Climate Resilient Agriculture and Food Systems in Ethiopia

Ogola Robert John Ouko

WAGENINGEN
UNIVERSITY & RESEARCH

BENEFIT

Climate Resilient Agriculture and Food Systems in Ethiopia

Ogola Robert John Ouko
Water Systems and Global Change Group
Environmental Sciences
Wageningen University

Internship Report

WAGENINGEN
UNIVERSITY & RESEARCH

BENEFIT

Ogola J.R.O (2021). *Climate Resilient Agriculture and Food Systems in Ethiopia.* Wageningen Centre for Development Innovation, Wageningen University & Research. Wageningen.

Photo cover: Irene Koomen

Contents

Acknowledgements

I am grateful for the support of experts from BENEFIT programme and Ethiopian government ministries who gave their expert's opinions. This study was supported and done within the context of the BENEFIT partnership with close supervision from Dr. Irene Koomen. My thanks also go to Wageningen Centre for Development and Innovation (WCDI) fraternity for allowing me to conduct my research internship in amazing organisation, Dr. Dawit Alemu and Dr. Akalu Teshome for facilitating smooth connection with Ethiopian Experts.

List of abbreviations and acronyms

AGRA	Alliance for Green Revolution in Africa
ATA	Agricultural Transformation Agency
BENEFIT	Bilateral Ethiopian Netherlands Efforts for Food, Income and Trade
CCAFS	Climate Change Agriculture and Food Security
CSA	Climate Smart Agriculture
CGIAR	Consortium of international Agricultural Research Centers
EEFCCC	Ethiopian Environment, Forestry Climate Change Commission
EIAR	Ethiopian Institute of Agricultural Research
EPA	Environmental Protection Authority
DFID	Department for International Development
EU	European Union
FAO	Food and Agriculture Organization
GoE	Government of Ethiopia
G4AW	Geodata for Agriculture and Water
GIZ	German Agency for International Corporation
GWP	Global Water Fund
IFPRI	International Food Policy Research Institute
MoA	Ministry of Agriculture
MoWIE	Ministry of Water, irrigation and Energy
MoFE	Ministry of Forestry and Environment
NAP	National Adaptation Plan
NMA	National Meteorological Agency
PfR	Partners for Resilience
RTI	Research Triangle Institute
STCs	Sub-Technical Committees
SWOT	Strength, Weakness, Opportunity and Threats.
UNDP	United Nations Development Programmes.
USAID	United States Agency for International Development
UNEP	United Nation Environmental Programme
WI	Weather Impact

List of Tables and Figures

List of Tables

List of Figures

Executive Summary

Agriculture is one of the key sectors driving the economic growth of Ethiopia, however, the sector faces serious food production challenges to feed over 115 million of its population. Due to Ethiopia's low institutional and economic capacity to build climate resilience for improved agriculture and food systems, the country is facing numerous challenges of climate change. Floods and droughts predominantly cause havoc to Ethiopian agriculture and food systems leading to increased poverty, food insecurity and malnutrition.
This study analyses the current climate change adaptation strategies and policies enhancing climate resilience in Ethiopian agriculture and food systems for Ethiopia. The methodology of the study includes a literature review of information relevant to building climate resilience in agriculture and food systems, in-depth expert interviews and stakeholder network analysis simulation. The study themed four areas of concern to build climate resilience in agriculture and food systems in Ethiopia, these areas include climate information, water management, soil health and fertility, promotion of Climate Smart Agriculture (CSA) inputs and technologies as well as the policy concerns around the four themes. A SWOT analysis was conducted to focus on areas of strength and greatest opportunities.

