and feeding Practices	• Reduced open grazing and zero grazing • Feed improvement • Forage development and rangeland management • Livestock breed improvement and diversification • Alternative energy – biofuels, efficient stoves • In situ water conservation and harvesting • Early warning systems and weather and climate Information	• Increases livestock productivity • Reduces greenhouse gases • Reduces methane • Increases resilience of agriculture • Increases incomes • Reduces emissions
Other	• Livelihood diversification (apiculture, aquaculture) • Crop and livestock insurance • Post-harvest technologies (agro-processing, storage)	• Reduces deforestation • Reduces climate risk • Reduces losses

Source: FAO (2016a)

ANNEX 8

WOMEN, AGRICULTURE AND ICT: SOLUTIONS AND BARRIERS

A8.1 Problems facing women in agriculture that ICT may address

Even with their predominance in agriculture, women are systematically denied access to land, credit, extension services, markets and technology – including information and communications technology (ICT). Some of the challenges women face in agriculture that could be remedied with ICT are described below.

Women's rights to use, control and own land, which in turn implies rights to other forms of property, are inadequate and limit their production capacity. Cultural barriers to women's ownership of land are prevalent in most rural areas where agriculture takes place, especially in sub-Saharan Africa. Access to ICT can alleviate this gender divide in land rights by providing useful information, especially on land formalization processes.

Rural women may participate in but do not necessarily benefit directly from **agricultural extension programmes and research findings**. Extension services and research are increasingly being privatized, but private organizations produce only goods for which they foresee a high probability of an attractive financial return. Women, who are usually smallholders, are not used to paying for agricultural advice and have little money available to buy such services. This denies women access to extension and research services. ICT has the potential to change this by providing extension information through ICT media.

Technology is not gender-neutral, and there is little involvement by female farmers in technology design and implementation; this results in new technologies being inappropriate for female farmers. In some cases, the introduction of new technology has had the adverse effect of increasing women's workloads instead of providing them with expected benefits. In other cases, when a new technology begins to produce income, and especially when it becomes more profitable, men often take control of it. ICT has the potential to change this by providing ICT-facilitated technology.

Women usually find it harder to obtain **credit**. In addition, because they are excluded from extension services and cooperatives, it is difficult for them to access fertilizers and other agricultural inputs. Without credit, women find it even more difficult to overcome other obstacles, such as lack of labour and information. ICT has the potential to change this by increasing access to financial sources and ICT-related credit services.

A8.2 Main barriers to women's access to and use of ICT

Men and women differ in the kinds of ICT they use, their access to, control of and use of ICT. Additionally, there is still a persistent **gender-based digital divide** that is particularly wide in rural areas. As the number of ICT users increases, this divide unfortunately is increasing and is not expected to be removed just by increasing access. There are a number of gender-based barriers that restrict women's access to, control of and use of ICT – and unless they are appropriately addressed ICT-based initiatives for climate-smart agriculture (CSA) and rural development will not be effective[1].

A8.2.2 Cultural and social attitudes

Women's access to technology and technology education can be impeded by cultural and societal attitudes. For example, women sometimes find it harder to visit telecentres or cybercafés due to safety concerns especially if the facility is located next to a bar, or only frequented by men, or because of mobility concerns.

Another issue is the social or community perception of women's use of technologies or their participation in ICT training due to expectations to attend to traditional household duties.

In turn, ICT can overcome some of these cultural or social barriers. For example, for people with mobility constraints, instruction can be delivered through e-learning on computers or mobile devices. Mobile phones can allow people in remote locations to exchange information without having to physically move[2].

A8.2.2 Time and mobility constraints

Rural women's multiple roles and heavy domestic responsibilities often do not allow them time to learn about and use ICT. Rural women have heavy workloads, including fetching water, cooking, taking care of the children and cleaning – all in addition to their agricultural activities. ICT can help them to manage their time more efficiently[3].

A8.2.3 Finance and control

Women are less likely to be able to buy ICT hardware or pay for access or training because they generally have lower incomes than men. For example, when women own mobile phones or have access to any other ICT, they often do not control its use in the household. They may be forced to share their phones with other family members or the community and may access them only at specific times of the day or week[4].

Opportunities ICT offers in access to finance and financial services and programmes such as e-learning can empower women and increase the control they have over the use of ICT, as well as other aspects of their livelihoods.

A8.2.4 Literacy and education

Introducing ICT is not always simple for people who are illiterate. There are also other access barriers, including technical illiteracy, which is often exacerbated by women's lower education levels. For example, sending a short message service (SMS) text may be much more difficult for illiterate people or those with only basic literacy. Such people might find it difficult to type a message on a phone, for example. Using a computer and browsing the Internet are particularly difficult[5].

Other difficult tasks include subscribing and unsubscribing to mobile phone because the instructions are often in English, or the process requires different subsequent actions. Audio programmes, including radio, videos and images can offer more suitable alternatives to written information and can help overcome literacy barriers especially for rural women.

A8.2.5 High cost of ICT deployment

In spite of the increasing popularity of ICT equipment and access even in rural agricultural areas, the high cost of ICT deployment, constant power outages and the huge resources required to procure equipment, bandwidth and other logistics for smooth accessibility often limit access to ICT for a large portion of the population. This is especially true for women, who have limited resources and technological knowledge.

A8.2.6 Absence of basic infrastructure

Lack of power required for effective ICT access is a major challenge that a vast majority of the population faces, including women involved in CSA.

A8.2.7 Unfamiliarity with ICT

The basic skills and expertise required to access ICT are, in most instances, not readily available. Lack of familiarity with the range of ICT poses challenges to women, especially rural women who are not familiar with the technology. There is a need for ICT literacy skills, and women need to be encouraged to participate fully in, benefit from and contribute to information-sharing.

A8.3 Ways to overcome barriers to women's access to and use of ICT

A8.3.1 Content

FAO advises that the content needs to be gender-sensitive. Participatory approaches in ICT initiatives are needed to ensure they are appropriate for potential users. Female and male farmers do not always have the same information needs because they often have different locations along the value chain[6]. Content language and format needs to be appropriate for ICT applications to support productivity enhancement.

In addition, content should be taken from trusted and reliable sources, preferably in local languages and local contexts to ensure equitable access to agricultural knowledge. Information needs to be in formats that meet the information needs and preferences of different groups of users including women and men. Useless information gives little motivation for the users to make use of the technology or to learn how to use it. Since information needs may be different for women and men, it is always important to avoid making assumptions about what information each sex needs.

A8.3.2 Access and participation

ICT-based tools and the processes of developing them need to be relevant to the needs of men and women. Users need to be given a voice in formulation, implementation, and evaluation to ensure inclusivity. Participation in development and use of these tools should consider the daily timetables of men and women and not be a burden to them. Activities should be organized at a place that is accessible and socially acceptable to ensure broad participation. This should be ensured across all levels including at the design of the ICT and its applications. This ensures that people are placed at the centre, rather than the technology.

ICT becomes very effective if it is designed and implemented according to people's real needs which will create an enabling environment for programme implementation. One option to improve ownership is to involve local extension workers who communities already know well and trust[7].

A8.3.3 Capacity development

Capacity development needs to be done at three levels: the individual level, the organizational level and the level of the enabling environment. At the **individual level**, this means adapting the capacity-building initiative to the needs of men and women. It might be important to allow experience sharing through training women and men separately, but also bringing them together on some occasions[8].

