Food and Agriculture Organization of the United Nations

ETHIOPIA CLIMATE-SMART AGRICULTURE SCOPING STUDY

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PREFACE

Agriculture is the mainstay of the Ethiopian population and a key sector of the country's economy. However, on account of climatic, social and institutional factors contributing to low production and productivity, agriculture is unable to feed the population.

Climate-smart agriculture (CSA), as defined and presented by FAO at the Hague Conference on Agriculture, Food Security and Climate Change in 2010, contributes to the achievement of sustainable development goals. It integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges. CSA is composed of three main pillars – sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas (GHG) emissions, where possible.

This report on CSA in Ethiopia was initiated by the FAO Sub-regional Office for Eastern Africa to identify and document existing CSA practices in the country that enable stakeholders to understand the opportunities and constraints of adopting particular CSA technologies or practices. There is opportunity to use this information to inform agricultural related policies, programmes and projects in the country with the aim of sustainably increasing agricultural production and productivity; building resilience to climate-related hazards; and contributing to climate change mitigation.

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The report was prepared by FAO consultant Melaku Jirata and edited by Edward Kilawe and Sebastian Grey from the FAO Sub-regional Office for Eastern Africa (FAOSFE) and Amare Mengiste of FAO Ethiopia.

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ABBREVIATIONS/ACRONYMS

ADLI	agricultural development-led industrialization
AfDB	African Development Bank
AGP	Agricultural Growth Programme
ATA	Agricultural Transformation Agency
ACSAA	Africa Climate-Smart Agriculture Alliance
AU	African Union
BBM	broad bed maker
BERSMP	Bale Eco-Region Sustainable Management Programme
BOA	Bureau of Agriculture
CA	conservation agriculture
CAADP	Comprehensive Africa Agriculture Development Program
CAWT	conservation agriculture with trees
CBD	Convention on Biological Diversity
CCF-E	Climate Change Forum - Ethiopia
CDM	Clean Development Mechanism
CFGB	Canadian Foodgrains Bank
CGIAR	Consultative Group for International Agricultural Research
CRGE	Climate Resilient Green Economy
CSA	climate-smart agriculture
CIMMYT	International Maize and Wheat Improvement Center
DA	development agents
DRMFS	Disaster Risk Management and Food Security
DRSLP	Drought Resilient and Sustainable Livelihoods Programme
ECRGE	Ethiopian Climate-Resilient Green Economy
EIA	Environmental Impact Assessment
EIAR	Ethiopian Institute of Agricultural Research
EPA	Environmental Protection Agency
EPACC	Ethiopian Programme of Adaptation to Climate Change
FACASI	Farm Mechanization and Conservation Agriculture for Sustainable Intensification
FAO	Food and Agriculture Organization of the United Nations
FDRE	Federal Democratic Republic of Ethiopia
FGD	focus group discussion
FRC	Forestry Research Centre
FSP	Food Security Programme
FTCs	farmers training centres
GDP	gross domestic product
GGWSSI	Great Green Wall of the Sahara and the Sahel Initiative
GHG	greenhouse gas

GM-UNCCD	Global Mechanism of the United Nations Convention to Combat Desertification
GTP	Growth and Transformation Plan
HABP	Household Asset Building Programme
icipe	International Centre of Insect Physiology and Ecology
ICRAF	International Centre for Research in Agroforestry
ILRI	International Livestock Research Institute
IPMS	improving productivity and market success
ISD	Institute for Sustainable Development
KII	key informant interview
LWRC	Land and Water Resource Centre
MERET	Managing Environmental Resources to Enable Transitions
MoA	Ministry of Agriculture
MRV	measurement reporting and verification
NAMA	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Program of Action
NARS	National Agricultural Research System
NCATF	National Conservation Agriculture Task Force
NEPAD	New Partnership for Africa's Development
NGO	non-governmental organization
OFWE	Oromia Forest and Wildlife Enterprise
PSNP-PW	Productive Safety Net Programme – Public Works
RDPS	Rural Development Policy and Strategy
REDD+	Reducing Emissions from Deforestation and Forest Degradation
REST	Relief Society of Tigray
SG2000	Sasakawa Global 2000
SIMLESA	Sustainable Intensification of Maize-Legume Cropping System for Food Security in Eastern and Southern Africa
SLM	sustainable land management
SLMP	Sustainable Land Management Programme
SMS	subject-matter specialists
SNNPR	Southern Nations, Nationalities and People's Region
SOC	soil organic matter content
TVET	technical vocational education and training
UNCCD	United Nations Convention to Combat Desertification
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCC	United Nations Framework Convention on Climate Change
WFP	(United Nations) World Food Programme

EXECUTIVE SUMMARY

Agriculture is the mainstay of the Ethiopian population and a key sector of the country's economy.

However, on account of climatic, social and institutional factors contributing to low production and productivity, agriculture is unable to feed the population. The current study on climate-smart agriculture (CSA) was initiated to identify and document existing CSA practices in Ethiopia that enable stakeholders to understand the opportunities and constraints of adopting particular CSA technologies or practices.

The study methodology includes a desk review of relevant information, in-depth key informant interviews, collection of primary qualitative and quantitative data, as well as field visits to districts undertaking agricultural activities pertinent to CSA.

The study indicated that, as part of the improvement of livelihoods and food security, numerous traditional as well as innovative climate adaptation and mitigation agricultural development activities are conducted. Conservation agriculture is one of the key CSA activities conducted in Ethiopia from 1998 onwards. Since then, numerous trials and development work on conservation agriculture have been undertaken.

Conservation agriculture is promoted mainly by NGOs and the private sector with support from agricultural offices at all levels. This study found that the promotion of conservation agriculture technology has been affected by a lack of common understanding as well as other social and environmental issues that include open grazing and complete removal of crop residues. The study also indicated that there is untapped opportunity for the wide-scale promotion of conservation agriculture.

Major stakeholders promoting climate-smart agricultural activities in Ethiopia include the Ministry of Agriculture, international organizations (FAO, United Nations World Food Programme), the National Agricultural Research System (NARS), the Consultative Group for International Agricultural Research (CGIAR) and numerous NGOs. The Ethiopian government has put in place a number of policies, strategies and laws that are designed to support climate change mitigation and adaptation and sustainable development. Although the current policies, strategies and laws related to climate change and sustainable agriculture in Ethiopia are adequate, they lack detailed guidelines, manuals and action plans and are not sufficiently mainstreamed into existing programmes and projects.

There is a lack of adequate research findings on CSA practices in Ethiopia for the various agro-ecology, soil type, rainfall pattern, farming system, temperature and moisture ranges. Hence, research projects on CSA should be supported. Data on CSA and on conservation agriculture in particular, are insufficient at all levels.

Ethiopia lacks knowledge and skills pertaining to CSA and conservation agriculture in particular. For purposes of knowledge dissemination, a comprehensive capacity development approach that builds on the sound assessment of the needs of all stakeholders is required. Within diversified extension service delivery there is a need to build the capacity of all NGOs and conservation agriculture implementing organizations with major emphasis on the extension directorate of the Ministry of Agriculture. It is through the extension system that the technologies reach the wider community.

"There is untapped opportunity for the wide-scale promotion of conservation agriculture."


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BACKGROUND 1

1.1 Land, Agriculture and Food Security

The constitution of Ethiopia expressly provides that land and all natural resources are the property of the State and the people of Ethiopia. The constitution and the subsequent land laws have created free access to rural land to whosoever wishes to engage in agricultural activities. In reality, free access to land is not practically applicable. However, land can be acquired through inheritance, donation or land transfer through lease contract. Agricultural land in Ethiopia cannot be sold.

Agriculture has always been the backbone of the Ethiopian economy. Agriculture in Ethiopia includes crops, livestock, forestry, fisheries and apiculture. It is the most important sector of the national economy and the main source of livelihoods for 85 percent of the population. Yet the agriculture sector in Ethiopia is characterized by low productivity and is unable to meet the food security needs of the people and the country. Ethiopia is hence characterized by food insecurity emanating from environmental challenges and other structural and institutional factors.

Smallholder agricultural production remains low, particularly for cereal crops, which is attributed to erratic and unreliable rainfall and the failure of current agricultural techniques to mitigate such conditions; inefficient use by farmers of agricultural resources such as soil amendments; and rainwater that contributes to soil degradation. Other contributory factors include limited use of improved seed and fertilizers and inadequately resourced agricultural extension systems. Moreover, the dry lowlands experience erratic rainfall at times with very severe droughts, the impact of which, together with land degradation, human population growth and climate change, has greatly impaired the country's economic and social development and its food security status.

Managing climate variability will help reduce vulnerability and pave the way for adaptation to climate change. Climate information and policies are very fundamental to deal with the impacts of climate variability and change on development and resource management problems. A climate-smart agriculture (CSA) production system would consider understanding systems and clients to enhance institutional capacity for the implementation and upscaling of CSA practices and approaches.

The adaptive capacity of communities and the responsiveness of institutions to facilitate actions in CSA need to be integrated into research and development.

It is therefore important to have a proactive platform for governmental institutions, NGOs, donors, the private sector and civil society organizations in Ethiopia to fill gaps and enhance collective action on CSA.

1.2 Objective of the Study

The CSA scoping study was initiated by FAO with the objective of identifying and documenting existing CSA practices in Ethiopia that enable stakeholders to understand the opportunities and constraints to adopting particular CSA technologies or practices. Major activities conducted included:

- reviewing CSA practices and technologies that have been adopted and implemented;
- identifying key CSA programmes and projects;
- mapping of stakeholders involved in past and present CSA activities;
- identifying constraints faced by the farmers and opportunities in using the various techniques;
- identifying key policies and institutions relevant to CSA in the country;
- identifying the impact of CSA practices and policies on gender equity;
- identifying key challenges and untapped opportunities; and
- providing recommendations that stem from the analysis.

1.3 Study Methodology

The main study methodology involved the collection of primary and secondary data on CSA from various sources. More specifically the study involved:

Desk review of relevant information

This required a desk review and sourcing of information from available sources which included reports and documents on CSA in Ethiopia, CSA meeting and conference proceedings, annual progress reports for some CSA projects, organizational databases and the Internet. It involved the review of current policy documents, guidelines, strategies and manuals related to CSA in Ethiopia. These documents were reviewed throughout the study period and key issues were identified for further interrogation and consideration. Information from the desk review was moreover used to inform the design of the data collection tool (questionnaire).

In-depth key informant interviews

Key informant interviews (KIIs) were conducted with officials and experts from relevant government ministries and departments as well as from various international, national, community-based, civil-society and private-sector organizations. The interviews were conducted in accordance with a discussion guide based on the terms of reference for the report. The KIIs helped to identify the roles and responsibilities of organizations at national, regional and woreda (district) levels as well as existing constraints and opportunities to promote and scale up CSA.

Collection of primary qualitative and quantitative data

Field visits were conducted to woredas that are undertaking agricultural activities pertinent to CSA. Data were collected through participatory rapid assessment methods. This involved interviewing farmers and conducting focus group discussions with farmers and extension agents. In addition, discussions were held with input dealers on various aspects of their operations.

FARMING SYSTEMS AND CLIMATE-SMART AGRICULTURE TECHNOLOGIES AND PRACTICES 2

2.1 Existing Farming Systems

The farming system in Ethiopia can be classified into five major categories – the highland mixed farming system, lowland mixed agriculture, the pastoral system, shifting cultivation and commercial agriculture (Befekadu and Berhanu, 2000).

In Ethiopia over 95 percent of the annual gross total agricultural output of the country is said to be generated from smallholder farmers with an average farm size ranging from 0.5 to 2 hectares. The contribution of medium to large-scale commercial farms to gross total agricultural output is only about five percent (Central Statistical Agency of Ethiopia, 2011). Smallholder agriculture is the focus of this study.

The existence of diverse agro-ecological conditions enables Ethiopia to grow a large variety of crops, which include cereals like teff, wheat, maize and barley; pulses like horse bean, field peas, lentils, chickpeas and haricot beans; oil seeds like sesame, linseed, niger seed and rapeseed; and different types of fruits and vegetables (Central Statistical Agency of Ethiopia, 2011). Even though the country is known to produce various types of crops, food insecurity is a major challenge.

"Diverse agro-ecological conditions enable Ethiopia to grow a large variety of crops, which include cereals like teff, wheat, maize and barley; pulses like horse bean, field peas, lentils, chickpeas and haricot beans; oil seeds like sesame, linseed, niger seed and rapeseed; and different types of fruits and vegetables."

Ethiopia has the largest livestock population in Africa and the tenth largest in the world. Livestock is an integral part of the farming systems in the country. It is the source of many social and economic values such as food, draught power, fuel, cash income, security and investment in both the highlands and the lowlands as well as the pastoral farming systems. As in the case of crops, the sector makes a significant contribution to GDP and is a major source of foreign exchange. However, the livestock resource of the country is also characterized by low productivity levels. At present the per capita consumption of milk and meat is estimated to be the lowest in the world.

The government of Ethiopia has given top priority to the agricultural sector and has taken a number of steps to increase productivity. The strong dependence of the country on agriculture, which is very sensitive to climate variability and change, is a cause for concern.

Ethiopia's annual greenhouse gas (GHG) emissions were estimated at 150 Mt CO_2e in 2010, with 50 percent and 37 percent of these emissions resulting from the agricultural and forestry sectors respectively. In agriculture, livestock production accounted for more than 40 percent of the emissions, while in forestry the main culprit was deforestation for expansion of agricultural land, which accounted for over 50 percent of forestry-related emissions, followed by fuelwood consumption at 46 percent of forestry-related emissions. Figure 2 indicates the major sources of GHG emissions within the agriculture sector[1] of Ethiopia. The largest proportion of emissions results from enteric fermentation, followed by manure left on pasture, both of which are related to livestock production.