From the SWOT analyses conducted, it became clear that climate information is very important for farmers to strategically plan their farming activities considering the increased climatic variability the country is facing. Currently, a low number of farmers have been reached with tailored weather information services yet there is a huge potential in Ethiopia. The dissemination of climate information mostly is through project development programmes hence, face lots of uncertainty for continuity after the projects period end. For future response, suggestions such as integrating weather models for long-term weather predictions, support for inter-ministry dialogue and liberalization of policy to support public-private partnership are key. Other areas of great concern were the integration of tailored weather advisory into the country's extension systems and capacitating extension agents on climate technologies information use and dissemination since they are new.

To build resilient agricultural and food systems, proper soil health and fertility and water management determine the quantity and quality of food production. Currently, due to high degradation, deforestation, the trade-off of crop residue for livestock production and increased high temperatures, the soils are unable to produce to their full potential. Hence concerns on how to improve soil fertility and water retention capacity to boost production sustainably are encouraged. Consequently, water is a major factor in crop production and is also prioritized by the government of Ethiopia. Being one of the big agenda to increase water productivity through efficient irrigation systems and management of watershed ecosystems, support is much needed to expand irrigation systems and restore watershed for continued food production in times of climate change.

Promoted mainly by different research institution and NGOs, CSA input and technologies such as improved crop varieties, small scale irrigation, early warning systems, crop diversification have received support from the Ministry of Agriculture as some of the approaches to cushion farmers against climate shocks. The study found that the promotion of CSA practices has been affected by inadequate improved CSA inputs and climate advisory on the technologies packages. The study also indicates great opportunities for untapped tested CSA technologies for upscaling to enhance climate resilience and food production in Ethiopia.

The analysis shows that the major stakeholders promoting climate-resilient agriculture and food systems in Ethiopia include FAO, UNEP, World Bank, DFID, USAID, CGIAR and EU through sponsoring various projects. The government ministries and (inter)national research institutions are also involved through research and advice to farmers and the Federal government. A number of policies and have been designed to help Ethiopia mitigate and adapt to climate change for resilience and sustainable development. Recently, the Government of Ethiopia launched a 10- Year Perspective Development Plan (2021-2013) with the main goal to end overreliance on rainfed agriculture by expanding the country's irrigation system capacities and encouraging irrigation investments.

The study found that Ethiopia has good climate-resilient strategies and policies, however, the government need to mainstream SMART action plans to realize the country's policy goals. To achieve the strategies goals, the we recommends mainstreaming weather advisory in the national extension

systems, Policy support to involve private service providers whose inputs are key for the transformation of the climate resilient agricultural systems, support to farmers by subsidizing costs of agricultural insurance, climate information, CSÁ promotion and implementations, strengthening capacities of research institutions to develop detailed content periodically to support various platforms, agro-weather and extension services, and support the government to establish strategic frameworks and plans that addresses the gaps in policy documents to successfully implement and reduce policy governance conflicts.

1 Introduction

Ethiopia's agriculture sector contributes 33.3% of its gross domestic product and employs about 80% of the population (Tesso, 2020). However, the sector remains fragile and vulnerable to climate change, affecting agriculture and food systems in the country. Ethiopia with a population of about 115 million in 2020[1] and forecasted to rise to 120 million by 2030 is putting increasing pressure on resources available (DFID, 2012). Agricultural yields are struggling to keep up with the population increase and climate change effects. Climate-induced hazards such as droughts, rising temperatures and floods are a major threat to the agricultural productivity, food systems and livelihoods of over 65% of the households who are food insecure and living in poverty (OPHI, 2020; WFP, 2019).

The country has experienced recurrent droughts and 11 flooding episodes between 2010 and 2021, some of which resulted in substantial humanitarian crises[2]. For example, the 2015-16 drought, which resulted in the worst famine in the country history and left over 10 million people in need of urgent food relief assistance. According to the 2018 ND-GAIN Index[3], which summarizes a country's vulnerability to climate change and its readiness to improve resilience, Ethiopia ranks 157 out of 181 countries, is the 20th most vulnerable country, and the 44th least ready country.