This approach can allow men and women to freely learn separately but also create an environment for them to share across genders. For some people, it is more difficult to express themselves in mixed groups. Training sessions should take into account women's and men's timetables and be realistic to encourage participation. Measures like the provision of childcare during sessions can persuade women to attend.

Literacy courses can alleviate the limitations for illiterate people in the use of ICT.

At the **organizational level,** the ICT capacities of organizations involved in agriculture or rural development initiatives should be developed to better mainstream gender in their programmes. For example, farmer organizations should be gender-sensitive and understand the need for equal participation and opportunities for men and women. Systems and structures should also be gender-responsive with gender-aware staff, gender-responsive monitoring and evaluation systems and learning mechanisms to address gender gaps when and where they surface. This also requires gender-sensitive leadership to make the right decisions on strategies, approaches and budgets.

At the **enabling environment level**, ICT policies and e-agriculture strategies should be gender-responsive by ensuring that all stakeholders are represented, including women and men at all levels. Information on gender differences in access to, use of and effect of ICT needs to be available. Accurate sex-dis-aggregated data and indicators need to be collected to inform policymakers about potential gaps and inequalities and develop strategies to address them.

A8.3.4 Partnerships

Partners involved in ICT processes need to understand gender equality challenges and how to overcome them. Analysis of gender awareness of every partner engaged in the initiative is important. Partner organizations need to be trained in gender challenges to ensure that all parties are in agreement. Implementing partners should be gender-sensitive to ensure men and women benefit equally from the initiative.

Trust for partners makes the implementation of community ICT initiatives easier. Incorporating the private sector such as in public–private partnerships can help increase the access of women and men to information or financial services in areas that were previously not covered because they are less interesting to commercial operators. The collaboration between the private sector governments and the development community can help to close the gender gap.

A8.3.5 Technologies

Value chain players need to recognize the infrastructure constraints, as well as gender-based restrictions, that can limit the effectiveness of the newest technologies. The most appropriate technologies to overcome specific constraints need to be deployed. The purpose of using ICT for agricultural development is to find solutions to problems. Technologies might cause problems for women and should be deployed judiciously. For example, women in rural areas point out that using a mobile phone to exchange information about farms and agricultural products can get them into trouble with their spouses when they suspect infidelity.

Radio is one of the most accessible media, but needs to be used with caution if it is to contribute to gender equality. Many local radio stations are owned by men, as are most of the radio presenters, and they choose the topics featured. Women need to be more involved in rural radio stations to make the programmes more relevant to all. Radio programmes should also be combined with mobile phones to encourage listeners to call in to ask questions, or to intervene by sending a text. The Internet can make radio programmes available at all times while also serving as a valuable resource for radio producers.

Exchanging information is a traditional activity for male and female farmers but time and mobility constraints often limit exposure to new information providers. Traditional information channels may need ICT to provide them with access to expertise and up-to-date information. One example is the Women of Uganda Network which relies on the strength of locally developed information channels to increase the audience for its services.

Women's groups listen to local agricultural radio shows, call extension officers or share information between groups. They are given radio cassette players to record the information and mobile phones to call and share this information with other female farmers. Another example is the Dimitra Clubs of the Food and Agriculture Organization of the United Nations, which use solar radios and mobile phones to connect listeners to rural radio allowing questions and feedback on air and facilitating discussions among listeners after the radio programme has ended.[9]

A8.4 Economic, social and environmental sustainability

Providing income-generating opportunities and ideas that are immediately applicable can serve as a good incentive for ICT adoption and ensures economic sustainability. This encourages men and women to invest time and resources to learn about the ICT because they find it immediately relevant and because of the potentially long-term changes it could bring to their daily lives.

Farmers, and in particular small ones, with access to accurate information on the use of inputs and on yield results for different crops are better positioned to make decisions.

ICT initiatives designed to improve gender equality should target not only women, but also men, the larger family unit, and the community in order to ensure social sustainability. This family or community-centred approach to ICT initiatives eases women's access to ICT.

Taking the following actions within a community will help ensure ICT uptake and sustainability.

- **Conduct a gender analysis to identify opportunities for how ICT can enhance current practices.** The analysis should describe where

and how men and women participate in the specific value chain or agricultural activity and should capture what information and services male and female farmers need and how they are currently meeting those needs. It should also assess what kinds of ICT are already in use and the type of access men and women have to them (direct or mediated). Sex-disaggregated data on education and income and on attitudes towards technology use should be collected to help identify the most appropriate ICT application. For ICT applications to increase the productivity of women and men farmers, it is necessary to ensure that appropriate content is developed for them.

- **Develop direct relationships with male and female farmers.** The most recent ICT innovations will fail to bring women into agricultural programmes if leaders and practitioners do not engage with women directly. Buyers, extension agents, input suppliers and other service providers must reward the appropriate individuals for their participation in the value chain. Because ICT reduces overall transaction costs for firms, this can allow them to invest more in developing relationships directly with their suppliers.
- **Use ICT to complement existing information channels.** Male and female farmers are already exchanging information, often through word of mouth. Women especially rely on these informal communication channels because time and mobility constraints often limit their exposure to new information providers. ICT can support and enhance these channels by providing access to expertise and up-to-date information.
- **Identify employment opportunities for women with agriculture-related ICT service providers.** The potential for women to find employment with agriculture-related ICT service providers should not be overlooked. Women can be employed as call centre consultants and operators, delivering agricultural information to farmers. This may be a particularly attractive option for female agricultural extension officers who find it challenging to travel to remote districts to meet with farmers. Also, rural women should be recruited and trained at the village level to act as information intermediaries for other farmers; this approach is used in the Community Knowledge Worker Initiative in Uganda.[10]
- **Design two-way ICT programmes to collect and disseminate information.** In gathering data on farmers, it is critical to ensure that the data being collected are sex disaggregated. This includes data to fill long-standing gaps in information on land holdings, productivity and labour-force participation. Establishing mechanisms for men and women to become co-creators of knowledge products will enhance understanding of innovation occurring at the local level or for capturing men's and women's climate adaptation and mitigation strategies.
- **Develop gender-equitable national or regional ICT policy.** The gender dimensions of rural infrastructure and the enabling environment are an important consideration; ICT can only affect women's lives if infrastructure reaches them, and appropriate policies and programmes are in place to address poverty and gender challenges in accessing and using ICT.

ANNEX 9

ECONOMIC EMPOWERMENT OF WOMEN THROUGH CLIMATE-SENSITIVE AGRICULTURE: TWO CASE STUDIES

Buy from Women (BfW) is an innovative product with a global, end-to-end, mobile-enabled supply chain platform connecting women with information, finance and markets and providing a 360-degree view of their business. For a smallholder agricultural practitioner, the platform provides easy mobile-enabled access to value added agricultural services on climate-sensitive agricultural practices, including weather and market prices. The platform also captures digital transaction history for farmers, creating an economic identity, credit history and data-driven access to finance. It connects female farmers to the supply chain, increasing access to markets.

A9.1 Rwanda

Rwanda is a landlocked country in the Great Lakes region of East Africa. Almost 70 per cent of the Rwandan workforce is employed in agriculture, and the sector generates one third of the country's gross domestic product and nearly half of all exports. The focus of policies and strategic documents is to move agriculture from a low-production, subsistence-based sector to one that is market oriented and creates value and increases rural incomes, income security and the quality of life of the Rwanda's rural population in Rwanda. The adverse effects of climate change threaten these goals.