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Farming system	Smallholder agriculture	Commercial agriculture
Highland mixed agriculture	95% of the annual gross total agricultural output of the country	Commercial farms contribute to only 5% of gross total agricultural output
Lowland mixed agriculture		
Pastoral and agropastoral farming	Average farm size ranging from 0.5 to 2 hectares	
Shifting cultivation		

Figure 1: Importance of smallholder farming systems in Ethiopia

1 FAOSTAT, 2015

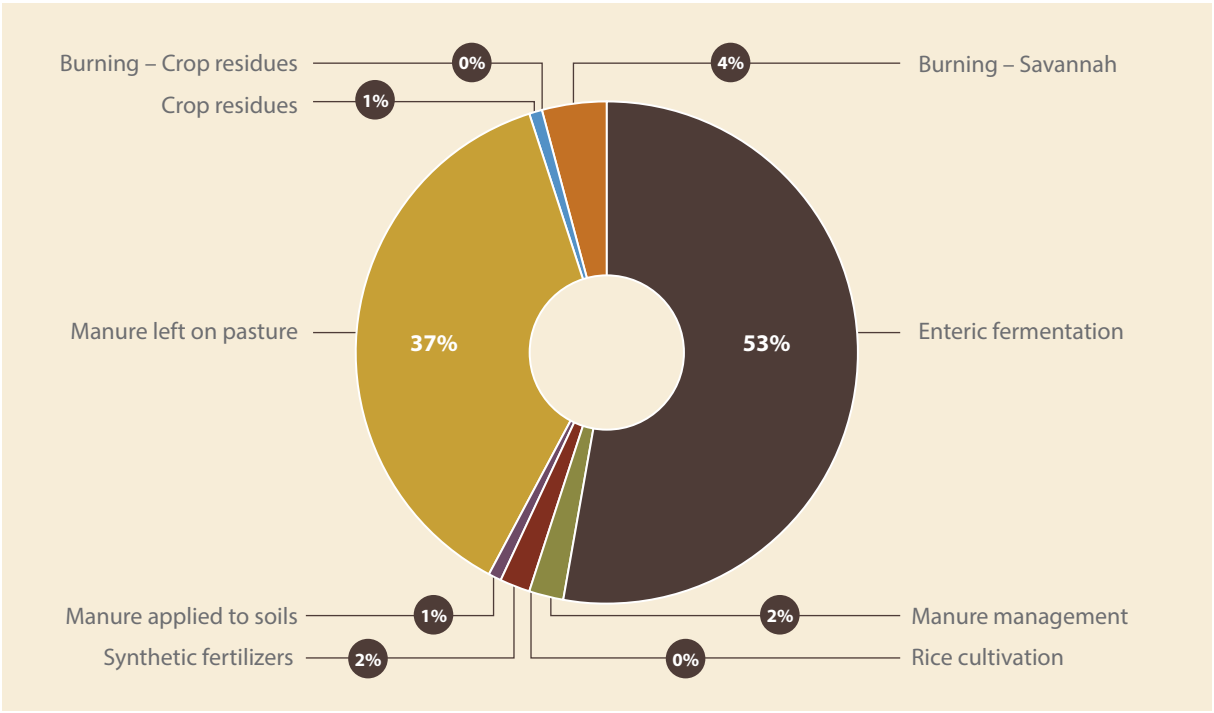

Figure 2: GHG emissions in Ethiopian agriculture in 2012 (FAOSTAT, 2015)

2.2 Climate-Smart Agriculture Practices

Climate-smart agriculture (CSA) is defined by FAO (2010) as agriculture that sustainably increases productivity, enhances resilience of livelihoods and ecosystems, reduces and/or removes greenhouse gases (GHGs) and enhances achievement of national food security and development goals.

CSA includes proven practical techniques such as mulching, intercropping, conservation agriculture, crop rotation, integrated crop-livestock management, agroforestry, improved grazing and improved water management. CSA also involves innovative practices such as improved weather forecasting, early-warning systems and climate-risk insurance. CSA aims to get existing technologies off the shelf and into the hands of farmers, as well as to develop new technologies such as drought-tolerant or flood-tolerant crops to meet the demands of the changing climate.

2.2.1 CSA practices and technologies implemented and adopted

As part of livelihoods and food security improvement, a multitude of agricultural development activities are conducted in Ethiopia, both traditionally and innovatively. Currently, agricultural development activities carried out in the country are supported by a number of policies, strategies and institutions. Of the numerous agricultural development activities conducted, mention should be made of those that are considered important in addressing issues related to climate change and are contributing to climate change adaptation and mitigation. Such agricultural practices in Ethiopia include integrated watershed management, integrated soil fertility management, sustainable land management, conservation agriculture, agroforestry, crop residue management, composting, promotion of improved livestock feed and rangeland management.

Integrated watershed management: Ethiopia is one of the countries seriously affected by land degradation, and addressing this problem is a major priority for the country. In Ethiopia integrated watershed management is conducted through various projects and programmes, which include the Sustainable Land Management Programmes (SLMP1 and SLMP2), Managing Environmental Resources to Enable Transitions to more Sustainable Livelihoods (MERET) project, Productive Safety Nets Programme – Public Works (PSNP-PW) and numerous NGOs. CSA in SLMP2 refers to proven practical techniques — such as mulching, intercropping, conservation agriculture,

no-till, crop rotation, cover cropping, integrated crop-livestock management, agroforestry, improved grazing and improved water management — and innovative practices such as use of drought-resistant food crops. In an effort to implement this programme in many parts of the country, reports indicate that to date about 1 708 100 hectares of land were treated under area closures; and appropriate physical and biological soil conservation methods were applied to 2 076 000 hectares of land.

Reports indicate that land and crop production and productivity have increased due to an increase in land available for cultivation, increased availability of water for irrigation, improvement in the fertility status of the soil as well as improved agronomic practices. It is reported that soil organic matter content sequestration can be achieved by implementing sustainable land management practices that add high amounts of biomass to the soil, cause minimal soil disturbance, conserve soil and water, improve soil structure and enhance activity and species diversity of soil fauna (Woodfine, 2009).

Box 1: Case Study 1 - Debremawi Learning Watershed Site

Debremawi Watershed is located in the Yilmanadensa District of Amhara Regional State. It has an estimated total area of 700 hectares, with a total population of 3 000 households in two kebeles –Debremawi and Fereswega. The area is characterized by midland agro-ecology and adequate rainfall. Agriculture in the form of crop production and livestock rearing is the mainstay of the population. Maize is the main crop grown, while teff, barley, faba bean and haricot bean are also major crops in the watershed. Farmers in the watershed also rear cattle and small ruminants (sheep and goats). Agricultural productivity in the watershed is constrained by numerous factors, particularly severe soil erosion and a decline in soil fertility, which are compounded by the complete removal of crop residue for livestock feed and fuelwood while inadequate extension services also play a role. It is to deal with this challenge that an NGO known as the Water and Land Resource Centre (WLRC), in collaboration with Amhara Region Natural Resource Management Bureau, started an intervention in 2012. The objective was to curb environmental degradation, improve agricultural productivity and contribute to increased food security of the population. In order to accomplish this objective, activities conducted in the watershed include physical soil conservation, demonstration of improved crop varieties and improved livestock management.

Capacity building in the community through training of development agents and farmers and provision of inputs like improved seeds are conducted by the NGO. In addition, the community is assisted in developing their resilience to climate change and environmental degradation through creating community consensus on these and other environmental hazards. As a result of the WLRCs' work, the community agreed to enclose degraded land and to use it for animal feed through a cut-and-carry system.

Enclosure of the degraded lands and avoiding open grazing has brought a tremendous change to the environment of the area within a short period of time. Within two years, degraded lands were covered with vegetation (trees and grasses) and gullies had started refilling. Since open grazing is avoided, some portion of the crop residues are left on the soil, which leads to increased soil organic matter. Soil erosion has been drastically reduced and water infiltration has improved. Farmers have begun adopting crop varieties that are suitable to their environment and local needs. The work done so far has created suitable conditions for farmers to adopt other CSA technologies such as conservation agriculture, small-scale irrigation, planting of fruit trees and establishment of feed lots.

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Debremawi Learning Watershed with lush vegetation on previously degraded land

Integrated soil fertility management: The Ministry of Agriculture has recently been placing emphasis on soil fertility management so as to increase agricultural productivity and overcome the current challenges of food insecurity. Some programmes currently underway by the Ministry of Agriculture include national soil fertility mapping, management of vertisols and acidic soils, collection of information on soils from various stakeholders and implementation of soil fertility management practices recommended by research. Improving farmers' capacity in improved soil fertility management is a programme conducted nationwide, mainly through national and regional extension. A number of NGOs and development partners are also undertaking agricultural development activities related to soil fertility improvement. The main activities being promoted include training and promotion of appropriate fertilizer application, composting, crop rotation and intercropping with a focus on improving food security. As a result, large numbers of farmers have adopted improved fertilizer application, compost preparation and application as well as intercropping. Recent reports indicate that due to the improved extension services in these areas, significant improvements have been made in crop productivity.

As part of integrated soil fertility management, promotion of composting was set as a target in the climate change component of the Growth and Transformation Plan (GTP). Hence the Ministry of Agriculture, through its regional offices, is promoting the preparation and use of compost as a major agricultural extension activity in all regional states of Ethiopia. Compost is an organic matter resource that has the ability to improve the chemical, physical and biological characteristics of soils. The advantages of using organic manure include the addition of nutrients to the soil and the sequestration of carbon dioxide, thereby reducing its adverse effects on global warming.

Although activities carried out so far are encouraging, agricultural production in Ethiopia is characterized by low crop productivity owing to a decline in soil fertility. The lack of appropriate and adequate soil fertility management is still a major challenge in smallholder agricultural production.

Conservation agriculture: In Ethiopia, soil conservation practices such as reduced tillage have long been undertaken by farmers; however, the promotion of conservation agriculture technology began in earnest in 1998 through the joint promotion and demonstration of the technology on the plots of 77 farmers by Sasakawa Global (SG2000), Makobu and regional agricultural development bureaus.

On average, the yields of the 1998/99 conservation agriculture demonstration plots were similar to the average yield of conventional tillage plots. During this initial introduction period of conservation agriculture, further trials were carried out between 1999 and 2003 at the Jima, Bako and Melkasa research centres on maize, sorghum and teff. These trials indicated that conservation tillage plots gave higher yields compared with the conventional tillage (Tesfa, 2001; Worku, 2001; Tolesa, 2001). The studies also indicated lower production costs for conservation agriculture fields. The general pattern emerging from these data is that yields increase both in the short and long term as a result of conservation agriculture. This is consistent with reviews of research in Latin America, Africa and Asia that conclude that conservation agriculture yields are between 20 to 120 percent higher than those in conventional agriculture (Kassam *et al*., 2009; Derpsch *et al*., 2010). There are several mechanisms by which conservation agriculture can improve yields. Mulching and residue management can increase soil fertility and the availability of nutrients to plants. Improved water availability throughout the cropping cycle is another key mechanism of yield improvement or stabilization.

Since the initial trials and introduction, conservation agriculture has been promoted by different organizations including FAO, the Agricultural Transformation Agency (ATA), the International Maize and Wheat Improvement Center (CIMMYT) and a number of NGOs such as Ethiopia Wetland, FH Ethiopia, Self Help Africa, AGRA, Canadian Foodgrains Bank and Wolayita Terepeza Development Association, among others. In 2010 FAO, in collaboration with the Federal and Regional Agricultural Offices, provided technical and financial support for conservation agriculture promotion in Ethiopia. Accordingly, 24 conservation agriculture demonstration plots were established, involving 600 smallholder farmers in 12 woredas of the Amhara, Oromia and Tigray regions. FAO also introduced a range of conservation agriculture equipment including jab planters and oxen-drawn seed and fertilizer planters in those same woredas in 2010 and supported the training of 72 extension agents to conduct conservation agriculture farmer field schools, of which 32 were also trained in the assembly and operation of conservation agriculture equipment. In 2012 and 2013, ATA supported 6 000 farmers in seven woredas to practise conservation agriculture as well as training 327 experts and 750 development agents in conservation agriculture

in selected woredas in the country. ATA's target for 2014 was to have 50 000 farmers practising conservation agriculture in 57 woredas across the country. CIMMYT, in collaboration with national and regional research organizations (for example the Ethiopian Institute of Agricultural Research [EIAR]), has been conducting conservation agriculture trials and demonstrations in numerous parts of the country through a programme known as Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA).

In terms of adoption of conservation agriculture, information from various sources indicates that in areas where conservation agriculture has been adequately demonstrated, for example in some parts of Amhara, Oromia and Tigray, adoption has been reported to be significant. Some of these areas include West Gojam Zone, East Gojam Zone and South Gonder Zone of Amhara Regional State and West Wollega Zone, East Wollega Zone, South Shewa Zone and West Shewa Zone of Oromia Regional State. These are areas that are known for teff and maize production.

A study conducted at Bako and Adaa woreda of Oromia Region indicated that more than half (57.4 percent) of the sample respondents were found to be adopting a component or more of the conservation tillage technology package. Among these adopters, 10 percent have used only one component, 75 percent have used two components and 15 percent have used all three components. Bako and Adaa are maize and teff-growing woredas, respectively.

Wondwossen *et al.* (2008) reported that adopters of three components of conservation agriculture (mulching, minimum ploughing and crop rotation) have higher yields than non-adopters. Similarly, adoption of the three components substantially increases labour productivity (yield per unit of labour). Wondwossen *et al.* (2008) further reported that farmers in teff-growing areas have stronger incentives to adopt conservation agriculture technology as teff is more labour intensive than maize. The report also indicated that crop yields increase as more components of conservation agriculture are adopted, and that the amount of labour per unit of crop yield declines as more components of conservation agriculture are practised, implying that there are labour savings from full adoption of all the conservation agriculture principles.

It has also been reported that in areas where weed problems are prevalent, most farmers will easily adopt herbicide use as part of their farming practice. In Adaa District, where teff crop is important, farmers practise minimum ploughing, which is much more affordable since teff requires frequent ploughing. Conservation agriculture saves more labour on teff, which requires intensive ploughing four to six times before planting. Minimum tillage also represents an important economic appeal to farmers in terms of reducing production costs, particularly expenditure on labour, seeds and other yield-improving inputs.

In general, however, adequate data on the adoption of conservation agriculture in Ethiopia are not well documented and available at all levels.

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Box 2: Socio-economic and environmental impacts of conservation agriculture

Environment, biodiversity and soils: Conservation agriculture has a significant impact in reducing soil erosion through increased rainwater infiltration and buildup of soil organic matter for increased soil moisture storage. Conservation agriculture can improve biodiversity at farm and community level and support improved ecosystem services such as water and nutrient cycling. It can also support flood control through improved water infiltration in agricultural fields.