Due to Ethiopia's diverse agro-ecological zones across the country, it's impossible to generalize future climate change projections. However, based on the climate change profile of Ethiopia, the country is projected to face increasing average temperatures of 1^{0}C by 2030, and 2^{0}C by 2050 (MoFAN, 2018). These climate changes will cause increased uncertainty and variability in seasons and rainfall as well as increased extreme events in the country. The lowland is predicted to suffer most with prolonged droughts and increasing temperatures affecting agro-pastoral production systems in the region. The highland on the other hand is predicted to suffer from extreme events such as dry spells coupled with irregular and intense rainfall leading to flooding, erosion, storms and overall lower agricultural and food production.

Buffering the economy from severe climate shocks and building resilience to climate change-induced stressors is an urgent matter for Ethiopia. It is with this sense of urgency that the Government of Ethiopia (GoE) took a proactive action through the launch of the Climate Resilient and Green Economy Strategy (CRGE) in 2011 to address climate change concerns (FDRE, 2011). Another major step is the launch of the National Adaptation Plan (NAP) in 2019, which aims to mainstream climate change adaptation initiatives with ongoing development efforts including the Productive Safety Nets Programme (PSNP)[4] and Sustainable Land Management Programme (SLMP) (FDRE, 2019). The inclusion of CRGE as one of the cross-cutting elements in the country's current growth and transformation plan (GTP II) also shows the government's commitment to addressing climate change-related issues affecting the economy and particularly the agriculture sector (FDRE, 2016). The government acknowledges that in the long-term if climate change is not tackled, the country's economic growth will be at risk.

[1] worldometer (www.Worldometers.info).

[2] https://reliefweb.int/disasters?advanced-search=%28C87%29

[3] https://gain-new.crc.nd.edu/country/ethiopia

[4] https://essp.ifpri.info/productive-safety-net-program-psnp/

1.1 General and specific objectives of the study

The general objective of the study was to analyse the current climate change adaptation strategies and policies enhancing climate resilience in Ethiopian agriculture and food systems. This was to enable the RAISE-FS project to understand and consider what adaptation changes are necessary to lead the transformation to a sustainable Ethiopian food system.

- The study formulated below specific objectives to address the general objective;
- To give an overview of climate change impact on agriculture and food systems transformation in Ethiopia
- To explore climate-resilient strategies tested and/or applied in Ethiopia.
- Identifying programmes and projects geared towards enhancing climate resilience.
- Identifying unexploited opportunities to improve climate-resilient agriculture and food systems.
- Reviewing key policies and strategies relevant for the transformation of agriculture and food systems.
- To map and analyse stakeholders' networks building climate resilience in Ethiopia.
- Provide recommendations that stem from the analysis.

1.2 The study report structure

The structure of this study report is as follows. In chapter 2, a description of the methodology used in the study is presented. Chapter 3 contains analyses of the current agriculture and food system in Ethiopia, programs and projects towards agriculture and food systems, relevant policies and strategies frameworks in accordance with the specific objectives set and finally mapping and analysis of stakeholders and policy networks in Ethiopia. In Chapter 4, the study draws conclusions and recommendations that stem from the analysis.

2 Methodology

2.1 Data Collection

The data collection involved both a desktop literature review and in-depth key experts/informant.

2.1.1 Literature review

The desktop review was conducted to analyse the current agriculture and food systems situation, identify projects enhancing climate resilience and identify key policies and strategies relevant for the transformation of agriculture and food systems in Ethiopia. This involved sourcing scientific literature and information from different databases such as google scholar, RefSeek and Scopus. The publications and reports were searched using keywords, logical operators, probable titles and filtering techniques. Search terms used included keywords like agricultural transformation, agricultural and food system resilience, agricultural policy, Ethiopia. These keywords were identified with synonym derived from literature, combined into a complete search string, connected with Boolean operators “ÄND” for different keywords and “OR” for the synonym of the same keywords. The string was then keyed in selected databases to retrieve the data.