Rwanda is highly vulnerable to climate change because it relies strongly on rain-fed agriculture for rural livelihoods and exports. Extreme weather events associated with climate change have increased in frequency and magnitude in recent years. Floods, storms and landslides have been increasingly reported in the high-altitude western and northern provinces and droughts in the eastern province. The associated damage has resulted in harvest losses and proliferation of diseases and has reduced land availability for farmers. These weather events disproportionally affect female farmers, who mainly hold small plots of lands and do not have equal access to production inputs, agricultural extension services and finance. Poor harvests due to droughts, flooding and soil erosion not only lead to a loss of income for them, but also to a loss of nutritional diversity and food shortages for their households and communities.

A9.1.1 Areas of work

The UN Women Rwanda BfW pilot project connects smallholder farmers (men and women) to the agricultural supply chain and provides them with critical information on market prices, sensitization on gender equality and other upcoming opportunities via text messages. During registration on the BfW platform, farmers' land plots are

mapped; this information is then used to generate a yield forecast. The registration process also captures farmers' and cooperatives' experience with finance and provides real-time reports in dashboard form of important performance indicators.

Implementation of the platform in Rwanda also addresses the problem of post-harvest losses caused by climate change by connecting the people climate change most directly affects – female farmers – to climate-resilient agricultural extension information, finance and markets. Through the creation of an individual profile on a digital platform, female farmers can know the exact size of their land; forecast their production; and determine their needs in terms of fertilizers, improved seeds and pesticides. The platform connects them to the agricultural supply and value chain and provides them with critical information on weather, climate-resilient agricultural techniques and market prices via text messages.

Face-to-face capacity-building sessions on the use of organic fertilizers and sustainable pest, irrigation and water management techniques complement the information the platform provides. Furthermore, by enabling female farmers to track their harvest on the platform over several seasons, they can not only measure the effectiveness of these newly adopted production techniques, but also build a verifiable record to establish themselves as business entities. The BfW project thus aims to unlock traditional and innovative sources of finance for female farmers and cooperatives that can be used for investment in climate-smart agricultural techniques.

A9.1.2 Lessons learned and experience gained

The BfW project builds on a one-year pilot phase, during which the digital platform was developed and tested at 12 farmer cooperatives. Significant results were achieved, with 3,200 farmers registered on the digital platform, along with their land size. By the end of the pilot phase, some cooperatives had already tripled their production and income. Building on these achievements, the aim is to expand the project to reach new beneficiaries and include additional features on the platform.

From initial assessments ofas of May 2018, the BfW platform as designed and used in Rwanda has had some challenges and offers lessons to other country offices interested in introducing or expanding the platform. Some of these challenges are:

- The platform initially designed for Rwanda did not function at the operational level, and much needed to be changed, including restructuring the database. For instance, there was no provision for including cooperative-specific information such as cooperative agent and lead farmer; the level of access was not specified, meaning anyone who logged in could see all the information; and the digital platform was not connected to the Android application.
- The platform information flow is one way: information is stored, and communication is made to farmers, but there is no provision for farmer feedback and provision of updates on the use of the platform.
- An unstructured backend of the application makes data analysis and integration of further platform modules challenging.
- There was a significant initial challenge in connecting the web-based platform to mobile application.
- A lack of power and Internet connectivity in rural areas made online applications difficult to use.
- There is limited access to computer or smartphone technology at the individual farmer level. According to the 2013–2014 national Integrated Household Living Condition Survey, 51 per cent of female heads of household and 68 per cent of male heads of household owned at least one mobile phone, compared to 76.1 per cent of all Rwandans; this makes an online model problematic in some areas.

A9.2 Mali

In February 2013, UN Women in Mali launched the Women's Agriculture and Sustainable Development (Agriculture Femmes et Développement Durable) programme, with the goal of economically empowering 40,000 women in the Kayes, Koulikoro, Segou, Sikasso, Mopti and Gao regions by 2020. Increasing the productivity of female farmers by providing better access to technological innovations and information is one of the four outcomes of this programme.

UN Women in Mali also developed the mobile business management platform BfW, which links female farmers to information, markets, and finance,

giving them a 360-degree view of their business. Female farmers receive information on modern techniques of smart farming involving challenges related to preservation of the environment and climate change.

In Mali, where women account for more than half of agricultural workers but lack access to means of production, such as land and markets, the Women's Agriculture and Sustainable Development programme, which is funded by the Governments of Denmark, Luxembourg and Sweden, is empowering rural women through a combination of skills training and access to modern technology.

ANNEX 10

RECOMMENDATIONS FOR IMPROVING THE BUY FROM WOMEN PLATFORM

This annex explores the performance of the current model of the Buy from Women (BfW) platform as it is being piloted in Rwanda versus its intended purpose. Recommendations for possible improvement, drawn mainly from mission assessments, are also presented.

A10.1 Database

A10.1.1 Status

Data are entered into the registration system and customer relations management database. It has taken significant time to adapt the platform as originally developed to the Rwandan context. Also, as noted in Annex 9, the level of access was not specified, allowing anyone who logged in to see all information; and the digital platform was not connected to the Android application, among other issues. Moreover, not managing the data on-sitesite in Rwanda resulted in avoidable delays in implementation.

A10.2 Input and harvest prediction

A10.2.1 Status

Currently, in the Rwanda pilot, 3,200 farmers are registered on the platform, each with an individual profile that highlights their land size, production forecasts, contracts, loans, sales, inputs and crop life cycles. Twelve cooperatives are also registered.

Through registration of farmers' mobile phone numbers in their digital profiles, the mobile platform allows market information and key notes on meteorological developments and agricultural techniques to be shared with smallholder farmers via text messages, enabling them to plan their agricultural production based on good quality, up-to-date market information. Analysis of the aggregated information contained in individual farmers' digital profiles, including the size of their land plots, helps the cooperatives more accurately forecast their overall harvest volume and revenue.

A10.1.2 Recommendations for improvement

For future database development, the platform should be designed in the host country, allowing for easy customization and ensuring incorporation of the country context in the design phase.

There should be dedicated staff to manage the pre-platform phase, preferably staff with information technology programming skills, which will speed adaptation of the platform. An information and communications technology (ICT) staff member who can advise on ICT work and manage ICT vendors should be used rather than ICT user support staff.

A10.2.2 Recommendations for improvement

Incorporate data on the farmers' ability to increase productivity into the backend of the application.

A10.3 Access to market and value chain

A10.3.1 Status

The BfW platform facilitates farmer linkages to other actors along the agriculture value chain, increasing the gender responsiveness of farmers' cooperatives and increasing farmers' capacities to use efficient

production and post-harvest handling techniques. By establishing a digital platform connecting all actors along the agriculture value chain, the project intends to connect female farmers to quality information, markets and financial services and to allow them to establish themselves as economic entities through the creation of verified digital records.

For example, all 12 cooperatives covered under the project have been linked to the Rwanda Grains and Corn Corporation, which facilitated the delivery of approximately 655 metric tonnes of maize harvest for the 2013 Season A. This represents an immense potential for increased markets for products handled though the platform. Linking other actors along the value chain (e.g. buyers, financial institutions, input providers) to the platform will be an important step in increasing direct benefits for female smallholder farmers and cooperatives.