Climate change mitigation: Evidence on conservation agriculture, greenhouse gas (GHG) emissions and carbon sequestration indicates that conservation agriculture can help mitigate climate change by reducing existing emission sources and sequestering carbon in soils and plant biomass. Baker *et al.* (2007) estimate that the conversion of all croplands to conservation tillage globally could sequester 25 Gt C over the next 50 years. This is equivalent to 1 833 Mt CO_2-eq/yr, making conservation tillage among the most significant opportunities from all sectors for stabilizing global GHG concentrations. Scaling down these global estimates to the continental, landscape or plot scale to estimate the mitigation potential of conservation agriculture in sub-Saharan Africa entails considerable challenges. Overall there is insufficient information on the GHG impacts of conservation agriculture practices, especially for developing countries in the tropics and subtropics (Milder *et al.*, 2011).

Soil fertility: In terms of soil fertility, the improved soil structure resulting from conservation agriculture enhances aeration and other conditions required for efficient nutrient cycling. Soil organic matter has been found to increase significantly over time in conservation agriculture systems, primarily due to the introduction of additional organic matter as crop residues or mulch and to the reduction or elimination of tillage, which tends to accelerate the oxidation of soil organic matter (Hobbs *et al.*, 2008; Kassam *et al.*, 2009). Zero tillage systems are also associated with increased levels of available phosphorus in the upper soil layer (e.g. 0-5 cm), due largely to the role of biological processes in phosphorus cycling (Milder *et al.*, 2011).

Water management: Conservation agriculture has been found to have beneficial effects on water management and water-use efficiency. With an increase in soil organic matter and root density under conservation agriculture, water infiltration and water holding capacity are improved, making water more available throughout the farming cycle. Kassam *et al.* (2009) reported that for each percent increase in soil organic matter, an additional 150 m^3/ha of water can be stored in the soil (in Sintayehu, 2011). Surface mulches and improved soil pore structure also increase infiltration and absorption capacity, while reducing evaporation. These benefits help reduce the risk of erosion and flooding during heavy rains, contribute to aquifer recharge and make more water available for crops.

Food security: Sustained and stable food production generated by conservation agriculture systems can significantly improve the food security and nutritional status of vulnerable households and communities. Conservation agriculture can help stabilize yields in the face of climate shocks such as droughts by reducing evapotranspiration and regulating soil temperatures as well as supporting the management of pests and diseases in crop production if appropriate crop rotations and combinations are used. These benefits are especially important for poor and vulnerable smallholder farming households.

Box 3: Conservation agriculture principles, practices and technologies in Ethiopia

In the past, soil tillage has been associated with increased soil fertility. It has recently been recognized that, in the long term, this process leads to a reduction of soil organic matter. Soil organic matter not only provides nutrients for the crop, but is also a crucial element for the stabilization of soil structure. Therefore, most soils degrade under prolonged intensive arable agriculture. This structural degradation of the soils results in the formation of crusts and compaction, ultimately leading to soil erosion and reduced agricultural productivity. As a result, the conservation agriculture components that are currently being promoted include:

Reduced tillage: In Ethiopia, land preparation is mainly carried out with a view of getting rid of weeds, but it also helps in breaking compacted soils and improves moisture infiltration. However, moisture infiltration is much better in soils that are less tilled but not compacted by the effect of overgrazing. Conservation agriculture using reduced tillage in Ethiopia has been demonstrated on maize, wheat, teff, sorghum, faba bean and onion and has shown successful results. Upscaling of conservation technology is currently under way.

Crop residue management: The success of conservation agriculture in Ethiopia is highly dependent on crop residue management. Crop residues provide protective cover for the soil and increase soil infiltration. Research has shown that when 35 percent of the soil surface is covered with uniformly distributed residues, splash erosion will be reduced by up to 85 percent. Approximately two tons of maize residues per hectare are necessary to obtain 35 percent soil cover, which has been established as the minimum amount required for achieving a substantial reduction in relative soil erosion (Tolesa, 2001). In many parts of the country, however, crop residues have traditionally been used for multiple purposes including fuel, building materials and animal feed, which conflict with their use in conservation agriculture. Among these, livestock-related use (feed) is probably the most widespread in the country.

Crop rotation and intercropping: In a system with reduced mechanical tillage based on mulch cover and biological tillage, alternatives have to be developed to control pests and weeds. Practising crop rotation and intercropping has many advantages, which include reduced risk of pest and weed infestations; better distribution of water and nutrients through the soil profile; exploration for nutrients and water of diverse strata of the soil profile by roots of many different plant species, resulting in a greater use of the available nutrients and water; increased nitrogen fixation through certain plant-soil biota; improved balance of nitrogen, phosphorus and potassium (N-P-K) from both organic and mineral sources; and increased formation of organic matter. Better nutrient management through crop rotation can decrease nitrogen fertilizer use by up to 100 kg N per hectare per year, substantially lowering related greenhouse gas (GHG) emissions (nitrous oxide has a global warming potential 310 times greater than CO_2) as well as reducing the costs of production. Reduced synthetic fertilizer use also leads to reduced greenhouse gas emissions from the manufacturing process and transportation (PANW, 2012). However, in most parts of the Ethiopian farming system farmers hardly practise crop rotation and mono-cropping is the dominant cropping system.

As part of expediting the adoption of conservation agriculture, a technical committee was established in the Extension Directorate of the MoA in 2005 with the major objective of enhancing the promotion of conservation agriculture. The conservation agriculture technical committee was not successful for a number of reasons, among others the restructuring of the agricultural offices and a lack of broad-based committee representation. Since then a number of workshops and studies have been conducted on conservation agriculture in Ethiopia. Most recently, in March 2014, the MoA and FAO, with funding from COMESA, held a national stakeholders meeting (called a National Conservation Agriculture Taskforce Formation Workshop) to discuss how to improve coordination of conservation agriculture in the country. The meeting resulted in the development of terms of reference and nomination of national conservation agriculture taskforce members from Government, development partners, research, CSOs and the private sector to provide support for the promotion and coordination of conservation agriculture across the country.

As a result of past work and present promotional efforts, conservation agriculture has been adopted by a number of smallholder farmers in many parts of the country. However, the promotion and adoption of conservation agriculture technology is constrained by various factors, which include weak integration into existing extension planning, prevalence of open grazing, shortage of livestock feed, removal of crop residue for animal feed and firewood, and lack of knowledge on appropriate cropping systems, crop rotations and intercropping combinations, among other factors (see Box 4).

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Severe land degradation caused by overgrazing

©FAO/Tamiru Legesse

Box 4: Challenges to conservation agriculture promotion in Ethiopia

Despite conservation agriculture having been introduced in Ethiopia over 16 years ago, adoption of the practice remains low and has not progressed as fast is it could have. Some of the challenges in the promotion and adoption of conservation agriculture in the country are listed below:

Inadequate integration of conservation agriculture into the Agricultural Extension Service: Conservation agriculture promotion in Ethiopia has been implemented mainly by NGOs and private sector organizations, while emphasis given by responsible government institutions like the Ministry of Agriculture, in particular the Agricultural Extension Directorate, has not been sufficient in the past. In particular, conservation agriculture is not adequately integrated into the existing agricultural extension delivery system of the MoA. In addition, since conservation agriculture has mostly been implemented by NGOs, there has not been adequate government follow-up, support and appropriate monitoring to ensure sustainability and wide adoption of the practice.

Open grazing system: Open grazing is a challenge not only to conservation agriculture in Ethiopia, but also to overall agricultural development and environmental sustainability. Open grazing results in the removal of crop residues from conservation agriculture fields and causes soil compaction that results in hard pans and difficulty in planting using simple planters or simple rippers that are suitable for smallholders. If livestock are accustomed to feeding on crop residues, a conflict of interest can be created when crop residues need to be kept for mulching. Crop-livestock conflicts need to be considered when promoting conservation agriculture.

Lack of alternative energy sources: In most parts of rural Ethiopia, crop residue is not only used as a livestock feed, but also as a fuelwood for cooking purposes. Most farmers do not have woodlots and hence crop residue is one of the main sources of fuelwood for cooking. In promoting conservation agriculture there is a need to consider mechanisms to support farmers to access alternative energy sources.

High input prices: Prices for high-quality inputs such as herbicides, fertilizer, improved seeds and implements have been steadily increasing in Ethiopia and at times the prices are beyond the capacity of many smallholder farmers. One example is non-selective herbicides which, according to farmers, have more than doubled in price within three years. A means of supporting smallholder farmers to access inputs so that they can undertake conservation agriculture and other CSA practices is needed.

Lack of availability of required inputs and equipment: It has frequently been reported that inputs such as non-selective glyphosate-based herbicides are difficult to access and those that are available are not effective, thus making it difficult for farmers to adopt conservation agriculture owing to weed problems. The same applies to other inputs required for practising conservation agriculture such as seeds for rotation crops as well as conservation agriculture implements such as rippers and direct seeders, which are not available at times or, when available, are of poor quality.

Shortage of credit facilities: Credit service is an important factor that influences adoption of agricultural technologies, especially for poor farmers who often have limited financial resources for purchasing agricultural inputs and implements.

CSA practice	Components	Why it is climate smart
Conservation agriculture	• Reduced tillage • Crop residue management – mulching, intercropping • Crop rotation/intercropping with cereals and legumes	• Carbon sequestration • Reduce existing emissions • Resilience to dry and hot spells
Integrated soil fertility management	• Compost and manure management, including green manuring • Efficient fertilizer application techniques (time, method, amount)	• Reduced emission of nitrous oxide and CH_4 • Improved soil productivity
Small-scale irrigation	• Year-round cropping • Efficient water utilization	• Creating carbon sink • Improved yields • Improved food security
Agroforestry	• Tree-based conservation agriculture • Practised both traditionally and as improved practice • Farmer-managed natural regeneration	• Trees store large quantities of CO_2 • Can support resilience and improved productivity of agriculture
Crop diversification	• Popularization of new crops and crop varieties • Pest resistance, high yielding, tolerant to drought, short season	• Ensuring food security • Resilience to weather variability • Alternative livelihoods and improved incomes
Improved livestock feed and feeding practices	• Reduced open grazing/zero grazing • Forage development and rangeland management • Feed improvement • Livestock breed improvement and diversification	• Improved livestock productivity • GHG reduction • CH_4 reduction
Other	• *In situ* water conservation/harvesting • Early-warning systems and improved weather information • Support to alternative energy – fuel-efficient stoves, biofuels • Crop and livestock insurance • Livelihoods diversification (apiculture, aquaculture) • Post-harvest technologies (agro-processing, storage)	• Resilience of agriculture • Improved incomes • Reduced emissions • Reduced deforestation • Reduced climate risk

Figure 3: Summary of some common CSA practices in Ethiopia

Box 5: Case Study 2 - Adoption of conservation agriculture in Sibusire woreda of Oromia Regional State

Sibusire is one of the woredas in the East Wollega Zone of Oromia Regional State where smallholder farmers have adopted conservation agriculture. Ecologically the woreda is characterized by highland, midland and lowland agro-ecology accounting for 70 percent, 20 percent and 10 percent of the land, respectively. Maize is the dominant crop of the woreda, followed by teff and sorghum. Other crops like faba bean, field peas and haricot bean are grown, but in smaller quantities.

The topography of the land is rugged, with numerous hills and dales as a result of which soil erosion is the major form of land degradation. The overall crop productivity of the woreda is low owing to a decline in soil fertility emanating from erosion, mono-cropping and a lack of adequate knowledge on improved agronomic practices. Moreover, crop residue is completely removed, mainly for household fuelwood and livestock feed. The remaining organic matter is burned for land-clearing purposes.

SG2000 Ethiopia began an intervention in the woreda in 2001 with the aim of improving overall crop productivity. Conservation agriculture is one of the technologies employed. Woreda subject matter specialists (SMS), development agents (DAs) and farmers were intensively trained in conservation agriculture practices which included reduced tillage, crop residue management and crop rotation. Farmers were trained in appropriate weed management technologies, with major emphasis on the application technique of non-selective herbicides, particularly Roundup. Numerous maize and teff conservation agriculture demonstrations were conducted and successful demonstration field days were organized.

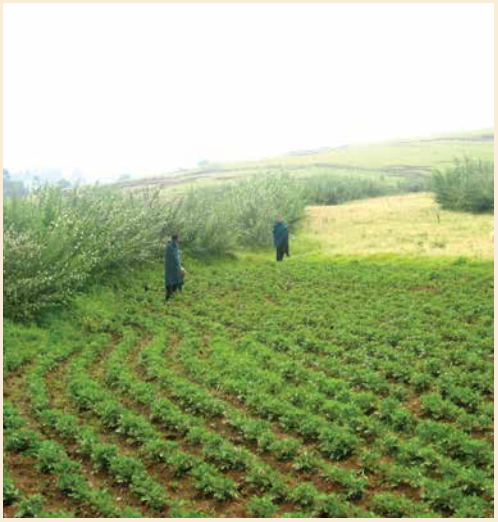
In 2014 the report from the woreda office indicated that over 4 000 smallholder farmers were practising conservation agriculture on an estimated 3 500 hectares of land, mainly on maize and teff crops. As part of this study, visits were made to two of the kebeles – Chari and Burka-atalo. Agro-ecologically, Chari kebele is mid-altitude with maize as the dominant crop, while Burka-atalo is high altitude and teff is the dominant crop. Focus group discussions conducted with both teff and maize farmers in these kebeles indicated that the yield of both crops under conservation agriculture is higher than the conventional method. Farmers also reported a marked reduction in soil erosion, better build-up of soil organic matter and improved rainwater infiltration. The main reasons for adoption of conservation agriculture reported by these farmers were improved yield and the time-saving nature of conservation agriculture. Women farmers explained that conservation agriculture is "pro poor". Women farmers and both married and women-headed households benefited from conservation agriculture technology, mostly through reduction in time spent in the fields.

Conservation agriculture in Chari kebele of Sibusire woreda, Oromia Regional State

Agroforestry: Agroforestry is an old agricultural activity traditionally practised in many parts of Ethiopia. The practice involves the integration of trees and shrubs into farmland either through planting or natural regeneration. In Ethiopia, the moringa tree is traditionally interplanted with sorghum and other crops in Konso, Omo, Burji, Sena and Mele woredas of SNNP Regional State. Currently, the Agricultural Extension Directorate of the MoA has identified the use of this tree as an important technology for climate change adaptation and promotion is under way in South and North Welo, East and West Hararghe and Sidama Zones, among others, through seed collection and establishment of nurseries. The Ministry provides training on the environmental, agricultural and nutritional importance of the tree to encourage its use.