The grey literature was also searched to identify evaluation reports, policy documents, strategies available from websites of identified institutions and organizations including portals or donor governments. Some of these institutions involved directly or indirectly included the Agricultural Transformation Agenda (ATA), Ethiopian Institute of Agricultural Research (EIAR), International Food Policy Research Institute (IPFRI) and Climate Change Agriculture and Food Security (CCAFS) programme, Food and Agriculture Organization (FAO), United Nations Development Programmes (UNDP) among others.

The documents identified were reviewed throughout the study and major issues were further considered for interviews with identified experts. Additionally, the information from the reviews helped to inform the design of the questionnaire was used for interviews.

2.1.2 Expert interviews

Key national and international experts, and government officials from relevant ministry departments and national institutions were interviewed using semi-structured Interviews (questionnaire), the interviewees are indicated in appendix 1; in appendix 2 the interview guideline is given. Based on terms of reference for the report, the interviews were conducted following the guided discussion. Although to find more information required, in-depth questions other than the one composed were asked. This way unexpected issues were covered and specific relevant information gathered (Adams, 2015). The key experts and government officials helped to validate information gathered from the literature review, identify the gaps and opportunities to promote and upscale Climate Smart Agriculture (CSA) technologies as well as policies to improve climate resilience and sustainable production among farmers in Ethiopia.

2.2 Data Analysis

Data was analysed in two ways. Based on the literature review and experts’ interviews, data was collected and themed into four main areas, i.e. climate information, soil health and fertility, water management as well as promotion of CSA input and practices. A SWOT analysis was then conducted to determine the strength, weaknesses, opportunities and threats in building climate resilience in Ethiopian agriculture and food systems. SWOT analysis is a technique used to provide answers to questions to

each of the four words whose first letter forms the acronyms. Conducting analysis using the SWOT framework help in focusing activities on areas of strength and greatest opportunities (Nyambi, 2012)
Secondly, a network analysis was introduced as a tool to map and understand how different stakeholders interact to improve the adaptive capacity to climate change effect. Gelphi tool was used to map and analyse key stakeholders involved in enhancing climate resilience through resource flows, information advice and policy lobbying and advocacy. This helped to examine the role and importance of stakeholders in a larger network. One network structural attribute of centrality was chosen to explore how the network structures influence farmer climate resilience. Centrality was chosen to give a measure of the relative position of stakeholder to its network, stakeholder importance and ability to leverage resources and influence decision from other institutions (Huggins, 2000). Using the directed network in-degree centrality, out-degree and in-degree which measure the number of flows and relations from one node to its wider network or wider network to one node were used, respectively. The out-degree in this study was used to reveal the power and social influence of keynote stakeholders and their contributions to improving resilience. On the other hand, In-degree was used to reveal the power and influence of stakeholder to influence policy change with the federal government in Ethiopia (Norberg & Cumming, 2008). A similar application of this metric has been used to study network attributes influencing value chains climate resilience (Canevari-Luzardo, 2019).

3 Study Findings

3.1 Overview Climate Change Impact on Agriculture and Food Systems Transformation

3.1.1 Impact of Climate Change on Agriculture and Food Systems

The Ethiopian agriculture sector is the main driver for economic growth. The sector intensification, growth and transformation are largely led by the government through Agricultural Growth Programme (AGP) as part of the GTP (Gebru et al., 2018). The sector is dominated by rainfed agriculture and smallholder farmers who produce 96% of the annual total gross agricultural output (Evangelista et al., 2013; Jirata et al., 2016). Since the 1980s, rainfall has become erratic in Ethiopia as a result of climate change causing recurring El Nino and La Nina episodes (Aragie, 2013; DFID, 2012). This has caused the climate to become hotter and wetter caused by increasing average temperatures, droughts and flooding respectively, thus, leading to reduced yields and increased crop failures. During the period 1991-2008, Ethiopia lost a cumulative amount in the range of 13-40% of its original level of agricultural output due to climate change making it more vulnerable to produce efficient food for the growing population (Aragie, 2013; Bekele et al., 2020). Future climate change could reduce Ethiopia's GDP by 8-10% in 2050 (Bekele et al., 2020; USAID, 2020). The climate change effects also impact negatively on the country's food distribution, farm incomes, food prices, imbalance in imports and exports, unemployment to many the actors involved in agriculture (see figure 1 for an overview of potential impacts of climate change). Increasing climate change effects continue to pose a high risk to food insecurity for the rapidly growing Ethiopian population leading to increased economic pressure, rural to urban migration, more debts to the struggling Ethiopian economy due to more importation and increased nutritional problems.