A10.3.2 Recommendations for improvement

The digital platform should enable entry for user credentials to all important actors along the value chain (e.g., buyers, financial institutions, input providers). This will ensure a broader benefit to the whole value chain. Value chains are also complementary to each other, so the platform should capture as many other products as possible, including crops, animals, retail, and crafts, to harness value chain complementarity.

Considerations for possible linkages to cross-border value chains might need to be explored given that most products are linked to regional or global value chains.

A10.4 Access to finance, credit and forms of payment

A10.4.1 Status

By creating an online tracking record of farmers' production and enabling famers to forecast production for the next harvest, the platform facilitates establishment of creditworthiness for farmers and thus their access to financial services and production inputs. For example, as noted, all 12 cooperatives covered have been linked to the Rwanda Grains and Corn Corporation. By respecting their forward contracts, farmers can build a production and credit history – which facilitates their engagement with financial institutions and increases their chances of securing loans and accessing financial services.

A10.4.2 Recommendations for improvement

The platform features should be up-scaled to include connections to other banking and credit services to give the farmers a wider range of products to choose from. This will also reduce the proportion of the unbanked population in the country. The credit history accumulated on the platform can serve as security for larger loans from established commercial institutions. The security of the data on the system must be addressed if this up-scaling is to take place.

A10.5 Platform cost and financial sustainability

A10.5.1 Status

Assessment of the Rwanda pilot has found a lack of clarity on funding and confirmed funding for the initiative and no clear information on the total cost of the platform. Thus, the sustainability of the platform over the long run cannot be assessed.

A10.5.2 Recommendations for improvement

The total cost of the platform and related operating costs should be assessed, and funding secured to avoid delays. The cost of the initiative (financial, time/staff time, equipment etc.) should be compared with that of similar platforms (e.g., the International Trade Centre's SheTrades, WEConnect, the World Food Programme's Farm to Market Alliance, TruTrade) implemented by other agencies and organizations and similar ongoing initiatives in the country.

Resources should be secured for implementation of the BfW initiative after UN Women climate-smart agriculture (CSA) flagship programme funding ends or a clear strategy for raising resources prepared to sustain continuous use of the platform.

UN Women undertook a financial sustainability analysis of the Rwanda pilot to determine which revenue model is the most promising for financial sustainability for the BfW platform. There are three Revenue models that could be considered to begin generating revenue in Year 3 of implementation:

- Business-to-consumer model
- Business-to-business (B2B) model
- Hybrid model

UN Women determined the three potential business models based on who will be paying for the services offered through the platform. They assumed that value (demand for service) and ability to pay (assuming that the platform increases users' income and ability to pay) rather than management structure (who is charging) determines willingness to pay. Customers (farmers directly), businesses (on behalf of customers) or customers and businesses (hybrid) will pay.

The **business-to-consumer model** allows direct feedback from farmers. Its advantages are that it facilitates a built-in feedback loop: sustainability strategy is built into the model. As long as farmers are consistently satisfied with the product, they will continue to cover the operating costs, and the model allows for a more targeted intervention. Its disadvantages include high marketing and management costs, the fact that a pay-per-service culture is still new in Rwanda, that businesses need to clearly demonstrate its economic value before expecting payment from farmers, and that it can be difficult to find the price point all farmers are willing to pay that will cover operating costs. Under this revenue model, the main advantage is that farmers are involved, which allows for feedback; one drawback is that it takes a long time before this model reaches the break-even point.

The **business-to-business model** integrates value -chain actors as paying customers. Its advantages are that it entails lower marketing and management costs and that it facilitates training trainers and linkages along the value chain. Its disadvantages are that catering to the diverse needs of the various participating enterprises may prove challenging and costly; data security and the need to ensure the protection of private financial data may be daunting; and the exclusion of farmers as paying customers may, in effect, remove them from the feedback loop. The model breaks even around Year 9, which is a long time, but better than the business-to-consumer model. Because of the customizable nature of the platform, this model allows for revenue diversification to other businesses in addition to cooperatives.

The **hybrid model** captures benefits from both of the other revenue models and has the earliest break-even point. Its advantages are that it capitalizes on the benefits of both models and spreads risk by diversifying funding streams and is easily adaptable to different contexts (e.g., cooperatives of female handcrafters). The disadvantages are many of the same as for the other two models in terms of setting prices and adapting the platform for each customer.

The hybrid model allows the BfW platform to combine the benefits of the business-to-business and business-to-consumer models through a 'freemium' approach, whereby businesses pay more to subsidize smallholder farmers and low-income users. This is ideal, if the platform is to be used as a public good targeting customers' cooperatives. After the analysis, it was recommended that the BfW adopt the hybrid model as the most likely one to lead to financial sustainability.

A10.6 Capacity-building

A10.6.1 Status

To leverage the BfW technology, it is complemented by traditional face-to-face training and capacity-building initiatives for programme beneficiaries, increasing their understanding of gender concepts within agriculture, efficient agricultural techniques, and the use of the digital platform itself. Thus, the BfW project aims at reducing the gender gap in agriculture in terms of access to market information, technical skills, and financial and productive inputs. To support female farmers in Rwanda, UN Women and the World Food Programme have collaborated in developing a new training resource, the *Trainer's Manual on Mainstreaming Gender in the Agricultural Value Chain in Rwanda*, with the expectation that it will guide other similar trainings in the region and beyond.

UN Women contends that, since gender-responsive training has been available, female farmers' access to farm inputs has changed. For instance, in the cooperatives that benefited from the training, female farmers now outnumber male in terms of accessing fertilizers. This provides evidence of female farmers' increased active involvement along the value chain. In addition to gender mainstreaming and the functionalities of the platform, training on CSA practices will be needed to ensure that farmers are acquainted with it. For example, training on agricultural practices and pest management techniques in Rwanda is said to have

resulted in increased adoption of efficient farming techniques by smallholder farmers. As a result, the harvest output of project beneficiaries is expected to have increased while maintaining or improving produce quality standards.

A10.6.2 Recommendations for improvement

With the finalization of this manual and that cited above on gender mainstreaming in the value chain, there is an opportunity to train as many farmers as possible on CSA and gender-related matters. Training materials on information and communications technology (ICT) should also be developed to complement these manuals. This task should be fast-tracked to ensure that women will realize the full benefit.

REFERENCES

Adedayo, A.G., M.B. Oyun and O. Kadeba. (2010). 'Access of Rural Women to Forest Resources and Its Impact on Rural Household Welfare in North Central Nigeria.', *Forest Policy and Economics* 12,: pp. 439–450. 10.1016/j. forpol.2010.04.001.

African Development Bank. (2006). *Empowering Women in Africa Through Access to Sustainable Energy: A Desk Review of Fender-Focused Approaches in the Renewable Energy Sector.* Tunis, Tunisia: Office of the Special Envoy on Gender, Tunis, Tunisia.

African Development Bank. (2016). *Feed Africa. Strategy for agricultural transformation in Africa 2016–2025*, May 2016. Abidjan: ADB.

AGRA (Alliance for a Green Revolution in Africa). (2014). *Establishing the Status of Postharvest Losses and Storage for Major Staple crops in Eleven African Countries (Phase II).* Nairobi, Kenya: AGRA.

Barrett, C.B., M.R. Carter, J. McPeak, and A. Mude. (2008). *Altering Poverty Dynamics with Index 608 Insurance: Northern Kenya's HSNP+. BASIS brief 2008-08.* Madison, Wisconsin: University of Wisconsin.