In northern Ethiopia, the Relief Society of Tigray (REST) has been promoting agroforestry in many parts of the region as part of sustainable agriculture. Agroforestry is one of the key agricultural activities conducted in SLM Programme 1. The Agricultural Extension Directorate has also developed a technology package for wider promotion of *Faidherbia albida* in Ethiopia. In 2011 the government of Ethiopia announced a national programme to plant over 100 million *Faidherbia* trees in farmers' fields as part of the activities outlined in the Climate Resilient Green Economy (CRGE) Strategy. Organizations such as ICRAF are also conducting research into agroforestry that includes field trials of different tree species as well as planting densities and tree-crop combinations and their impact on agricultural yields and the physical environment.

The agroforestry practices being promoted and tested are intended to address issues of soil fertility, soil erosion and diversification of farm produce as well as agricultural yield, resilience to climate variability (for example through provision of shade during hot spells) and creation of favourable microclimates for certain crops. Integrating perennial trees or shrubs in agricultural lands used both for crop production and grazing in Ethiopia has been documented to improve soil cover and ensure green cover during the off-season (Kitalyi *et al*., 2011). In addition, research is ongoing into the use of conservation agriculture with trees (CAWT), a technology that combines agroforestry and conservation agriculture. CAWT on farm trials in Boset and Meiso woredas in Oromiya Region by the Forestry Research Centre (FRC) using a mix of *Sesbania* and *Faidherbia* showed mixed results in terms of maize yield when compared with conventional tillage and conservation agriculture. Other tree species that have been used in agroforestry in Ethiopia include *Calliandra* and *Cajanus*.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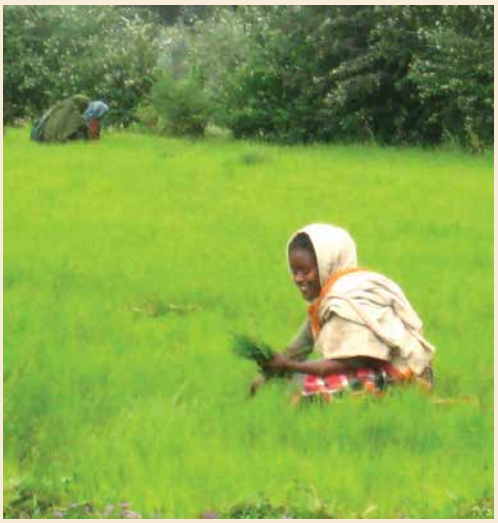
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Agroforestry promoted by Sustainable Land Management Programme I in Gagusashikudad woreda of Amhara Region

Crop rotation and intercropping: In Ethiopia the promotion of crop rotation is conducted in many parts of the country as a regular extension programme. The importance of crop rotation in improving soil structure, reducing soil degradation and improving yields is well documented. Increased levels of soil organic matter enhance water and nutrient retention and decrease synthetic fertilizer requirements. Crop rotation effectively delivers on both climate change adaptation and mitigation. Better nutrient management through crop rotation can decrease the use of nitrogen fertilizer and related greenhouse gas (GHG) emissions associated with the production, transportation and use of chemical fertilizers (PANW, 2012).

Use of effective microorganisms: Effective micro-organisms (EM) are mixed cultures of beneficial natural fermentative microorganisms that can be applied to increase the necessary microbial diversity needed for living. The use of EM technology has expanded in the last two decades from crop production to water treatment, odour control, animal husbandry, human health and numerous other industrial treatments. This technology has recently been promoted by the private sector and NGOs. Effective microorganisms improve the digestibility of livestock feed, shorten the time for composting and are used for many other agricultural purposes such as removing bad odours from poultry farms as well as for removal of mucilaginous substances. The use of effective microorganisms has the potential to improve productivity. However, the potential to mitigate climate change by reducing greenhouse gas emissions through managing microbial processes requires more research. Some research has been done in Ethiopia on the use of effective microorganisms to increase the productivity and growth rate of broilers.

"The area under small-scale irrigation infrastructure increased from 853 000 hectares in 2009 to 2 084 760 hectares in 2013. The area under irrigated crop production stood at 1 231 660 hectares in 2013."

Small-scale irrigation: Ethiopia has embarked on the promotion and implementation of small-scale irrigation across the country. Consequently, the area under small-scale irrigation infrastructure increased from 853 000 hectares in 2009 to 2 084 760 hectares in 2013, while the area under irrigated crop production stood at 1 231 660 hectares in 2013 (MoA, 2014). Irrigation

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and water availability increase biomass and contribute significantly to improved crop and forage productivity. The availability of irrigation infrastructure and sufficient water for crop and livestock production can also increase the number of cropping seasons and reduce the risks associated with rain-fed agriculture and the rearing of livestock in a drought-prone and water-scarce country. This can have a significant impact on food security and climate change adaptation. In irrigated agriculture, appropriate water management is a requirement for efficient water utilization coupled with improved agronomic practices. There is a need to ensure that appropriate training on agronomy and water management is given along with support to develop irrigation infrastructure. In the absence of irrigation, many farmers have practised different forms of rainwater harvesting, including in-field rainwater harvesting as well as more advanced practices such as roof rainwater harvesting. These techniques can support farmers to retain water for improved crop resilience to weather variability, particularly mid-season dry spells.

Crop diversification and improved variety popularization: As part of ensuring food security, the government of Ethiopia, international organizations and NGOs are involved in the development and popularization of new crops and crop varieties at community and household level. Initiatives like the Eastern Africa Agricultural Productivity Project (EAAPP), SLM and the Agricultural Growth Programme (AGP) that are implemented by the government and NGOs are conducting crop variety popularization activities. Crop varieties that are resistant to pests and diseases will reduce the need for pesticides; they also reduce carbon emissions by decreasing pesticide demand as well as the number of in-field applications. However in recent years, as a result of climate variability, wheat rust such as yellow rust and stem rust has become a big challenge in the major wheat-growing areas of the country, causing complete devastation of crops. Maize virus is also becoming a major threat in areas where maize is grown, especially in warm climate regions of Ethiopia.

Post-harvest handling: Climate change will continue to exert its influence not only on agricultural production, but also on post-harvest aspects. This will require some attention in terms of climate-smart post-harvest technologies; for example losses incurred from pests such as grain weevil may increase with rising temperatures, while there may also be losses from the effect of floods. Increasing temperatures may also reduce the period in which agricultural produce can stay fresh. As a result, technologies that have been promoted in the country include smallholder-friendly post-harvest technologies like multi-crop threshers, maize shellers, solar fruit driers and improved grain storage structures in many parts of Ethiopia.

2.2.2 Traditional CSA practices

Various types of traditional CSA practices have been implemented and adopted in Ethiopia. Such practices include the Derashe Traditional Conservation Agriculture, Konso Cultural Landscape, Hararghe Highland Traditional Soil and Water Conservation, Hararghe Cattle Fattening, Hararghe Small-Scale Traditional Irrigation, Ankober Manure Management and Traditional Agroforestry in Gedeo Zone, East Shewa Zone, East Wollega Zone and West Gojam Zone.

Traditional conservation agriculture is practised in a number of places in Ethiopia, one of which is Derashe (Sagandoye valley) special woreda in SNNP Regional State. Sagandoye valley in Derashe District is characterized by rainfall irregularity in terms of onset, dry spells and early cessation. Therefore, food insecurity caused by low agricultural production and productivity is a major challenge. As a result of the challenge, farmers in the valley have long practised traditional conservation agriculture on an estimated 11 000 hectares. Under this traditional practice, sorghum and maize are grown without tilling the land. Seed placement is conducted in rows using pointed sticks. Weeding is done frequently, even during the dry season when there are no crops on the farm. After harvesting, crop residues are laid on the ground following the contour in a rectangular manner to conserve moisture from rain. Animals are not allowed to enter the farm and there is no crop residue removal at all. However, there is no systematic crop rotation and intercropping, and promotion of these aspects requires support from the extension service.

Traditional conservation agriculture practices are also carried out by smallholder farmers in many woredas of the Gambella and Benishangul-Gumuz regions. Here the hoe is the main traditional implement used for seed placement without frequent ploughing of the land. However, similar to the Derashe District, traditional conservation agriculture in Benishangul-Gumuz and Gambella regions is not accompanied by crop rotation.

The Konso Cultural Landscape is located in an SNNP Regional State close to Derashe Special Woreda. The area is characterized by hilly terrain and soil erosion is the major form of environmental degradation. Farmers in Konso practise a highly sophisticated yet traditional brand

of terracing, agroforestry and manure management that consistently provides good harvests and maintains the integrity of the land. This traditional soil conservation activity has contributed to significant reductions in soil erosion and has also supported climate change adaptation. As a result of its traditional land terracing practices, the Konso Cultural Landscape is now registered as a UNESCO World Heritage Site.

As in the Konso special woreda, farmers in the Hararghe highlands are following traditional soil and water conservation practices. In addition to soil conservation, farmers in Hararghe zones are practising small-scale water harvesting and river diversion, which they utilize for irrigated crop production. Traditional animal fattening (mixed crop-livestock agriculture) is also practised in Hararghe through a cut-and-carry system. In addition, there are traditional agroforestry practices in places like East Showa, East and West Wollega and West Gojam Zone, particularly in Bure and Wonberima woredas. In Ankober woreda of Amhara Region, farmers traditionally spread animal manure on crop fields, as a result of which significant increases in crop biomass and yield have been reported.

These and a number of other traditional CSA practices take place across Ethiopia. This traditional knowledge needs to be documented and tapped in order to develop sustainable and appropriate CSA technologies for the country.

2.3 CSA and Biophysical Conditions

The Rural Development Policy and Strategy Document (MOFED, 2003) states that Ethiopia is characterized by the existence of many agro-ecological zones, which differ in terms of rainfall, soil types, altitude and the like. It further states that all development efforts will be based on detailed development plans for each agro-ecological region so as to bring about the maximum possible growth in each region, thereby accelerating and sustaining the country's overall agricultural development.

For drought-prone regions, the policy states that special attention will be given to the regeneration of natural resources as well as soil and water conservation and environmental protection as a matter of great importance. The strategy for regions with reliable rainfall is to increase crop production and productivity while undertaking natural resources development. Agroforestry and animal resources development are areas that can be greatly expanded.

In Ethiopia various projects and programmes are implemented in the different agro-ecological zones of the country. PSNP-PW is implemented in moisture-deficit food-insecure districts. Such districts are characterized by drought and low moisture, contributing to low crop production and productivity. The SLM programme is implemented mainly in districts with adequate rainfall that are affected by severe land degradation, mostly as a result of erosion and inappropriate land-management

practices. The Drought Resilient and Sustainable Livelihoods Program (DRSLP), which is funded by the African Development Bank (AfDB), is implemented in pastoral and agropastoral areas of the country. These are areas characterized by a harsh climate caused by high temperature. The programme focuses on natural resources management and livestock infrastructure development as a means to address resilience, productivity and environmental degradation challenges.

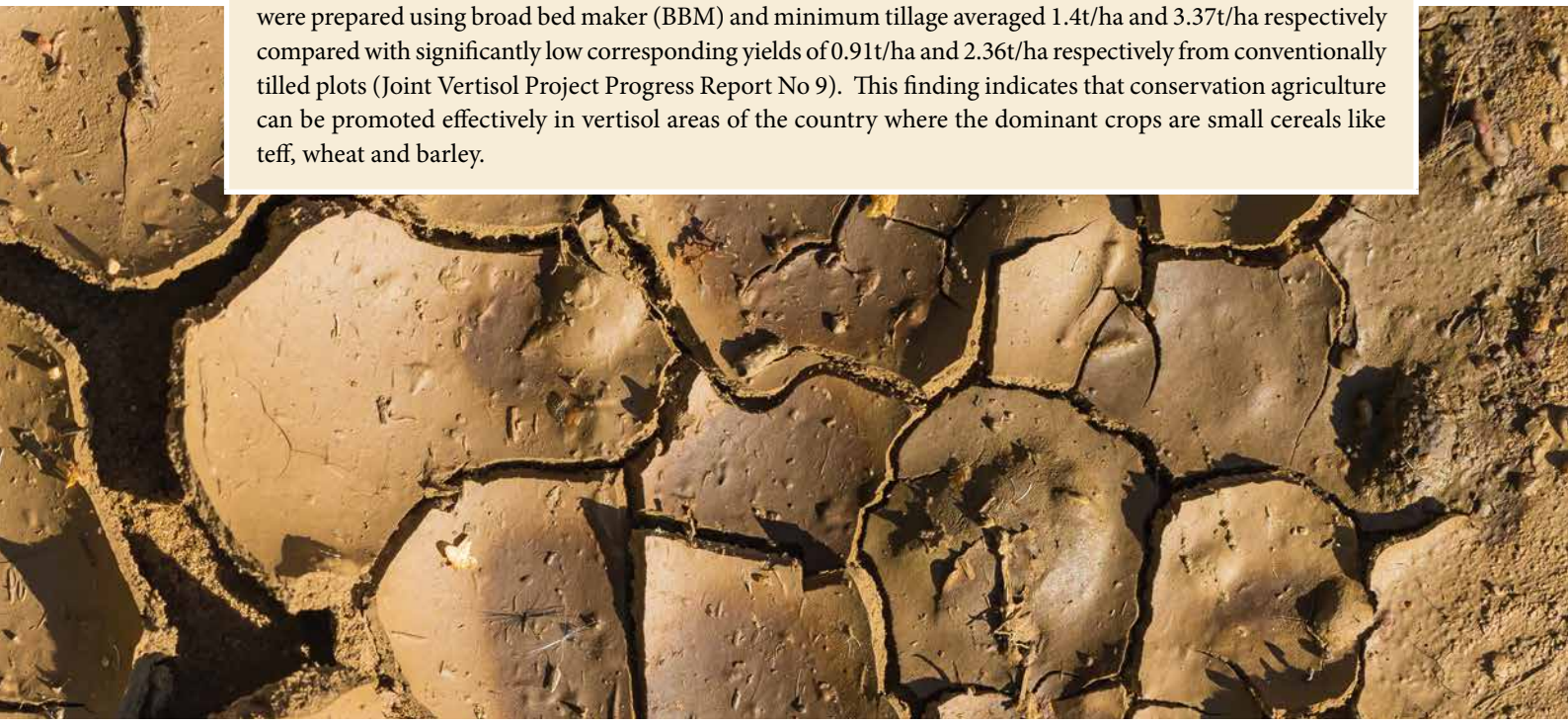
Conservation agriculture in Ethiopia is practised in various agro-ecological zones, from low to high altitude, as well as different temperature and rainfall ranges. Conservation agriculture technology is mainly adopted in mid-agro-ecological zones with adequate rainfall. Such districts are located in East and West Gojam, East and West Wollega and West Shewa zones. Conservation agriculture technology is also adopted for a wide range of soils, which include lithosols and vertisols. This is in line with the report of Lamourdia (2010) which states that conservation agriculture is adaptable to all kinds of climatic, soil and cropping conditions.