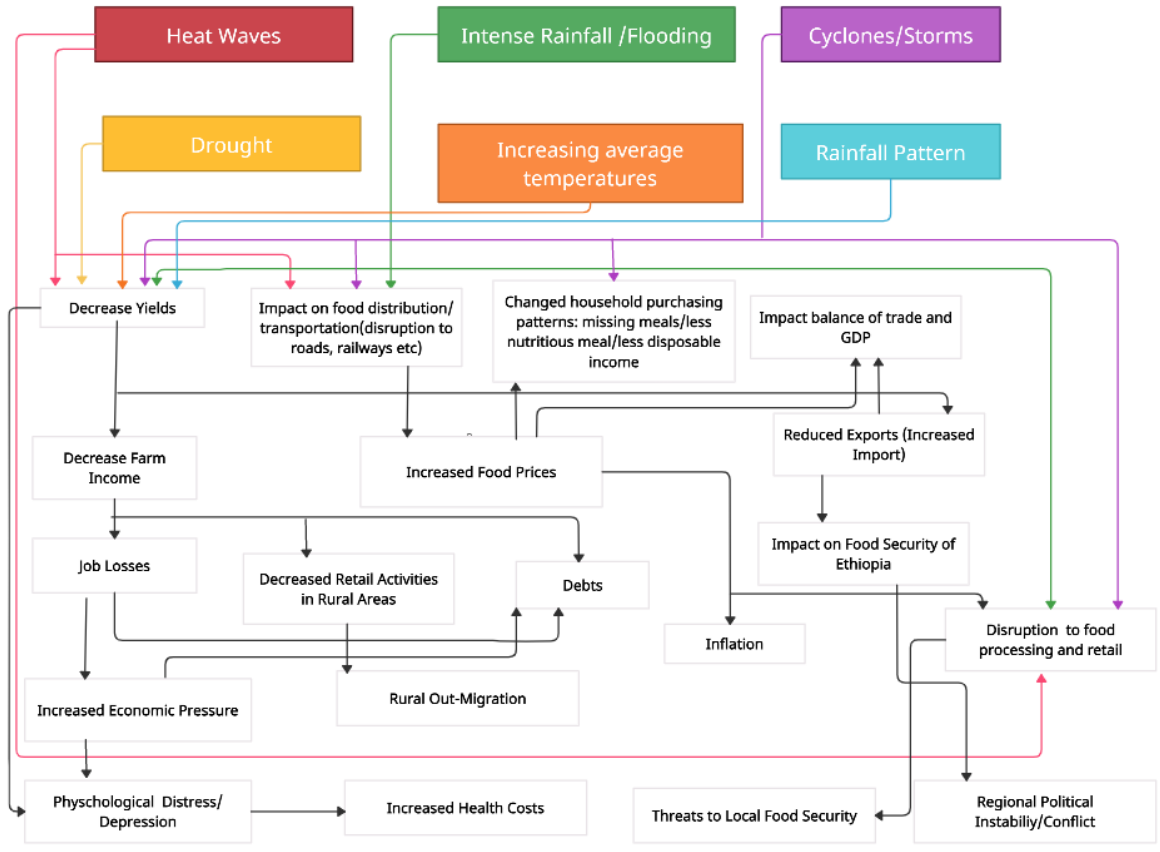

Figure 1: Impacts of Climate change on food systems (Source: climatecouncil.org.au)