Beaujon Marin, Amanda, and Anne T. Kuriakose. (2017). *Gender and Sustainable Forest Management: Entry Points for Design and Implementation*. Washington, DC: Climate Investment Funds.

Behailu Legesse Kaptymer, Jemal Abdulkerim Ute, Musa Negeso Hule. (2019). 'Climate Smart Agriculture and Its Implementation Challenges in Africa.', *Current Journal of Applied Science and Technology*.

Cecelski, Elizabeth. (2000). *The role of women in sustainable energy development*. Colorado: National Renewable Energy Laboratory. NREL/ SR-550-26889

Clancy, Joy and Soma Dutta .(2005). *Women and Productive Uses of Energy: Some Light on a Shadowy Area*. Paper presented at UNDP Meeting on Productive Uses of Renewable Energy, Bangkok, Thailand, 9–11 May 2005. Adopted from: Okalebo, J. and M. Hankins. (1997.) "Why Women Adopt Solar Dryers", *ENERGIA News*, Vol. 1, No. (3), pp. 6–7.

Clancy, J. S., Winther, T., Matinga, M. N., and& Oparaocha, S. (2011). *Gender equity in access to and benefits from modern energy and improved energy technologies.* (World Development Report; No. 2012). Leusden, the Netherlands: ENERGIA/Norad/World Bank.

Cochrane, K., C.; De Young, D. Soto, and T. Bahri, (Eeds.). (2009). *Climate Change Implications for Fisheries and Aquaculture: Overview of Current Scientific Knowledge.* FAO Fisheries and Aquaculture Technical Paper No. 530. Rome: FAO.

GCCA+ (The Global Climate Change Alliance Plus Initiative).COMESA-EAC-SADC (2011). "Programme on Climate Change Adaptation and Mitigation in the Eastern and Southern (COMESA-EAC-SADC) Region".. Accessed 3 November 2022. https://www.gcca.eu/programmes/programme-climate-change-adaptation-and-mitigation-comesa-eac-sadc-region. http:// www.gcca.eu/sites/default/files/ACP/description_of_the_action_comesa_revised_annex1_feb2012.pdf

Coulter, Janna. E., Rebecca A. Witinok-Huber, Brett L Bruyere and Wanja Dorothy Nyingiet al. (2019). "Giving women a voice on decision-making about water: barriers and opportunities in Laikipia, Kenya". *Gender, Place & Culture* 26(4), pp. 489–509.

Criterion Institute, 2015. 'Designing a Gender Lens Investing Action Plan: A Tool for

Investment".', Accessed 3 November 2022. https://criterioninstitute.org/wp-content/uploads/Gender-Lens-Investing-Action-Plan-A-Tool-for-Investment.docx

Haddam, CT. CTCN (Climate Technology Centre and Network). (2017). *Climate-Smart Agriculture Manual for Agricultural Education in Zimbabwe*. Copenhagen: CTCN.

Danielsen, Katrine. (2012). *Gender equality, women's rights, and access to energy services an inspiration paper in the run-up to Rio+20* Copenhagen: Ministry of Foreign Affairs of Denmark, Copenhagen, Denmark

de Haan, Nicoline, and Fraser Sugden. (2015). 'Including Women and the Poor in Water Management Systems'. Brief for GSDR. Colombo, Sri Lanka: International Water Management Institute, Colombo, Sri Lanka.

Nellemann, C., E. Corcoran, C. M. Duarte, L. Valdés, C. De Young, L.L. Fonseca, and G. Grimsditch. (2009). *Blue carbon:* A Rapid Response Assessment. Nairobi: United Nations Environment Programme, GRID-Arendal. www.grida.no.

Doss, Cheryl, Chiara Kovarik, Amber Peterman, Agnes R. Quisumbing, and Mara van den Bold (2013). 'Gender Inequalities in Ownership and Control of Land in Africa: Myths versus Reality'. Discussion Paper 01308. International Food Policy Research Institute, Washington, DC.

Doss C, C. Kovarik C, A. Peterman A, A. Quisumbing A, M. Van den Bold. M (2015.) "Gender inequalities in ownership and control of land in Africa: myth and reality". *Agricultural Economics* 46(3), pp.: 403–434. https://doi.org/10.1111/agec.12171

El-Fattal, Lamia. (2012). 'Climate-Smart Agriculture Is 'Smarter' When Informed by a Gender Perspective'. Policy Brief. Bangkok: Women Organizing for Change in Agriculture and Natural Resource Management., Bangkok.

ENERGIA (International Network on Gender and Sustainable Energy). (2007). *Where energy is women's business: National and regional reports from Africa, Asia, Latin America and the Pacific.*: The Hague: ENERGIA., The Netherlands.

Federal Department of Foreign Affairs, Swiss Agency for Development and Cooperation. (2015). Gender Analysis of Maize Post-Harvest Management in Kenya: A Case Study of Nakuru, Naivasha and Embu Districts. Harare, Zimbabwe: Swiss Cooperation Office Southern Africa, Harare, Zimbabwe.

FAO (Food and Agriculture Organization of the United Nations) (. 2011). *Women in Agriculture: Closing the Gender Gap for Development: The State of Food and Agriculture*. Rome: FAORome: FAO.

------FAO (Food and Agriculture Organization of the United Nations) (2013a). *Climate-Smart Agriculture Sourcebook*. RomeRome: FAO: FAO.

------FAO (Food and Agriculture Organization of the United Nations) (2013b). 'Forests, Food Security and Gender: Linkages, Disparities and Priorities for Action'. Background Paper for International Conference on Forests for Food Security and Nutrition, Rome, 13–15 May. Rome: FAO.

------FAO (Food and Agriculture Organization of the United Nations) (2013c). Mainstreaming Gender in Fisheries and Aquaculture: A Stock-Taking-Taking Exercise Final Report. Rome: FAO.

------FAO (Food and Agriculture Organization of the United Nations) (2013d). *Good Practice Policies to Eliminate Gender Inequalities in Fish Value Chains*. Rome: FAO.

------FAO (Food and Agriculture Organization of the United Nations) (2014). 'FAO Success Stories on Climate-Smart Agriculture: CSA on the Ground'". Booklet. Rome: FAO, Rome.

------FAO (Food and Agriculture Organization of the United Nations) (2015). "'Dimitra Clubs: A Unique Approach'. Brief. Rome: FAO, Rome.

------FAO (Food and Agriculture Organization of the United Nations) (2016a). 'Eastern Africa Climate-Smart Agriculture Scoping Study: Ethiopia, Kenya and Uganda'". Rome: FAO, Rome.

------FAO (Food and Agriculture Organization of the United Nations) (2016b). 'Gender in Forestry: Basic Knowledge'. Sustainable Forest Management Toolbox Module. Rome: FAO, Rome.

------FAO (Food and Agriculture Organization of the United Nations) (2016c). 'How Can Women Control Water? Increase Agriculture Productivity and Strengthen Resource Management'. Brief. Rome: FAO, Rome.

------FAO (Food and Agriculture Organization of the United Nations) (2017). 'Water for Sustainable Food and Agriculture: A Report Produced for the G20 Presidency of Germany'. Rome: FAO, Rome.

------FAO (Food and Agriculture Organization of the United Nations) (2019). "Climate Change: Implications for Fisheries and Aquaculture Overview of Current Scientific Knowledge" FAO Fisheries and Aquaculture Technical Paper 530. Rome: FAO.