In Ethiopia it was reported that mean temperature increased by 1.3°C from 1960 to 2006, with more hot days and nights and fewer cold days and nights. The temperature is highly variable from year to year and season to season (FDRE, 2011). Climate data over the past 55 years (1951 to 2005) indicate that there has been a warming trend in the annual minimum temperature (NAPA, 2007). It is also reported that Ethiopia is vulnerable to accelerated soil erosion caused by existing pressures and degradation of its land area, 79 percent of which has a slope greater than 16 percent, and 25 percent of which has a slope greater than 30 percent (FDRE, 2011).

Box 6: Conservation agriculture on vertisols in Ethiopia

Vertisols occupy about 12.7 million hectares of land in Ethiopia, of which 7.6 million hectares (approximately 60 percent) are in the highlands (Tekalign *et al*., 1993). Most of the vertisols are prone to excess water and poor workability and are underutilized. Vertisols are very susceptible to erosion and as a result the intensity of degradation on vertisols is becoming very severe, which has an adverse effect on agricultural production and productivity. Common crops grown on vertisols are teff, wheat, barley, chickpea, lentil, faba bean and fenugreek (*Trigonellafoenum graecum*), but the yields of these crops are quite low as a result of water logging and a lack of improved technology.

In an experiment carried out on vertisols in Ethiopia it was reported that grain and straw yields of plots that were prepared using broad bed maker (BBM) and minimum tillage averaged 1.4t/ha and 3.37t/ha respectively compared with significantly low corresponding yields of 0.91t/ha and 2.36t/ha respectively from conventionally tilled plots (Joint Vertisol Project Progress Report No 9). This finding indicates that conservation agriculture can be promoted effectively in vertisol areas of the country where the dominant crops are small cereals like teff, wheat and barley.

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CSA PROGRAMMES AND PROJECTS 3

Climate-Smart Agriculture in Southern Ethiopia: This project is implemented jointly by Farm Africa and SOS Sahel, Self Help Africa and Vita in 15 woredas. Through its landscape approach, the project is aimed at sustainable land management. Activities employed include the promotion of agroforestry, small-scale irrigation, soil and water conservation, small ruminant rearing, cut-and-carry livestock feed promotion and promotion of value-chain crops such as pepper.

Climate-Smart Initiative for PSNP and HABP beneficiaries: The PSNP programme began in 2005 as a joint programme by the government of Ethiopia and a consortium of donors in response to chronic food insecurity in rural Ethiopia. The programme operates as a safety net, targeting transfers to poor households in two ways — through public works (PW) and direct support. The PSNP reaches more than seven million people and is currently operating in 319 woredas in the country. The PSNP is linked to the Household Asset Building Programme (HABP), another core element of the national Food Security Programme (FSP). Together, the programmes help build households' food security and their ability to cope with disasters. The HABP provides credit and agricultural extension services to support vulnerable households to engage in both farm and non-farm activities. The HABP has demonstrated the value of combining social protection with livelihoods diversification activities to improve household resilience. The Climate-Smart Initiative seeks to strengthen these two important food security programmes. The programme aims to strengthen the contribution of PSNP and HABP to climate resilience, focusing on fine-tuning of existing PSNP-PW and HABP livelihoods activities to make them more climate-smart. The programme is financed by the World Bank and Care Ethiopia and implemented by a consortium of partners including Farm Africa, ICARSA and the International Livestock Research Institute (ILRI). The Climate-Smart Initiative includes actions such as supporting access to climate and weather information for smallholder farmers as a means of climate risk reduction.

"The PSNP reaches more than seven million people and is currently operating in 319 woredas in the country."

Reducing Emissions from Deforestation and Forest Degradation (REDD+): REDD+ aims to reduce emissions from deforestation and forest degradation, and enhance the role played by conservation and sustainable management of forests in climate change mitigation. By creating financial value for carbon stocks, it aims to show the value of forests. Now under the Ministry of Environment and Forests, it was one of the early priorities in the CRGE. Thus REDD+ is evolving in the context of a policy environment that is promoting reforestation and afforestation as a way of tackling land degradation. The country has been taking steps regarding the undertaking of REDD+ readiness studies, conducting national forest assessments, setting reference levels, identifying safeguards, testing forest management models and developing national forest monitoring and measurement reporting and verification (MRV) systems among other assessments that can inform the country's national REDD+ strategy and programme.

One of the REDD+ projects is the Bale Mountains Eco-Region REDD+ Project, which builds on the Bale Eco-Region Sustainable Management Programme (BERSMP) that has been running since 2007 and is implemented by the Oromia Forest and Wildlife Enterprise (OFWE) and the NGOs Farm Africa and SOS Sahel Ethiopia with funding from the Norwegian Government. It is the first large-scale REDD+ pilot project in Ethiopia. The aim of the project is to enhance the biodiversity and ecological processes of the Bale Mountains and improve the wellbeing of the community. The project is working on improving traditional activities such as beekeeping, furniture making, processing of wild coffee and production of eco charcoal from bamboo. This provides opportunity for the community to earn money without cutting down trees. The project is expected to result in an estimated 18 million tonnes of CO_2e emission reductions over the 20-year project lifetime.

Climate-Smart Push-Pull Technology Promotion: This technology is promoted jointly by the International Centre of Insect Physiology and Ecology (icipe) and Jima Zone Agricultural Office. The project started in Boterbecho woreda in 2013 and is operating in nine kebeles. So far 1 080 farmers have participated in the demonstration of green leaf desmodium and Barachiaria grass for the control of maize stalk borer. This technology is reported to be effective for the control of the parasitic weed striga in maize and sorghum fields as well. Information obtained from icipe indicated that a national technical committee was established in February 2014 within the Agricultural Extension Directorate of the Ministry of Agriculture. Members include staff from MoA, EIAR, ATA, Institute for Sustainable Development (ISD) and icipe. The work being conducted by icipe is seeking to adapt and implement the push–pull technology for the increasingly arid and hot conditions associated with climate change as well as to identify, test and select new drought-tolerant crops and plants that can be incorporated into the push–pull system.

Enhancing income of smallholder farmers through integrated soil fertility management: The project is also known as the AGRA soil health project and is being implemented in forty woredas of the four main regions – Amhara, Oromia, Tigray and SNNP Regional States. It has a number of components that focus on addressing acidic soils, upscaling of new fertilizers, p-fertilizer application on soil test base and conservation agriculture.

"REDD+ aims to reduce emissions from deforestation and forest degradation, and enhance the role played by conservation and sustainable management of forests in climate change mitigation."

Humbo Assisted Natural Regeneration Project (Afforestation and Reforestation): The project was developed by World Vision Australia and is supported by the World Bank Bio Carbon Fund. It is one of the first registered clean development mechanism (CDM) forestry projects in Africa, covering 2 728 hectares. The livelihoods of the community at Humbo and Soddo woredas where the project operates depend mainly on mixed agriculture, crop production and livestock rearing, while some members of the community are participating in off-farm activities. The project involves the regeneration of 2 728 hectares of degraded native forests with indigenous, bio-diverse species. These forests act as a carbon sink to mitigate climate change while at the same time building environmental, social and economic resilience for future climate change impacts.

To date, 2 728 hectares of degraded forest that were continually being exploited for wood, charcoal and fodder extraction have been protected, and are now being restored and sustainably managed. Over the 30-year crediting period, it is estimated that over 870 000 tonnes of carbon dioxide equivalent will be removed from the atmosphere, making a significant contribution to mitigating climate change (World Vision, 2006).

Crops surrounding reforested areas also benefit through modification of the microclimate, which comes about through a combination of reduced wind speed, lower temperatures, higher humidity and greater infiltration of water into the soil. The resulting healthier crops and livestock are essential to community members' nutritional status, health and livelihoods, so the implications for development are enormous (World Vision, 2009).

"MERET operates in five regions and one administrative council in 72 woredas covering 500 sub-watersheds. Beneficiaries are about 1.5 million per annum (40 percent of which are women)."

MERET Project: Managing Environmental Resources to Enable Transition to More Sustainable Livelihoods (MERET) is a WFP-supported project initiated in the 1980s. This marked the beginning of large-scale soil and water conservation in Ethiopia. The main objective is to increase the ability of food-insecure households to meet necessary food needs and improve livelihoods through land rehabilitation, proper natural resources management, productivity enhancement, asset creation and diversification of livelihoods.

MERET operates in five regions and one administrative council in 72 woredas (Tigray [17], Amhara [23], Oromia [16], SNNP [12], Somali [3] and Diredewa [1]) covering 500 sub-watersheds. Beneficiaries are about 1.5 million per annum (40 percent of which are women). The major activity components are water harvesting, reforestation, seedling production, soil fertility management and construction of farmland terraces.

Agricultural Growth Project: The Agricultural Growth Project (AGP) of Ethiopia is aimed at increasing agricultural productivity and market access for key crop and livestock products in targeted woredas, with increased participation of women and youth. It has three components:

(i) agricultural production and commercialization;
(ii) small-scale rural infrastructure development and management; and
(iii) AGP management, monitoring and evaluation (M&E).


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The Ex-Ante Carbon-Balance (c-balance) Analysis for the Agricultural Growth Project (AGP) in Ethiopia showed that the net effect of AGP is to create a carbon (C) sink of 5.9 $MtCO_2e$ over 20 years, which represents the balance between the GHG emitted (mainly as a consequence of the increased use in agro-chemicals and of the infrastructure planned) and C sequestered (essentially through scaling-up of best practices). The adoption of sustainable agricultural practices could therefore be seen as complementary to the intensification of crop production, not only for the relevant agronomic implications, but also from a climate change mitigation point of view.

Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA): This project is currently implemented by CIMMYT in collaboration with federal and regional research centres. It is part of the African Food Security Initiative (AFSI). It focuses on maize as the main staple and legumes as an important dietary protein source for the rural poor. SIMLESA started operating in Ethiopia in 2010 to increase farm-level food security and income through conservation agriculture technologies that ensure sustainability and productivity. The programme is operating in eight federal and regional research centres in 17 districts. Activities so far indicated yield increment attained under conservation agriculture over years across locations (Shimeles, 2014).

The aim of the programme is to improve farm-level food security and productivity, in the context of climate risk and change, through the development of more resilient, profitable and sustainable farming systems that overcome food insecurity for significant numbers of farmers. The programme promotes the use of maize-legume technologies of adapted varieties and develops comprehensive agronomic packages that increase productivity and sustainable intensification of maize-legume cropping systems.

Farm Mechanization and Conservation Agriculture for Sustainable Intensification (FACASI) Programme: The fundamental hypothesis of FACASI is that lack of labour, animal draught power and engine power is limiting productivity of many farming systems in sub-Saharan Africa. The FACASI programme supports the SIMLESA and other conservation agriculture initiatives in the country through evaluation and demonstration of two-wheel tractor-based technologies for conservation agriculture. Partners in this programme include EIAR and CIMMYT.

Box 7: Use of the chisel plough for conservation agriculture in Ethiopia

The traditional chisel plough is the main implement used by farmers for land preparation in Ethiopia. The chisel plough is suitable for furrow preparation for row crops, particularly maize, sorghum and pulse crops. It is also suitable for teff and other small cereals to undertake only one pass before sowing without much disturbance of the soil. It is thus a suitable conservation agriculture implement. However, in recent years with massive promotion of teff line planting, farmers complain of a lack of teff row planters.

Sustainable Land Management (SLM) Programme: The first phase of the SLMP (SLM I) was launched in 2008. It has successfully introduced a number of sustainable land management practices and rehabilitated thousands of hectares of degraded land using physical and biological measures in 45 selected woredas and watersheds. The second phase (SLMP II) for the period 2013-2019 builds on the results of SLMP I. The SLM II Programme covers six regions, 90 new and 45 existing woredas or watersheds and 937 kebeles (SLM II project document, 2013). Direct and indirect beneficiaries of the project include an estimated 1 850 000 people in six regions namely Oromia; Amhara; Tigray; Southern Nations, Nationalities and Peoples' Regional State; Gambela; and Benishangul-Gumuz. SLM II introduced measures to address climate change or variability related risks and to maximize greenhouse gas (GHG) emission reductions so as to meet targets in the Growth and Transformation Plan (GTP) and the Climate Resilient Green Economy (CRGE) goals, while reducing land degradation and improving land productivity of smallholder farmers.

The project has four components, of which component 1 on integrated watershed and landscape management is crucial as far as CSA is concerned. In this component, promotion and adoption of conservation agriculture technologies was described as a key agricultural activity. Other CSA activities mentioned in this programme are integrated soil fertility management, small-scale irrigation schemes, integrated tree-food crop-livestock systems at the homestead, poultry and animal fattening, beekeeping and management of public and communal lands through promotion of activities like soil and water conservation measures, water harvesting structures, forest and woodland management practices and the like.

Drought Resilient and Sustainable Livelihoods Programme (DRSLP) in Ethiopia: The programme is hosted in the Livestock Development Sector of MoA and began in 2013. The principal objectives are to contribute to poverty reduction, food security and sustainable economic growth through enhanced rural incomes. The programme seeks to improve livelihoods and resilience of the pastoral production system in the Afar and Somali Regional States of Ethiopia. The programme includes natural resources management activities such as water resource development, rangelands management and soil and water conservation, along with various capacity-building activities.

Great Green Wall for the Sahara and the Sahel Initiative (GGWSSI): The GGWSSI, a programme that stretches across 12 countries in the Sahara and Sahel regions, aims to support the efforts of local communities in the sustainable management and use of forests, rangelands and other natural resources. It also aims to contribute to climate change mitigation and improve food security and livelihoods of people in the Sahel and the Sahara. In Ethiopia the GGWSSI is meant to reinforce the Climate Resilient Green Economy (CRGE) Strategy. The GGWSSI is an African Union programme supported by the Food and Agriculture Organization of the United Nations (FAO), the European Union and the Global Mechanism of the United Nations Convention to Combat Desertification (GM-UNCCD).