3.1.2 Agricultural and Food systems Transformation

Ethiopian agriculture is on a transformational trajectory from traditional systems to modern systems to become more efficient and sustainable for food production following the intensification of the agricultural systems. The GoE is putting efforts to improve agricultural productivity and its resilience to climate change effects through various development and transformation programmes, advocating for climate-smart adaptation strategies and enabling policies. As one of the steps to build a green economy, agriculture and forestry which contributes to 87% of the emission are given priority with major structural and policy changes (FDRE-CRGE, 2011; Minten et al., 2018). This is to ensure the country reduces its emission by 60% per year for low carbon economic development, abate land degradation, reduce the impacts of climate change and improve the livelihoods of rural households. Moreover, climate-smart agricultural practices and sustainable land management programmes are the focus of implementation in the agricultural sector (Hin & Mekonen, 2019). As an example, linking efforts to improve water productivity through water harvesting and drip irrigation is one way to strengthen the resilience of agricultural systems for the production of vegetables, cereals and legumes which is beneficial to food systems and the environment.

Consequently, the transformation of food systems in Ethiopia is being influenced by population growth, urbanization, infrastructural development income growth (Minten et al., 2018). The notable changes in the diet include a decline in the relative share of cereals and a rise in high-value chain products such as fruits and animal-sourced foods (Minten et al., 2020). Additionally, major changes have been noted in the supply chain such increased reliance on the market products by consumers. Hence, developing a resilient and sustainable food systems to meet such market demands is very important for Ethiopia.

3.2 Analysis of Key Themes and Programmes Enhancing Climate Resilience

To improve climate resilience, four main areas of climate information, water management, soil health and fertility as well as promotion of CSA input and Technologies are key (Figure 2). The study also looked at the policies environment around these themes (see section 3.3). In this section, the study gives an analysis of the adaptation practices per theme, their benefits and limitation and/or trade-offs. Additionally, using SWOT analysis which incorporates information both literature and experts, the study determined the strength, weakness, opportunities and threats per theme for further improvement in building farmer climate resilience. There are also various projects and programmes working in different regions of Ethiopia including Oromia, Amhara, Tigray and Southern Nations, National and People's Republic (SNNPR) to improve farmers' climate resilience.

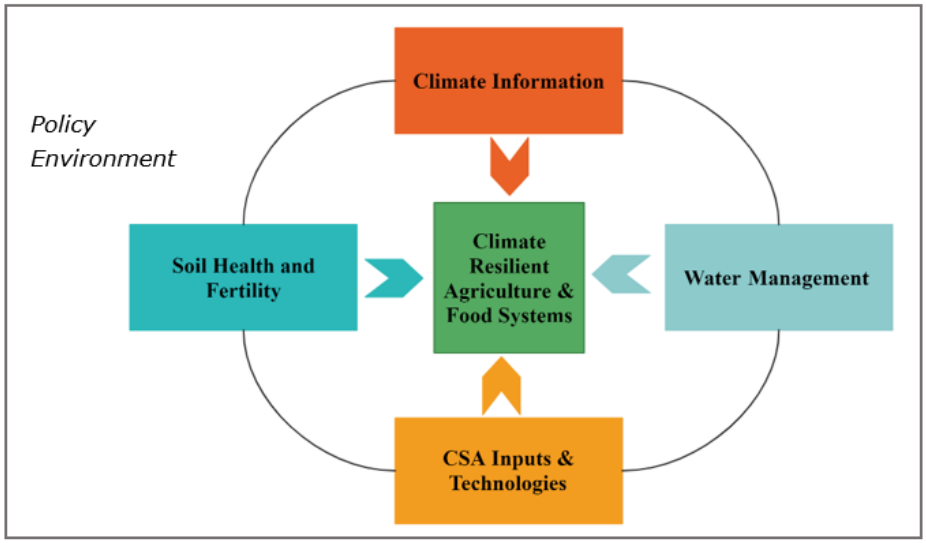

Figure 2: Framework of climate-resilient agriculture and food systems in Ethiopia.