------FAO (Food and Agriculture Organization of the United Nations) (2022). *The State of World Fisheries and Aquaculture (SOFIA) 2022: Towards Blue Transformation.* Rome: FAO.

Forum for Agricultural Research in Africa (FARA). (2008). *Inventory of Innovative Farmer Advisory Services using ICTs*, Accra, Ghana:. FARA.

Gatere, L., V. Hoffmann V., M. Murphy and M., P. Scollard P. (2020). *Losses in tomatoes produced in Laikipia County. Policy Briefs. V4CP, SNV & IFPRI.*

Glemarec, Yannick, Seemin Qayum, and Marina Olshanskaya. (2016). *Leveraging Co-Benefits Between Gender Equality and Climate Action for Sustainable Development: Mainstreaming Gender Considerations in Climate Change Projects*. Guidebook. New York: UN Women.

The Global Commission on the Economy and Climate. (2014). *Better Growth, Better Climate: The New Climate Economy Report, The Global Report*. Washington D.C.:The Global Commission on the Economy and Climate.

The Governance ClusterGTZ (Deutsche Gesellschaft für Technische Zusammenarbeit). (2010). *Climate Change and Gender: Economic Empowerment of Women Through Climate Mitigation and Adaptation?* Working paper. Eschborn Germany: GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit).

Hafkin, Nancy J. and Helen Hambly Odame., (2012). *Gender, ICTs and Agriculture* Situation Analysis for the 5th Consultative Expert Meeting of Technical Centre for Agricultural and Rural Cooperation (ACP-EU) ICT Observatory meeting on Gender and Agriculture in the Information Society, Wageningen, tThe Netherlands.

Hagedoorn, L. C., P. Bubeck, P., Hudson, P., L.M. Brander, M. L. M., Pham, andM., & R. Lasage., R. (2021). " Preferences of vulnerable social groups for ecosystem-based adaptation to flood risk in Central Vietnam". *World Development*, 148, pp. 1–-24.

Harsch, E. (2001). 'Making trade work for poor women'", *Africa Recovery Journal* (15) (4), p.: 6.

Hidayatullah, N. A., S. Blagojce, S., and A. Kalam., A. 2011. "Analysis of distributed generation systems, smart grid technologies and future motivators influencing change in the electricity sector". *Scientific Research,* 2, pp. 216–-229.

IFAD (International Fund for Agricultural Development). (2018). 'Design of Gender Transformative Smallholder Agriculture Adaptation Programmes: Gender and Climate Change Adaptation'. How to Do Note. IFAD Policy and Technical Advisory Division, Rome.

Karlsson, Gail. and Ana Rojas, A.. (2011). *The Benefits of Gender Balance in Climate Change Mitigation Investments and Sustainable Energy Initiatives*. ENERGIA. nergia. Available online at: http://gender-climate.org/wp-content/uploads/docs/publications/ENERGIA_GenderBalance_ClimateChangeMitigationInvestments.pdf

Kiptot, E. (2015). 'Gender Roles, Responsibilities, and Spaces: Implications for Agroforestry Research and Development in Africa'", *International Forestry Review* 17 (4),: pp. 11–21.

Kwadwo Asenso- Okyere and Daniel Ayalew Mekonnen. (2012). "The iImportance of ICTs in the pProvision of iInformation for iImproving aAgricultural pProductivity and rRural iIncomes in Africa"., United Nations Development Programme Working Paper 2012–15: January. International Food Policy Research Institute.

Mary Robinson Foundation. (2015). 'Women's Participation an Enabler of Climate Justice'. Trinity College, Dublin.

Mbow, Cheikh, Pete Smith, David Skole, Lalisa Duguma and Mercedes Bustamante. (2014). 'Achieving Mitigation and Adaptation to Climate Change through Sustainable Agroforestry Practices in Africa'. *Current Opinion in Environmental Sustainability* 6 (February), pp.: 8–14.

Mirkena, Tadele, Gemeda Duguma, Alfons Willam, Maria Wurzinger, Aynalem Haile, Barbara Rischkowsky, Ally Okeyo, Markos Tibbo and Johann Sölkner. (2012). 'Community-Based Alternative Breeding Plans for Indigenous Sheep Breeds in Four Agro-Ecological Zones of Ethiopia', *Journal of Animal Breeding and Genetics* 129, pp.: 244–253.

Ministry of Energy Mozambique, Embassy of Norway in Mozambique, NORAD and ENERGIA International Network on Gender and Sustainable Energy. (2012). *Mainstreaming Gender in the Energy Sector: Training Manual.*

Morrison, Jason. (2013). 'Collective Action: The Private Sector's Interest and Role in Collaborating to Address Water Challenges in Urban and Rural Areas'". *UNnited Nations Chronicle* L (1), April.

Mujuni, A., Kevin Natukunda and Donald Regira Kugonza. (2012). 'Factors Affecting the Adoption of Beekeeping and Associated Technologies in Bushenyi District, Western Uganda'", *Development* 24 (8).

Mutamba, M., K. Ndidzano, E. Matingo, S.L. Marongwe, L. Vambe and K. Murwisi. (2017). 'Cases of Climate-Smart Agriculture in Zimbabwe'". Pretoria: Vuna AfricaUNA, Pretoria.

Mwangi, Esther, Ruth Meinzen-Dick and Yan Sun. (2009). '"Does Gender Influence Forest Management? Exploring Cases from East Africa and Latin America'. CID Graduate Student and Research Fellow Working Paper No. 40. Cambridge, Mass.: Center for International Development, Harvard University, Cambridge, MA.

Nellemann, C., E. Corcoran, C. M. Duarte, L. Valdés, C. Nellemann, Christian, Ritu Verma and Lawrence Hislop (Eds.), eds. (2011). *Women at the Frontline of Climate Change: Gender Risks and Hopes*. A Rapid Response Assessment. Arendal, Norway: United Nations Environment Programme, GRID-Arendal.

Njuki, Jemimah, and Pascal Sanginga. (2013). 'Gender and lLivestock: iIssues, cChallenges and oOpportunities'. BriefIn *Bridging the Gender Gap: Women, Livestock Ownership and Markets in Eastern and Southern Africa*. Nairobi: International Livestock Research InstituteWRENmedia.

Njuki, Jemimah, Elizabeth Waithanji, Nabintu Bagalwa and Juliet Kariuki. (2013). *Guidelines on Integrating Gender in Livestock Projects and Programs*. Nairobi: International Livestock Research Institute.

Paris, Thelma R., Hilary Sims Feldstein and Guadalupe Duron. (2001). 'Empowering Women to Achieve Food Security: Technology'". Focus 6. Policy Brief No. 5. Washington, D.C.: International Food Policy Research Institute, Washington, DC.

Parvatha Reddy, P. 2015. 'Climate Resilient Agriculture for Ensuring Food Security.', Springer Nature.

A.R. Quisumbing and R.S. Meinzen-Dick, (Eds.) eds. Washington, D.C.: International Food Policy Research Institute.

Place, F., S. Franzel, J. DeWolf, R. Rommelse, F. Kwesiga, A. Niang and B. Jama. (2002). 'Agroforestry for Soil Fertility Replenishment: Evidence on Adoption Processes in Kenya and Zambia".'. In *Natural Resources Management in African Agriculture: Understanding and Improving Current Practices*, edited by C.B. Barrett, F. Place and A.A. Aboud (Eds.)., pp. 155–68. Wallingford, UK: CAB International.