Africa Climate-Smart Agriculture Alliance (ACSAA): The ACSAA, also known as the AU-NEPAD-INGO Alliance for Scaling-Up Climate-Smart Agriculture in Africa, was announced in June 2014 at the African Union (AU) Summit in Malabo. The main aim of the alliance is to support the rapid scaling-up of CSA to six million farming households across Africa through the collaborative efforts and practical, on-the-ground experience of Alliance members in agricultural research and implementation. The Alliance is coordinated by a pan-African steering committee that is convened by NEPAD and comprises international NGO members – Care International, Concern Worldwide, Catholic Relief Services, Oxfam and World Vision; and technical members – FAO, FANRPAN, FARA and CGIAR. The Alliance is unique in that NGOs are explicitly recognized for their involvement with communities and thus their ability to promote CSA at grassroots level. The Alliance is closely linked with NEPAD's programmes on agriculture and climate change, which are targeting having 25 million farmers practising CSA by 2025. Three "fast-start" countries have been identified for Alliance activities (Ethiopia, Niger and Zambia), and activities are expected to expand to other countries in the future. Concern Worldwide has been selected as the interim convener for Ethiopia. FAO will be supporting technical aspects of the work in Ethiopia.

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STAKEHOLDERS IN CSA ACTIVITIES 4

4.1 Government Ministries, Departments and Units

Ministry of Agriculture (MoA): The MoA houses several projects, programmes and units that are involved in the implementation of climate-related activities. Such projects, programmes and units include SLM, AGP, PSNP, MERET and CRGE and various pastoral and agropastoral livelihoods improvement projects.

Climate-Resilient Green Economy (CRGE) Coordination Unit: The MoA has established a dedicated CRGE coordination unit with a full-time coordinator and technical experts. The CRGE coordination unit is assigned to lead, steer, mainstream and monitor the performance of the agriculture sector's components of the CRGE. It is also implementing a pilot project known as the CRGE fast-track project. The project started in 2014 and is operating in 27 woredas of the four main regions with the aim of developing best practices for mainstreaming climate-resilience activities at grassroots level. CRGE focal persons at regional level are assigned to coordinate Regional CRGE Technical Working Groups that give guidance to regional and district level CRGE activities. At the community (kebele) level the development agents (DAs) serve as the CRGE focal persons.

Sustainable Land Management (SLM) Coordination Unit: The SLM Coordination Unit operates within the Natural Resources Management Directorate of the MoA and was established to undertake the physical and financial management of the SLM programme. This involves the development, planning and management of watershed resources, development and implementation of strategies and programmes, and the provision of technical support to regional SLM implementing offices. The unit consists of a team of experts including a national project coordinator, procurement and financial management specialists, M&E experts and technical experts in diverse disciplines.

"The Ethiopian Ministry of Agriculture houses several projects, programmes and units that are involved in the implementation of climate-related activities."

Soil Information and Fertility Directorate: This is a new directorate under the Natural Resources State Minister of MoA, established with the aim of collecting and disseminating knowledge on soil fertility.

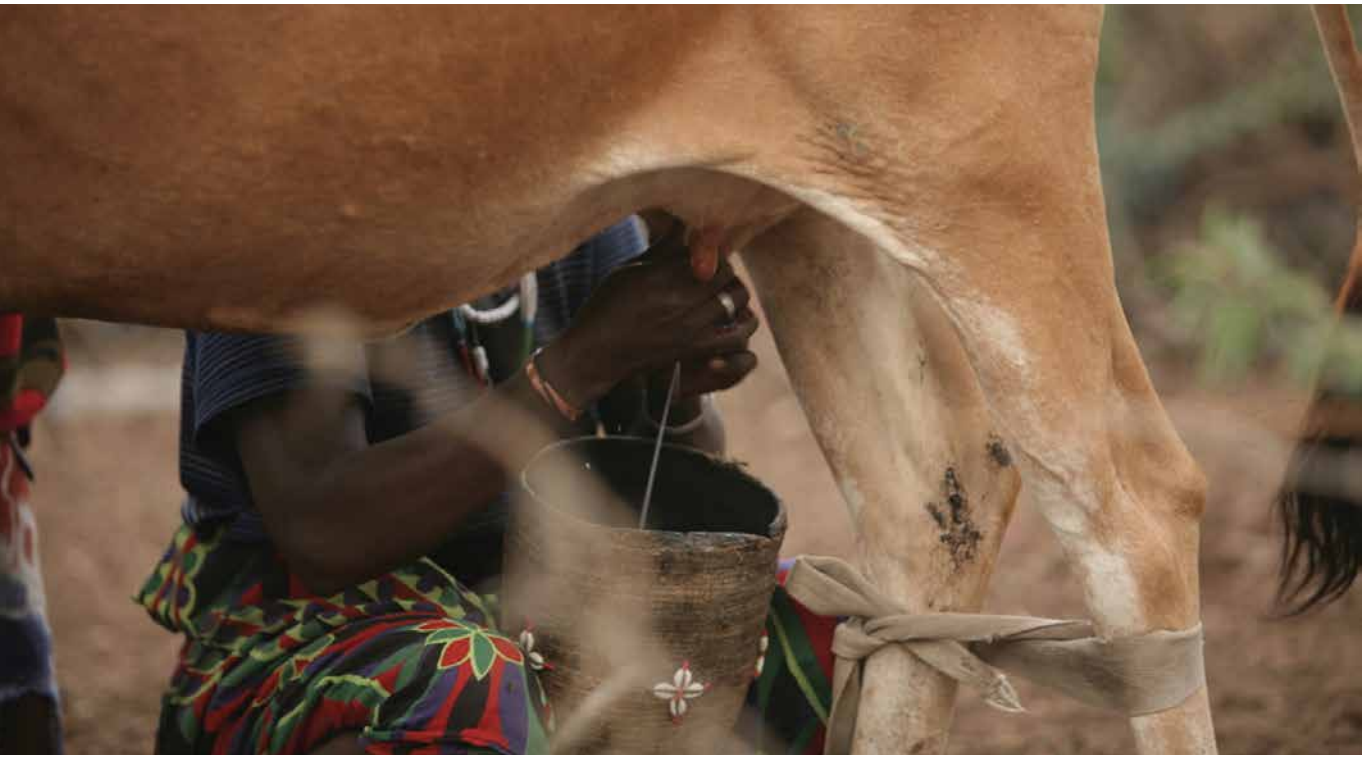
The directorate is working with ATA, EIAR and AGRA. The AGRA soil health project is hosted in this directorate, which is currently operating in 40 woredas of the four main regions. Major activities of the soil health project include promotion of conservation agriculture, scaling-up of new fertilizers and maintenance of soil laboratories.

Managing Environmental Resources to Enable Transitions to more Sustainable Livelihoods (MERET) Coordination Unit: The MERET project coordination unit functions within the structure of the federal and regional agricultural offices. The unit is answerable to the Natural Resources Management Directorate of the MoA. The project is financed by WFP and its main objectives are rehabilitation of degraded areas and livelihoods improvement of the people and community in the project site.

Agricultural Growth Programme (AGP) Coordination Unit: The AGP project aims to increase agricultural productivity and market access for key crop and livestock products in targeted woredas, with focused attention to women and youth. Project management is located within the MoA (Agriculture Sector). Coordination of AGP activities is undertaken through a high-level steering committee at the federal, regional and woreda levels for overall oversight and decision-making on major issues; and AGP coordination units at the federal and regional levels as well as dedicated focal persons at the zonal and woreda levels for day-to-day management.

Agricultural Transformation Agency (ATA): The Agricultural Transformation Agency is an organization established with the aim to transform the agriculture sector and realize the interconnected goals of food security, poverty reduction and human and economic development. Within ATA there is a directorate responsible for climate and environmental issues. The directorate is currently working on numerous climate-related activities, which include research on conservation agriculture and identification of climate-resilient agricultural activities. So far plastic rain gauges have been established in 28 woredas and there is a plan to establish 100 000 plastic rain gauges across the country in 2015. In addition, conservation agriculture promotion and demonstration activities were conducted in 54 woredas of Tigray, Amhara, SNNP and Oromia.

Ministry of Environment and Forests: Environmental degradation is a key issue in Ethiopia. In light of this, the Ministry of Environment and Forests as the national institution in charge of environmental and forest development issues has assumed a regulatory role and coordinates various activities within line ministries, agencies and non-governmental organizations. The mandate of the Ministry includes implementation issues like institutional coordination, legislative framework and monitoring, evaluation and review provisions.



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4.2 NGOs

NGOs play a major role in the welfare and livelihoods of communities in the country. A number of them are actively involved in agriculture and food-security programmes. Examples of NGOs that are involved in CSA-related activities are CCF-E, SG2000 Ethiopia, Self Help Africa, Farm Africa and FH Ethiopia.

Climate Change Forum - Ethiopia (CCF-E): The CCF-E is a multi-stakeholder group that meets regularly to discuss national responses to climate change. The CCF-E serves a broader coordination function by bringing together government, national and international NGOs, academia and research institutes, and bilateral, regional and multilateral donors to meet and co-operate on a wide array of climate change-related issues. The NGO is also implementing climate change adaptation agricultural activities in woredas like Lume, Dugda and Adama. Climate change-related activities of the NGO include biological soil conservation, physical soil conservation, water harvesting and small-scale irrigation, and promotion of horticulture crops for livelihoods diversification.

F**arm Africa:** Farm Africa is a registered charity organization that has been working directly with communities in Eastern Africa for over 25 years. Programme countries include Kenya, Ethiopia, Tanzania, South Sudan and Uganda. In Ethiopia, Farm Africa has been operating since 1988 with a mission to reduce poverty through strengthening the ability of African farmers to grow their incomes and manage their natural resources sustainably. With its various projects in the area of climate change, the organization is operating in over 30 woredas in Ethiopia. Some of the climate-related projects are:

- Climate-smart agriculture in 15 woredas of SNNP Regional State. It has been jointly implemented with SOS Sahel, Self Help Africa and Vita since June 2014.
- Climate-smart initiative for PSNP beneficiaries. The project is financed by the World Bank through CARE Ethiopia and has been operating in four woredas of the Hararghe and Bale zones of Oromia Region since 2013.
- The Bale REDD+ project: This joint project with SOS Sahel is operating in 13 woredas of Bale Zone.

SG2000 Ethiopia: In the 1998 crop season, SG2000 – in collaboration with Monsanto Central Africa Inc. and Makobu Enterprises PLC – initiated conservation agriculture demonstrations in Ethiopia on selected maize-growing peasant farmers' plots. As a direct result of SG2000's efforts from 1998 to 2006, more than 2 500 plots of maize and teff were planted under conservation agriculture in different parts of the country, primarily in Oromia, Southern Nations, Nationalities and Peoples' Regional State and Amhara regions. SG2000 has also sponsored research on conservation agriculture in Ethiopia that has been carried out at Jima, Bako and Melkasa research centres focusing on maize, sorghum, teff and wheat, particularly at the initial stage of conservation agriculture introduction. SG2000 has also sponsored and participated in various national conservation agriculture workshops carried out since 1998. Currently, SG2000 is promoting high-yielding crop varieties as well as quality protein maize in 24 maize-dominant districts of the country.

"As a direct result of SG2000's efforts from 1998 to 2006, more than 2 500 plots of maize and teff were planted under conservation agriculture in different parts of the country."

Self Help Africa: Self Help Africa is an international charity that promotes and implements long-term rural development projects in Africa. Self Help Africa works with local partners to support the provision of good quality local seed and planting materials. Activities include assistance to local communities to multiply their own seed, and provision of support for rural groups so that they can get certification for the seed that they produce. Along with improved seed production, the programme promotes conservation agriculture, particularly crop residue management, intercropping and crop rotation. Activities include the improvement of soil fertility through compost preparation and utilization as well as support in the promotion of Aybar broad bed maker (Aybar BBM) in vertisol-affected communities for drainage of excess water.

Canadian Foodgrains Bank (CFGB): CFGB is a partnership of 15 Canadian churches and church-based agencies working together to end global hunger. CFGB has established programme areas in Ethiopia, Kenya and Tanzania where conservation agriculture has been locally adopted and proven to improve soil health, farmers' profitability and overall system resilience. The CFGB network is well known for delivering an extensive large-

scale conservation agriculture programme in sub-Saharan Africa. The programme, in partnership with eight NGOs (known informally as a conservation agriculture hub), is currently operating in Afar, Oromia, Somali and SNNP Regional States of Ethiopia.

FH Ethiopia is implementing a project known as the Food Security and Economic Growth Programme as part of a consortium of six NGOs coordinated by Save the Children in Benishangul-Gumuz Regional State. In seven of the woredas the major activity conducted is natural resource management, while in two districts, Sirba-Abay and Belew, conservation agriculture demonstration plots were established in 2013 to promote climate-smart agricultural technologies and practices. The programme provides training to development agents and farmers.

Wolayita Terepeza Development Association is a local NGO working within Wolayita Kale Hiwot Church in two woredas of the Wolayita Zone, namely Kindokoyisha and Ofaworedas. In the two woredas, conservation agriculture (reduced tillage, mulching and crop rotation) was demonstrated on maize crops on the plots of 40 farmers in 2012. In 2013 the project involved 260 farmers and the number of farmers hosting conservation agriculture demonstration plots were increased. The project is financed by the Canadian Foodgrains Bank.

Land and Water Resource Centre (LWRC): One of the objectives of the LWRC is to establish modern learning watersheds in the Abay Basin and undertake research-supported participatory integrated watershed development activities. It is also intended to design an upscaling strategy based on the lessons learned from the learning watersheds to be applied at the basin level. To this end, the NGO has established seven learning watersheds in seven woredas and has started applying research-supported watershed development interventions to improve water and land management and people's livelihoods in the watershed. The project was initiated in 2012 and is operating in seven woredas of Amhara and Oromia regional states.

"The Land and Water Resource Centre has established seven learning watersheds in seven woredas and has started applying research-supported watershed development interventions to improve water and land management and people's livelihoods in the watershed."

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4.3 International Development Agencies

In Ethiopia there are numerous international development agencies that are working with government and civil society organizations in climate change mitigation and adaptation, as well as in areas related to the implementation of CSA. Some of the key agencies are the World Bank, FAO, GIZ, WFP and USAID.