Two major adaptation programmes strategies are currently being implemented to enhance climate resilience in agriculture and food systems in Ethiopia. These entailed climate-smart agriculture strategies including Sustainable Land Management programme and the Productive Safety Nets Programme.

3.2.1 CSA Adaptation Strategies

Climate-smart agriculture is promoted as one of the approaches that help in building a triple win for improving farmer productivity, resilience and mitigate greenhouse gas emissions, thus, promoted as environmental friendly (Lipper et al., 2014; McCarthy et al., 2011; Nciizah & Wakindiki, 2015). CSA is an integrated approach to managing landscapes in croplands, livestock, fisheries and forestry to address the interlinked challenges of food security and climate change[5].

Adoption of climate-smart agriculture practices such as agroforestry, integrated soil conservation management, water management systems, crop diversification are important adaptation strategies for smallholder farming systems in areas with high rainfall variability (Arslan et al., 2014; Schoeneberger, 2009; Teklewold et al., 2019; Thorlakson & Neufeldt, 2012). Crop switching was also considered as one of the key adaptation strategies identified (Tessema et al., 2019). CSA strategies have been identified to play a key role in improving food systems through reducing food insecurity, addressing malnutrition, food misdistribution as well as the relationship between agriculture and poverty in Ethiopia (Kebeda et al., 2019). Table 1 shows a summary of the key CSA strategies and practices being tested and promoted to farmers, their benefits and Limitation/trade-offs in improving farmer climate resilience in Ethiopia.

Table 1:Summary of CSA adaptation practices for climate resilience

Climate Resilience Theme	CSA Practices	Benefits	Limitation/ Trade-offs	Reference
Climate Information	Early warning systems such as improved weather information, pest and disease monitoring.	Increase farmers' preparedness and early planning for response strategies. Reduce farmer yield losses for climate risks. Improved income.	Expensive to resource poor farmers Lack of long-term early warning Systems information to farmers.	(Drechsler & Soer, 2016; Ewbank et al., 2019)
Integrated Water Management	Efficient water utilization, Mulching In-situ water harvesting /conservation Small-scale Irrigation Systems	Improve yields, income and food security. Reduced water runoff and topsoil erosion. Increased water productivity	Open structures are prone to dry due to high evaporation rates. Harbour disease carrying insects. Expensive to poor resource farmers.	(Adela et al., 2019; Bacha et al., 2011; Gebremeskel et al., 2018; Mengistie & Kidane, 2016; Teshome et al., 2010)
Integrated Soil Management	Crop residue management Contour farming and Terracing Compost & manure management including green manure. Agroforestry (Tree-based conservation agriculture).	Reduce emission from nitrous oxide and Methane. Improve soil productivity.	Input required in large amount due to low nutrient content. Crop residue management with conflictual intense for livestock production.	(Agegnehu et al., 2014; Gebremeskel et al., 2018; Yebo, 2015) (Amare et al., 2019; Chavarría et al., 2018; Duriaux-Chavarría et al., 2021; Hadgu et al., 2011)

[5] https://www.worldbank.org/en/topic/climate-smart-agriculture

		Create microclimate that improve the agriculture productivity. Trees store large amount of CO2.	Competition for resources such as light and nutrients. Alternate host to pest and invasive species.	
CSA Inputs & Practices/ Technologies	Adopt High yielding, tolerant to drought, pest resistance and short season. Crop Diversification Efficient fertilizer application techniques (time, method, and amount). Reduced tillage. Crop rotation or intercropping with cereals and legumes. Popularization of new crops and crop varieties.	Reduce emission from nitrous oxide and Methane. Resilient to weather variability for ensured yields. Alternative livelihood and improved income. Increased Carbon sequestration	Unsuitable for small pieces of land. High farm input requirement and competition for resources. Problems of weed and pest control.	(Dessie et al., 2019; Goshu et al., 2012; Michler & Josephson, 2017) (Aune, 2020; Kedir et al., 2021; Liben et al., 2018; Nagothu, 2016; Tsegaye et al., 2017)