Recha, J., P. Kimeli, V. Atakos, M. Radeny and C. Mungai. (2017). 'Stories of Success: Climate-Smart Villages in East Africa'. Wageningen, the Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security, Wageningen, Netherlands.

Saj, Stephane, Emmanuel Torquebiau, Etienne Hainzelin, Jacques Pages and Florent Maraux. (2017). 'The Way Forward: An Agroecological Perspective for Climate-Smart Agriculture"'., *Agriculture, Ecosystems & Environment* 250,: pp. 20–24. 10.1016/j.agee.2017.09.003.

SAP, PlaNet Finance, Grameen Ghana and Maata-N-Tudu. (2010.). *The Shea Value Chain Reinforcement Initiative in Ghana: CASE STUDY.* Stanford, California: Stanford Global Supply Chain Management Forum, Stanford Graduate School of Business.

Solar Electric Light Fund (SELF). (2003). "Renewable Energy Empowered Women: A SELF White Paper", SEWA Academy.

Shafiq, Muhammad. (2008). '"Analysis of the Role of Women in Livestock Production in Balochistan, Pakistan', *Journal of Agriculture & Social Sciences* 4 (1), pp.: 18–22.

Sheahan, Megan, and Christopher B. Barrett. (2014). 'Understanding the Agricultural Input Landscape in Sub-Saharan Africa: Recent Plot, Household, and Community-Level Evidence"'. Policy Research Working Paper 7014. Washington, D.C.: World Bank,. Washington, DC.

Sidhu, Kiranjot. (2007). "Participation Pattern of Farm Women in Post Harvesting Department of Extension Education", Punjab Agricultural University, *Studies on Home and Community Science* 1 (1), pp.: 45–49.

Sperling, L. 1987. "Wage employment among Samburu pastoralists of northcentral Kenya". *Research in Economic Anthropology*, 9, pp.: 167–-190

SOFA (State of Food and Agriculture) Team and Cheryl Doss. (2011). 'The Role of Women in Agriculture"'. ESA Working Paper No. 11-02. Rome: Agricultural Development Economics Division, Food and Agriculture Organization of the United Nations., Rome.

Solar Electric Light Fund (SELF), 2008. *Annual Report*, Washington D.C.: SELF.

Taylor, Marcus. (2018). 'What's Smart about Climate-Smart Agriculture?' Policy Brief #22. Oakland, Calif.,: Food First/ Institute for Food and Development Policy, Oakland, CA.

Treinen, Sophie, and Alice Van der Elstraeten. (2018). *Gender and ICTs: Mainstreaming Gender in the Use of Information and Communication Technologies (ICTs) for Agriculture and Rural Development*. Rome: FAORome: FAO.

UMFULA (Uncertainty Reduction in Models for Understanding Development Applications Project) (.n.d.). 'Gender, Agriculture and Climate Change in Malawi'. Brief. Future Climate for Africa Programme.

UNCTAD (United Nations Conference on Trade and Development) Enhanced Integrated Framework) . (2014). *The Fisheries Sector in the Gambia: Trade, Value Addition and Social Inclusiveness, with a Focus on Women,* United Nations Publication UNCTAD/ DITC/2013/4.

UNDP (United Nations Development Programme) and Gender and Water Alliance. (2006). *Resource Guide: Mainstreaming Gender in Water Management*.

------UNDP (2016). "Gender and Climate Change Gender and Sustainable Energy, Policy Brief 4." Ministry for Foreign Affairs Finland, Global Gender and Climate Alliance.

UNEP (United Nations Environment Programme) Risø Centre .(2011). *Progressing towards Post-2012 Carbon Markets*. Perspectives Series. Roskilde, Denmark: Technical University of Denmark.

------United Nations Environment Programme (2017). *Towards a Pollution-Free Planet* Background Report. United Nations Environment Programme, Nairobi, Kenya: UNEP.

UNFCCC (United Nations Framework Convention on Climate Change) (2007). *Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries*.

United Nations Industrial Development Organization. (2014). *Guide on Gender Mainstreaming, Energy and Climate Change Projects*, Vienna, Austria: UNIDO.

UNIDO (United Nations Industrial Development Organization) and UN Women. (2013). *Sustainable Energy for All: The Gender Dimensions*.

Unwin, T. (2009). *ICT4D: Information and Communication Technology for Development*, Cambridge UK: Cambridge University Press, UK.

UN Women (. 2016a). *Leveraging Co-Benefits Between Gender Equality and Climate Action for Sustainable Development: Mainstreaming Gender Considerations in Climate Change Projects*. Guidebook. New York: UN Women.

------UN Women (2016b). 'Women's Empowerment Through Climate-Smart Agriculture'. Flagship programme brief. UN Women, New York.

------UN Women (2017). 'UN -Women Strategic Plan 2018–2021'. UNW/2017/6/Rev.1. Executive Board of the United Nations Entity for Gender Equality and the Empowerment of Women.

UN Women. Strategic Plan 2018–2021 Flagship Initiatives.

UN Women (------2017). 'Buy for women' flagship initiative.

------UN Women (2018). "Mango Farmers in Kenya Get Access to New Technology to Counter Post-Harvest Losses". Accessed 3 November 2022. https://www.un.org/africarenewal/news/mango-farmers-kenya-get-access-new-technology-counter-post-harvest-losses http://africa.unwomen.org/en/news-and- events/stories/2018/03/mango-farmers-in-Kenya.

------UN Women (n.d.). *SDG 7: Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All.* Accessed 3 November 2022. http://www.unwomen.org/en/news/in-focus/ women-and-the-sdgs/sdg-7-affordable-clean-energy#notes.

UN Women and GCF (Green Climate Fund). (2017). *Mainstreaming Gender in Green Climate Fund Projects: A Practical Manual to Support the Integration of Gender Equality in Climate Change Interventions and Climate Finance*. Yeonsu-gu, Incheon, Republic of Korea: GCF.

UN Women and UNDP-UNEP PEI (United Nations Development Programme–United Nations Environment Programme Poverty-Environment Initiative). (2018). *The Cost of the Gender Gap in Agricultural Productivity: in Five African Countries, 2018*. Nairobi: UNEP

UN Women, UNDP-UNEP PEI (United Nations Development Programme–United Nations Environment Programme Poverty-Environment

Initiative) and World Bank. (2015). *The Cost of the Gender Gap in Agricultural Productivity in Malawi, Tanzania, and Uganda*. East and Southern Africa Regional Office: UN Women

United States Agency International Development (USAID). (2012). "Nutrient Manager for Rice", ICT and AG Profile.Fostering Agriculture Competitiveness Employing Information and Communication Technologies (FACET) project, Washington, D.C.: USAID.

United States Agency International Development (USAID)/and International Union for Conservation of Nature (IUCN) (2014). Women at the Forefront of the Clean Energy Future. White Paper of the USAID/ IUCN Initiative Gender Equality for Climate Change Opportunities.

Vermeulen, Sonja J., Bruce M. Campbell, and John S.I. Ingram. (2012). 'Climate Change and Food Systems', *Annual Review of Environment and Resources* 37, pp.: 195–222.