World Vision Ethiopia: World Vision is a Christian relief, development and advocacy organization working to create lasting change in the lives of children, families and communities living in poverty and injustice. World Vision has a long history of community development work in Ethiopia and a strong legacy of community-based forestry programmes. One of the climate-smart activities of World Vision Ethiopia is the Humbo Forestry and Forest Reclamation Project located in Humbo and Soddo woredas of SNNP Regional State.

Care Ethiopia has been involved in a wide range of initiatives related to climate-smart agriculture as mentioned in the sections above.

FAO has a long history of support to conservation agriculture and other climate-smart practices globally and in Ethiopia. FAO has in the past supported the MoA to demonstrate conservation agriculture to 600 smallholder farmers on 24 demonstration plots in 12 woredas of Amhara, Tigray, Oromiya and SNNP regions. FAO has also supported the introduction of conservation agriculture equipment including jab planters and oxen-drawn seed and fertilizer planters in those same woredas in 2010. FAO supported the training of 72 extension agents in conducting conservation agriculture farmer field schools, of which 32 were also trained in conservation agriculture equipment assembly and operations. In addition, FAO organized an experience-sharing visit to Zambia for Ethiopian government staff so as to create awareness and bring back learning on conservation agriculture from that country.

4.4 Research Organizations

There are many international research organizations in Ethiopia that include universities, CGIAR centres such as icipe, CIMMYT, ICRAF, ICARDA, ILRI, IWMI and CIAT, all of which are working on climate-smart agriculture in one way or another. CIMMYT, for example, is one of the organizations involved in the SIMLESA project. ICRAF is working on issues around agroforestry in Ethiopia, while ILRI is involved in research related to livestock feeds and improving livestock productivity. These organizations are working primarily with national and regional research institutes.

Ethiopia's National Agricultural Research System (NARS): NARS comprises the national Ethiopian Institute of Agricultural Research (EIAR), seven regional research institutes, higher learning institutions, NGOs and private companies involved in research. Research efforts are augmented by CGIAR centres that support different agricultural research projects to contribute significantly to research in partnership with the government system. Currently, national as well as regional research centres are involved in climate-related studies such as conservation agriculture, agroforestry, development of improved varieties (including drought-resistant varieties) and efficient irrigation water application techniques.

Box 8: Conservation agriculture research in Ethiopia

Research on conservation agriculture in Ethiopia began in the year 2000 at Jima, Bako and Melkasa research centres on maize, sorghum and teff crops in collaboration with SG2000 and the respective regional agricultural development bureaus. The objective of the research was to verify the effectiveness of conservation agriculture technology under the Ethiopian farming system. The results of this initial research indicated that conservation agriculture plots gave higher yields compared with the conventional tillage (Tesfa, 2001, Worku 2001, Tolesa 2001). This was also consistent with research conducted in Latin America, Asia and other parts of Africa that had concluded that conservation agriculture yields are between 20 to 120 percent higher (depending on location) than those in conventional agriculture (Kassam *et al.*, 2009; Derpsch *et al.*, 2010). To date, a number of other research organizations are involved in conservation agriculture research including CGIAR centres such as icipe, CIMMYT, ICRAF, ICARDA, ILRI, IWMI and CIAT, who are conducting research mostly in partnership with Ethiopia's National Agricultural Research System (NARS) including the Ethiopian Institute of Agricultural Research (EIAR), regional research institutes as well as higher learning institutions such as universities and also with NGOs and private companies.

Private sector

The private sector has a vital role to play in the promotion of CSA and conservation agriculture. A key factor in the adoption (or lack of adoption) of conservation agriculture and other climate-smart practices is the availability of high-quality inputs required to undertake these practices. Private sector organizations relevant to CSA include producers of agricultural products, retailers and distributors of farming inputs. In this regard, Makobu Enterprises is one of the leading private agrodealers involved in the promotion of conservation agriculture. Makobu Enterprises has been involved in conservation agriculture in Ethiopia from the initial stages of introduction, promotion and scaling-up by providing technical support and inputs free of charge for demonstrations under various environmental and farming systems. They continue to conduct training on conservation agriculture to this day.

Other agrodealers such as Lion International, Chemitex and GCT could also play a key role in the adoption and promotion of conservation agriculture, particularly by supplying inputs such as non-selective herbicide (glyphosate), which is crucial to get rid of complex weeds during land preparation. Other agrodealers such as Syngenta, Makamba, Ethiopian Seed Enterprise and Regional Seed Enterprises are also providing various types of inputs, mainly in terms of improved seed and fertilizers which can support conservation agriculture and CSA adoption. The role of buyers of CSA and conservation agriculture value-chain products has to be carefully examined as farmers will only grow what they can use themselves or sell for a profit. Financial service providers such as banks and microfinance institutes are also key stakeholders who play a crucial role in financing climate-smart investments by smallholder and commercial farmers as well as supporting entrepreneurs involved in various aspects of the CSA value chain such as equipment manufacture or import.

Other stakeholders

Other key stakeholders include the media, who play a key role in spreading the message of climate-smart agriculture.

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POLICIES, STRATEGIES AND INSTITUTIONS RELEVANT TO CSA

5

The Ethiopian government has put in place a number of policies, strategies and institutions that are designed to support climate change adaptation and mitigation and sustainable development as a whole.

5.1 Policies and Strategies

Policies, laws and strategies relevant to climate change in Ethiopia include the Climate Resilient Green Economy Strategy (2011), National Adaptation Program of Action (NAPA), Ethiopian Programme of Adaptation to Climate Change (EPACC) of 2011, Nationally Appropriate Mitigation Actions (NAMA) of 2010, Rural Development Policy and Strategies (2003), Growth and Transformation Plan (GTP), CAADP Compact and the National Environmental Policy of Ethiopia (1997).

"Ethiopia has signed and/or ratified many of the international conventions and protocols related to climate change and land degradation."

Ethiopia is a signatory to a number of multilateral agreements that have a bearing on the sustainable development efforts of the country. Ethiopia has signed and/or ratified many of the international conventions and protocols related to climate change and land degradation including the United Nations Framework Convention on Climate Change (1994), the Convention on Biological Diversity (CBD) and the United Nations Convention to Combat Desertification (UNCCD).

Climate Resilient Green Economy Strategy, 2011: The Climate Resilient Green Economy Strategy known as CRGE was developed in 2011 and launched at the 17th Conference of the Parties to the United Nations Framework Convention on Climate Change in Durban in 2011. The strategy takes an economy-wide approach to greenhouse gas reduction. According to the strategy, Ethiopia aims to achieve carbon-neutral middle-income status before 2025. The strategy is based on four pillars, of which the first two pillars are mainly related to CSA.

- **Agriculture:** Improving crop and livestock production practices for greater food security and better income for farmers while reducing emissions.

- **Forests:** Protecting and re-establishing forests for their economic and ecological value, including carbon stocks.
- **Power:** Expanding electricity generation from renewable sources of energy for domestic and regional markets.
- **Transport, industry and buildings:** Leapfrogging to modern and energy-efficient technologies in transport, industrial sectors and buildings.

Ethiopian Programme of Adaptation to Climate Change (EPACC) 2011: EPACC aims to build a climate-resilient economy through adaptation initiatives implemented at sectoral, regional and local community levels. The EPACC replaced the NAPA in 2011 and takes a more programmatic approach to adaptation planning. It outlines 29 components that include objectives around mainstreaming climate change within government policies and plans. In response, the country has prepared sectoral and regional programmes of adaptation to climate change.

Agriculture Sector Programme of Adaptation to Climate Change: The Agriculture Sector Programme of Adaptation to Climate Change was formulated in 2011 with the following objectives:

- to realize the commitment of the country to the United Nations Framework Convention on Climate Change (UNFCCC), that demands the integration of climate change into sectoral policies and development efforts;
- to have a working climate change adaptation plan, that after implementation, minimizes the vulnerability of the agriculture sector and the community to climate change hazards, and increases the strength of the sector to tolerate predicted climate change impacts;
- to mainstream and incorporate climate change adaptation into the social system and existing development efforts from bottom to top levels, making use of people's mobilization and coordination (FDRE, 2011).

National Adaptation Program of Action (NAPA): As a Party to UNFCCC, Ethiopia prepared its NAPA in 2007. The NAPA represented the first step in coordinating adaptation activities across government sectors. The NAPA document for Ethiopia identified immediate and urgent adaptation activities that address current and anticipated adverse effects of climate change including extreme climate events. It provides a framework to guide the coordination and implementation of adaptation initiatives in the country through a participatory approach; building synergies with other relevant environmental and related programmes and projects.

Growth and Transformation Plan (GTP): In 2010 Ethiopia developed a Growth and Transformation Plan (GTP) for the period 2010/11-2014/15. The GTP recognizes that the environment is a vital and important pillar of sustainable development, and states that building a 'Green Economy' and ongoing implementation of environmental laws are among the key strategic directions to be pursued during the plan period. It outlines building a climate-resilient green economy as a strategic priority for the country.

Ethiopia's Agricultural Sector Policy and Investment Framework (PIF) 2010-2020: The PIF provides a strategic framework for the prioritization and planning of investments that will drive Ethiopia's agricultural growth and development. It is designed to operationalize the CAADP Compact signed by the Government and its development partners. The PIF states that climate change is a crosscutting issue that will be addressed in all areas of the PIF. In view of the high level of agroclimatic diversity in Ethiopia, climate change is likely to affect agriculture in many and varied ways. The PIF states that a number of instruments need to be considered for adapting to climate change. These include research on new crops and farming systems suited to hotter or drier conditions, water harvesting, agroforestry, improved short-term and long-term weather forecasting and risk management measures to cope with increasing climatic variability. Mitigation measures such as carbon sequestration through conservation agriculture and reforestation should also be considered. In this way, climate change issues will be mainstreamed into the PIF by undertaking carbon accounting studies of all key investments and identifying opportunities for adaptation and mitigation.

"The Policy and Investment Framework states that climate change is a crosscutting issue that will be addressed in all areas of the framework. In view of the high level of agroclimatic diversity in Ethiopia, climate change is likely to affect agriculture in many and varied ways."

CAADP Compact: The Comprehensive Africa Agriculture Development Program (CAADP) has been endorsed by the African Heads of State and Government as a framework for restoration of agriculture growth, food security and rural development in Africa. One of the pillars of CAADP is extending the area under sustainable

land management and reliable water control systems, and CSA falls under this pillar. Ethiopia developed a CAADP Compact in 2009 and this provides the consensus around the goals and priorities that Ethiopia has set to accelerate agriculture growth, improve food security and thereby livelihoods, and the partnerships and assistance required to achieve these goals. In Ethiopia, government programmes and project activities have been aligned with the CAADP pillars. Accordingly, the Sustainable Land Management Programme, which has been financed by the World Bank and other donors, is implementing pillar I of CAADP, which is improving natural resource management and utilization.

Environmental Impact Assessment Proclamation: An Environmental Impact Assessment (EIA) is a tool used for the environmental assessment of projects to ensure that the environmental implications are taken into account before decisions are made. In Ethiopia, the EIA Proclamation of 2002 and the procedural guidelines developed by the Environmental Protection Agency (EPA) set the framework for EIA processes. With regard to development projects, the proclamation stipulates that no person shall commence implementation of a proposed project identified by directive as requiring EIA without first passing through an EIA process and obtaining authorization from the competent organization.

Environmental Policy of Ethiopia: The Government of Ethiopia (GoE) issued an Environmental Policy in 1997. The aim was to rectify the economic and social costs of environmental damage from widespread mismanagement of environmental resources, and to provide overall guidance in the conservation and sustainable utilization of the country's environmental resources. The policy considers the vulnerability of the country to climate variability and aims to promote a climate-monitoring programme, take appropriate mitigation measures, develop the energy sector, actively participate in protecting the ozone layer, and maximize the standing biomass in the country through a combination of reforestation, agroforestry, rehabilitation of degraded areas, re-vegetation, control of free-range grazing (in the highlands) and seeking financial support for offsetting carbon dioxide emissions from such activities.

Ethiopia Nationally Appropriate Mitigation Actions (NAMA): Ethiopia has reaffirmed its commitment to the Copenhagen Accord and has submitted a statement to the UNFCCC highlighting potential NAMAs in various areas including agriculture and forestry. In forestry this includes enhanced reforestation actions and sustainable forest management, reclamation of degraded lands, controlled grazing and area closures, and creation of forest buffers to halt desertification. In agriculture this includes composting and practising of agroforestry.

Policy	Year	Intention or goal
Environmental Policy of Ethiopia	1997	Overall guidance in the conservation and sustainable utilization of the country's environmental resources
Environmental Impact Assessment	Proclamation 2002	Ensure that the environmental implications are taken into account before decisions are made
National Adaptation Program of Action (NAPA):	2007	The NAPA represented the first step in coordinating adaptation activities across government sectors
CAADP Compact	2009	One of the pillars of CAADP is extending the area under sustainable land management and reliable water control systems
Growth and Transformation Plan (GTP)	2010	The GTP recognizes that the environment is a vital pillar of sustainable development
Agriculture Sector Programme of Plan on Adaptation to Climate Change/APACC	2011	The Agriculture Sector Climate Change Adaptation Plan
Ethiopian Programme of Adaptation to Climate Change (EPACC)	2011	More programmatic approach to adaptation planning
Climate Resilient Green Economy Strategy	2011	Carbon-neutral middle-income status before 2025

Figure 4: Summary of key policies relevant to CSA in Ethiopia

5.2 Institutions

CRGE Coordination Unit: The CRGE Coordination Unit is established within the MoA Natural Resources Management Directorate. Technical teams include the livestock subsector technical committee, soil and crop technical committee and sustainable land management technical committee. The major responsibility of the CRGE Coordination Unit is mainstreaming climate change adaptation and mitigation strategies into the regular activities of each sector. The CRGE Coordination Unit is implementing a pilot programme known as Agriculture Sector Fast Track CRGE in 27 woredas of the four main regions.

Rural Economic Development and Food Security Sector Working Group (RED & FS): The platform brings together government and development partners under three thematic technical committees – Agricultural Growth, Sustainable Land Management and Disaster Risk Management and Food Security (DRMFS). The mandate of the RED & FS sector working group is sharing information on government policies, strategies and programmes; review of sector-level implementation; coordinating and harmonizing efforts of various development partners supporting the sector; and promoting dialogue with development partners to provide overall support. It was officially established by government and development partners in 2008 to support government development objectives effectively.

National Conservation Agriculture Taskforce (NCATF): In March 2014, the first NCATF workshop was conducted. Terms of reference were developed and national taskforce members from Government, FAO, NGOs and the private sector were identified. The role of the NCATF includes supporting the coordination of conservation agriculture at national level, leading promotion of conservation agriculture implementation, providing technical support to federal and regional conservation agriculture implementing institutions, mobilizing resources and identifying issues for policy decisions and interventions.

National Committee for Promotion of Climate-Smart Push-Pull Strategy: A national technical committee was established within the Agricultural Extension Directorate of the Ministry of Agriculture in February 2014. Members include staff from MoA, EIAR, ATA, ISD and icipe.

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The aim is to reduce striga and stalk borer infestation of maize crops through intercropping with silver leaf desmodium and border planting with Napier grass.

The National SLM Steering Committee is chaired by the State Minister for Natural Resources in MoA and comprises high-level representation from the Ministry of Finance and Economic Development, Ministry of Water Irrigation and Energy, Ministry of Environment and Forests and development partners. The steering committee is responsible for providing policy guidance, oversight and overall supervision for project implementation.

The National SLM Technical Committee is also chaired by the State Minister for Natural Resources in MoA. It is made up of senior technical staff from institutions such as the Ministry of Agriculture; Ministry of Water, Irrigation and Energy; Ministry of Finance and Economic Development; Ministry of Environmental Protection and Forestry; Ethiopian Institute for Agricultural Research (EIAR); development partners supporting SLM projects or initiatives; and civil society organizations (NGOs) actively engaged in SLM activities. Generally, this body is responsible for providing technical advice to MoA on SLM.

5.3 Effectiveness of CSA Policies, Strategies and Institutions

In Ethiopia significant efforts are made to develop policies and strategies pertinent to climate change. Such policies are also adequately integrated into subsequent government plans such as the GTP. The GTP addresses climate change as a crosscutting issue under the strategic priority of environment and climate change. It outlines building a climate-resilient green economy as a strategic priority for the plan period of 2010 to 2015.

A number of developmental projects and programmes that are supported by policies have been initiated and implemented. Most of the work focused on soil and water conservation, soil/land management for improved agricultural productivity and reforestation practices. Many projects conducted in the country were recognizable by their use of approaches for climate resilience and adaptation. The MERET project and PSNP-PW are among the early programmes and projects operating in Ethiopia aimed at curbing environmental degradation and focused mainly on reducing soil erosion through the construction of physical structures such as terraces, check dams, cut-off drains and micro-basins, afforestation and revegetation of degraded and fragile hillside areas. A large volume of work has been done in such areas and some ecological and agricultural benefits have been obtained.

The SLM programme demonstrates how the green economy can be operationalized in practice by protecting natural assets and increasing local development by improving agricultural productivity in the country. In SLMP II, climate-smart agriculture is adequately incorporated and refers to practices that seek to increase agricultural productivity, strengthen farmers' resilience to climate change, reduce GHG emissions and increase carbon sequestration. SLMP II is working on capacity building to provide skills training to government and other stakeholders to promote climate-smart agriculture and thus promote implementation.

The most recent strategy related to climate change is the CRGE, which was developed in 2011. Institutional arrangements for coordinating and implementing public policy responses for CRGE are being developed. The responsibility of coordinating CRGE planning lies with the Ministry of Environment and Forests. The CRGE Inter-Ministerial Committee, under the Council of Ministers, provides oversight of the CRGE process. This Committee is the top body within the CRGE institutional arrangements. It is responsible for providing overall direction to the CRGE process and for approving financial decisions of the CRGE facility. The Committee comprises State Ministers and senior officials from participating institutions. The Government of Ethiopia is designing institutional arrangements that will enable demand-driven articulation and implementation of CRGE investments. The proposed arrangements include outlining a role for implementing and executing entities, along with the establishment of CRGE units within the implementing entities.

In addition, policies such as the Environment Policy are being operationalized through the development of District Environmental Management Plans, which have been prepared and are being implemented in various districts. Forest, soil and water conservation area enclosure activities have been exercised as main actions to achieve the desired goals.

Despite the fact that policies are being operationalized, more needs to be done to implement the policies and ensure their effectiveness. Another challenge is a lack of coordination and a relevant legislative framework and consultations on climate change-related activities, projects, research programmes and responses that are currently undertaken by the various stakeholders, especially between government NGOs and donor agencies. This may lead to duplication of efforts and inefficiencies in project implementation.

GENDER AND CSA 6

Women constitute nearly half of the country's population. Many of them are living in dire economic conditions characterized by endemic poverty and poor working and living conditions. Akililu and Alebachew (2009) reported that in Ethiopia, the majority of the poorest groups are composed of women, the disabled and those living with HIV/AIDS. Not surprisingly, these social and demographic groups are also the most vulnerable, least prepared and likely to be worst affected by climate change. Moreover, climate variability and change affects women as it makes fuelwood and water difficult to access. This forces rural women to walk longer distances to fetch water and collect fuelwood.

Conservation agriculture and other CSA practices have many benefits for women. These practices can lessen and spread their workload over time and reduce their burden of fetching water for crops. The practices can enable early planting of crops, make women less dependent on oxen or mechanical tillage equipment, increase crop productivity and production of different crops, and increase food security and nutrition among women and vulnerable groups. It has been said that when a woman practises conservation agriculture, she is not dependent on oxen or mechanical tillage equipment and can plant earlier. In conventional agriculture, women smallholder farmers who rent oxen or mechanized tillage equipment have experienced problems in planting on time. Women farmers without oxen often plant too late, as farmers who own the oxen give priority to their own fields. Women farmers practising conservation agriculture maintain that their work within agriculture has become more planned and systematic (including planting, use of fertilizer and crop rotation). Women manage to improve the welfare of their families due to increased agricultural productivity, improved access to and use of water and other natural resources, as well as the reduction in damage caused by environmental degradation and pollution.

It has been stated that if women farmers were given the same access to resources as men, women's agricultural yields could increase by 20 to 30 percent, national agricultural production could rise by 2.5 to 4 percent and the number of malnourished people could be reduced by 12 to 17 percent (Senay, 2012). The 1995 Ethiopian constitution, in article 35 (3), took a historic measure on gender equality. It provides women with the right to acquire, administer, control, use and transfer property. The proclamation states explicitly that women have equal rights to men with respect to the use, transfer, administration and control of land (WABEKBON, 2006). It is hoped that this will encourage improved land management and improved investment in sustainable agricultural practices such as climate-smart agriculture by both men and women. Studies on the gender implications of conservation agriculture in initiatives such as the FACASI Project are ongoing.

CONCLUSIONS AND RECOMMENDATIONS 7

7.1 Conclusions

- The current policies, strategies and laws related to climate change and sustainable agriculture are adequate. However, they are not adequately incorporated into extension guidelines and manuals (and the extension system as a whole) in a way that the great majority of the rural farming population could understand and participate in their implementation. For this reason adoption of practices such as conservation agriculture remains relatively low.

- Ethiopia has a number of adequate policies and strategies pertinent to climate change adaptation and mitigation as well as agriculture and food security. What remains to be done is creating awareness about the policies as well as promoting their implementation at all levels, for example through mainstreaming of the policies into agricultural extension and the development of national CSA and conservation agriculture implementation manuals.

- In Ethiopia there are numerous projects and programmes that are conducting and promoting climate-smart agricultural practices and technologies. However, these programmes and projects are being implemented in a fragmented project-based manner, which poses a threat to the sustainability of these initiatives.

- There are a number of institutions, organizations and government departments involved in climate-smart agriculture in Ethiopia. There is a need to ensure that these institutions, organizations and departments coordinate their efforts and conduct their work in a manner that adds value to one another rather than duplicating or being in conflict with one another.

- There is a lack of adequate research findings on climate-smart agriculture in Ethiopia for the various agro-ecological zones, soil types, rainfall patterns, farming systems, as well as temperature and moisture ranges. Hence there is a need to support more research projects on climate-smart agriculture, particularly action research and field-based research.

- Ethiopia is characterized by low agricultural production and productivity and there are significant yield gaps. Such low productivity is emanating from environmental factors such as climate change, soil erosion and land degradation as well as weak extension services. Therefore, improving productivity while addressing the adverse effects of climate change on agriculture is a major concern.

- There is a lack of common understanding on the content of conservation agriculture in different parts of the country among the conservation agriculture-implementing public, NGOs and private sector

organizations. At the moment there is no organization responsible for the promotion and technical support of conservation agriculture at all levels. Conservation agriculture is not incorporated in the annual action plans of the agricultural offices.

- So far efforts to promote conservation agriculture and other CSA practices have shown some encouraging results at grassroots level. There are woredas where farmers have adopted some of the components of conservation agriculture such as reduced tillage, soil mulching with crop residue and intercropping as well as other climate-smart practices such as agroforestry and water harvesting. However, documentation and data on adoption rates are lacking at woreda, zonal, regional and federal level.

- The presence of free grazing across many parts of Ethiopia remains a challenge to environmental management and the adoption of some climate-smart practices such as intercropping and mulching.

- There is a wealth of knowledge held by farmers on traditional soil and water conservation methods that can be useful in supporting the upscaling of climate-smart agriculture across the country. These practices need to be studied, documented and shared.

- In Ethiopia skills and knowledge on climate-smart agriculture, particularly on conservation agriculture, are not adequate and require support.

7.2 Key challenges to implementing CSA in Ethiopia

- Weak capacity on climate change adaptation and mitigation at all levels including the public sector, civil society organizations and the private sector remains a key challenge. There is a lack of skilled human resources at all levels.

- Organizations do not tend to work together in an integrated manner in CSA implementation and promotion. This is in part because of weak coordination mechanisms at federal and regional levels. In addition, there is a lack of mechanisms to bring together and coordinate stakeholders involved in different forms of CSA technology promotion.

- In Ethiopia conventional agricultural practices like frequent ploughing and removal and burning of crop residues have contributed to the deterioration of the physical quality of the soil and hence crop productivity decline is common.

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- In many parts of Ethiopia livestock husbandry is characterized by open grazing, land degradation and the loss of forests, which could lead to releasing large quantities of greenhouse gases. It is also reported that livestock is the largest major source of global methane emissions.

7.3 Untapped opportunities

Untapped opportunities to support the upscaling of CSA and conservation agriculture in Ethiopia include the following:

- There is willingness and commitment from the government to reduce poverty and ensure food security while addressing climate change. The government has developed policies and strategies that are pertinent to ensure food security as well as address climate change. The government has moreover ratified international climate change-related conventions.

- The country has developed a comprehensive green growth strategy that encompasses agriculture in the form of the Climate Resilient Green Economy (CRGE) Strategy. In the MoA, a CRGE coordination unit has been established for piloting climate-smart agriculture as well as mainstreaming the CRGE into agriculture projects and programmes.

- Regional states have embarked on the promotion of integrated watershed management to improve agricultural productivity, with major emphasis on avoiding open and uncontrolled grazing. This provides a good opportunity for large-scale implementation and promotion of climate-smart practices such as agroforestry and conservation agriculture.

- Resources are available in the form of projects and programmes like AGP, SLM, PSNP and others. These projects are operating in many parts of the country under various agro-ecological zones and farming systems.

- There are private sector organizations and numerous NGOs in the country. At grassroots level there are also adequate numbers of extension and development agents to create climate-related awareness, provide capacity-building training and promote climate-smart agricultural activities.

7.4 Recommendations

- CSA needs to be mainstreamed into core government strategies, guidelines, manuals and annual action plans. In this regard the experience of the SLM Programme is a good lesson for integrating CSA technologies into project and programme implementation manuals. Priority needs to be given to CSA practices that bring productivity gains, enhance resilience and reduce emissions.

- For effective CSA promotion, adequate mechanisms are needed for generating, capturing, and disseminating knowledge and information through the use of effective processes and institutional arrangements. Sources of knowledge on climate-smart agriculture include scientific research and indigenous knowledge. After knowledge has been created and sourced, it needs to be disseminated to users to support adoption of climate-smart practices.

- For CSA knowledge dissemination a comprehensive capacity-development approach for all stakeholders that builds on a sound assessment of needs is required. In this regard, within the diversified extension service delivery, there is a need to build the capacity of all CSA and/or conservation agriculture-implementing organizations, with major emphasis on the extension directorate of the MoA and integration of CSA and/or conservation agriculture into the country's extension package. It is through the extension system that the technologies reach the wider community.

- The CSA technology promotion process has to be documented at all levels of implementation so as to undertake evidence-based promotion and upscaling of the technologies. Documentation would provide a good basis for those involved in the implementation of CSA to attain knowledge and methodologies, which could then be used and applied for influencing policy-makers and for developing networks for the promotion of best practices.

- The importance of conservation agriculture as a key climate-smart practice for Ethiopia has to be recognized among high-level policy-makers and decision-makers as well as government and civil society organizations in the country. A solid awareness-creation programme of conservation agriculture technology should be provided to all stakeholders at federal and regional level.

- In areas where conservation agriculture technology has not yet been popularized, demonstrations have to be given at farmers' training centres (FTCs) and on farmers' fields. In this regard extension materials such as leaflets and brochures and organizing experience-sharing visits and farmers' field days are crucial.

- It is important to have a proactive platform for governmental institutions, NGOs, donors, private sector and civil society organizations in Ethiopia to fill gaps and enhance collective action on CSA. This can be done through the National Conservation Agriculture Task Force (NCATF). Enabling the existing climate-smart agriculture implementing institutions to share information, knowledge and experience is crucial.

- A wide range of measures are required to reduce the livestock sector's climate-change responses. These include improving production and feed systems, breeding low methane-emitting ruminants and introducing manure management methods that reduce emissions. Efforts should be made towards implementing restricted grazing to avoid overgrazing, which causes degradation, and crop residue removal through open grazing.

- CSA has to be integrated into tertiary level education, including TVET colleges and universities, so as to develop a large number of professionals with an in-depth knowledge of the subject.

- The CSA value chains need to be evaluated and strengthened in order to enable access to key inputs and equipment (e.g. rippers) needed as well as enabling the sale of CSA produce, particularly legumes used in rotations and intercropping.

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This climate-smart agriculture scoping study for Ethiopia was produced by the FAO. The study is aimed at identifying and documenting existing climate-smart agriculture practices in Ethiopia that enable stakeholders to understand the opportunities and constraints to adopting particular climate-smart agriculture technologies or practices.

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