Wambu, C.K., N.O. Openda and L.N. Kinuthia. (2016). 'Influence of Land Tenure on Gender Participation in Management of Water Projects in Njoro Sub-County, Nakuru'", *Research on Humanities and Social Sciences* 6 (20).

Women 2000 and Beyond (2005). "Gender Equality and Empowerment of Women Through ICT" *Women 2000 and Beyond*. . *(*New York: United Nations). September 2005.

World Bank, FAO (Food and Agriculture Organization of the United Nations), and IFAD (International Fund for Agricultural Development). (2009a). 'Module 6: Gender Mainstreaming in Agricultural Water Management', In *Gender in Agriculture Sourcebook*. Washington, D.C.: World Bank.

World Bank. (2009b). "Module 13: Gender in fisheries and aquaculture: Overview", *Gender in Agriculture Sourcebook*, pp. 561–591. Agriculture and Rural Development, Washington, DC: World Bank..

World Bank------n.d. "Module 3: Gender Equality and Energy M01: Overview of Gender Equality and Energy Issues, Gender and Energy". Accessed 3 November 2022. https://esmap.org/sites/esmap.org/files/DocumentLibrary/Gender_Energy_M01.pdf of E-Course on Gender Equality and Development.

------World Bank (2011a). Understanding Gender in Agricultural Value Chains: The Cases of Grapes / Raisins, Almonds and Saffron in Afghanistan, Report No. 62323.-.

Af. Agriculture and Rural Development Unit, Sustainable Development Department South Asia Region.

------World Bank (2011b). ICT in Agriculture Connecting Smallholders to Knowledge, Networks, and Institutions. Sourcebook.

World Resource Institute (WRI). 2011. *World Resources Report 2010–2011s 2010–2011: Decision Making in a Changing Climate – Adaptation Challenges and Choices*.. Washington D.C.: WRI (2011).

Zhenwei Qiang, Christine, Siou Chew Kuek, Andrew Dymond, and Steve Esselaar. (2012). *Mobile Applications for Agriculture and Rural Development*. Washington, D.C.: World Bank.

ENDNOTES

Executive summary

1. The gender gap in agricultural productivity means that, because of differences in social and economic circumstances, there is always a divide between how much men and women produce, with men tending to be more productive than women.

Chapter 1

1. FAO (2013a).
2. Vermeulen, Campbell and Ingram (2012).
3. Nellemann, Verma and Hislop (2011).
4. Mary Robinson Foundation (2015).
5. UMFULA (n.d.).
6. Glemarec, Qayum and Olshanskaya (2016).
7. SOFA Team and Doss (2011).
8. Sheahan and Barrett (2014).
9. UN Women, UNDP-UNEP PEI and World Bank (2015).
10. Glemarec, Qayum and Olshanskaya (2016).
11. UN Women (2016b).
12. El-Fattal (2012).
13. Saj et al. (2017).
14. The first of these covered Malawi, Tanzania and Uganda (UN Women, UNDP-UNEP PEI and World Bank, 2015). The most recent study in the series covered these three countries as well as Ethiopia and Rwanda (UN Women and UNDP-UNEP PEI, 2018)).
15. FAO (2011).

Chapter 2

1. SOFA Team and Doss (2011).
2. FAO (2017).
3. FAO (2016c).
4. World Bank, FAO and IFAD (2009a).
5. FAO (2013a).
6. de Haan and Sugden (2015).
7. UN Women, UNDP-UNEP PEI and World Bank (2015).
8. Wambu, Openda and Kinuthia (2016).
9. SOFA Team and Doss (2011); Doss et al. (2013).
10. FAO (2016c).
11. de Haan and Sugden (2015).
12. UNDP and Gender and Water Alliance (2006).
13. Ibid.
14. Morrison (2013).
15. Ibid.
16. FAO (2013a).
17. Ibid.
18. UN Women, UNDP-UNEP PEI and World Bank (2015).
19. FAO (2011).
20. Ibid.
21. FAO (2013a).
22. Ibid.
23. Ibid.
24. This material draws on FAO (2013a).
25. FAO (2011).
26. Njuki and Sanginga (2013).
27. Ibid.
28. Njuki et al. (2013).
29. Shafiq (2008).
30. Mujuni, Natukunda and Kugonza (2012).
31. Njuki and Sanginga (2013).
32. Mwangi, Meinzen-Dick and Sun (2009).
33. FAO (2013b).
34. FAO (2013a).
35. FAO (2016b).
36. Ibid.
37. Kiptot (2015).
38. Beaujon Marin and Kuriakose (2017).
39. Nelleman et al. 2009
40. Gatere et al., 2020
41. FAO (2013a).
42. UNIDO and UN Women, 2013.
43. Danielsen, 2012.
44. Global Commission on the Economy and Climate, 2014.

Chapter 3

1. UN Women, UNDP-UNEP PEI and World Bank (2015).
2. UN Women and GCF (2017).
3. UN Women (2016a).
4. See Annex I of UN Women (2017).

Chapter 4

1. The Statistics Division of the UN Department for Economic and Social Affairs has prepared World's Women reports at five-year intervals since 1990.

Annex 1

1. Saj et al. (2017).
2. Taylor (2018) outlines the sustainability gaps in the three pillars of CSA and gives suggestions on how they can be bridged.
3. Taylor (2018).
4. Ibid.
5. Ibid.

Annex 2

1. Mbow et al. (2014).

Annex 6

1. The information in this annex is drawn from FAO (2013a).
2. UNFCCC (2007).
3. Ibid.
4. REDD+: reduce emissions from deforestation and forest degradation, and foster conservation, sustainable management of forests and enhancement of forest carbon stocks.
5. UNEP Risø Centre (2011).

Annex 8

1. FAO (2015).
2. For more information on this initiative, see the GlobalGiving website, https://www.globalgiving.org/ projects/ckw/.
3. FAO, 2013a
4 FAO, 2013a
5 FAO, 2013a
6 FAO, 2013a
7 FAO, 2013a
8 FAO, 2013a
9 FAO, 2013a
10 FAO, 2013a

UN WOMEN IS THE UN ORGANIZATION DEDICATED TO GENDER EQUALITY AND THE EMPOWERMENT OF WOMEN. A GLOBAL CHAMPION FOR WOMEN AND GIRLS, UN WOMEN WAS ESTABLISHED TO ACCELERATE PROGRESS ON MEETING THEIR NEEDS WORLDWIDE.

UN Women supports UN Member States as they set global standards for achieving gender equality, and works with governments and civil society to design laws, policies, programmes and services needed to ensure that the standards are effectively implemented and truly benefit women and girls worldwide. It works globally to make the vision of the Sustainable Development Goals a reality for women and girls and stands behind women's equal participation in all aspects of life, focusing on four strategic priorities: Women lead, participate in and benefit equally from governance systems; Women have income security, decent work and economic autonomy; All women and girls live a life free from all forms of violence; Women and girls contribute to and have greater influence in building sustainable peace and resilience, and benefit equally from the prevention of natural disasters and conflicts and humanitarian action. UN Women also coordinates and promotes the UN system's work in advancing gender equality.

East and Southern Africa Regional Office
UN Gigiri Complex, UN Avenue;
Block M, Ground Floor
P.O. Box 30218- 00100 Nairobi, Kenya
Tel: +254 20 762 4778
africa.unwomen.org
Email: esaro.publications@unwomen.org

unwomneafrica
unwomneafrica
unwomen
unwomneafrica