3.2.2 Climate information

Figure 3 provides a summary of the SWOT analysis on climate information from literature and expert interviewed. Additionally, in Table 2, the study identified some of the key programmes and projects in Ethiopia with the core mandate of aiding farmer resilience through the provision of climate information and related activities for agriculture and food system and sustainability.

The provision of climate information to farmers has been considered as a decisive variable in adaptation decision making among farmers. Several weather institutions and agencies such as Agro-met, Weather Impact (WI)[6] and Geodata for Agriculture and Water (G4AW)[7] are working closely with the Ethiopian National Meteorological Agency (NMA) department to disseminate climate information to households in Ethiopia. The dissemination of climate information is conducted mainly through different platforms such as text messaging, radio and television broadcasting. Despite these efforts, few farmers are reached with tailored climate information services yet there are about 12 million farmers who could benefit from weather information for planning of agricultural activities. Moreover, the continuity of passing climate information to farmers after programmes end periods are faced with lots of uncertainties. According to an expert response, this is attributed to the fact that the Ethiopian government is yet to fully liberalize public-private partnerships engagements to upscale and provide tailored weather information according to regional agroecological differences for the farmers.

To assist the farmers becoming resilient against future climate shocks and stressors, early warning systems which provide reliable weather forecast are key. Early warning systems are important in reducing the frequency and severity of food insecurity and increase the resilience of farmers to climate variability (Kedir et al., 2021; Lewis, 2017). Farmers decision to adopt certain agricultural practices are influenced by the weather information they receive and personal observable factors (Bekele et al., 2020). Expert affirmed that farmers can choose optimal farming strategies to avoid total crop failures and capitalize on a temporary and favourable state of nature.

Long-term thinking on climate adaptation on which disasters such as floods and droughts need to be integrated into Ethiopian strategic plans. According to the experts, currently short-term interventions such as PSNPs are mostly used when disaster strikes are reactive rather than proactive. To improve climate resilience in agriculture and food systems in Ethiopia, the weather forecast needs to be

[6] https://www.weatherimpact.com/blog/products/ethiopia/

[7] https://g4aw.spaceoffice.nl/en/g4aw-projects/g4aw-projects#projectlist

improved. The current models that are used in Ethiopia provide short term weather information. These models need integration with long term weather scenario models to accurately provide more than three months of weather predictions to farmers and the government for decision making to improve farmer resilience.

Figure 3: Summary of SWOT analyses on climate information

Table 2: projects and programmes in climate information

Resilience practice / Project Name	Diversification of Crop & Livestock	Water management	Integrated Soil Management	Agro-forestry	Conservation Agriculture	Early Warning Systems
BRACED-CISRE	✓	✓	✓		✓	✓
Strengthening Climate Information and Early Warning Systems		✓		✓		✓
Weather Impact		✓				✓
Partners for Resilience	✓	✓		✓		✓
Agro-Met Project	✓	✓				✓
GIACIS	✓					✓
Common Sense	✓					✓

3.2.3 Water Management

Climate change poses a huge threat to rainfed agriculture especially to smallholder farmers who are the majority and fully rely on rainfall for food production (Gezie, 2019). The climate variability often makes these smallholder farmers lose their agricultural production as a result of climate change effects such as recurrent droughts, floods or late onset of rains leading to poor yields and food insecurity among households[8]. To sustain the agricultural production and growth, the Ethiopian government together with

[8] http://www.xinhuanet.com/english/2019-12/28/c_138662188.htm

other development partners such as the Global Water Fund (GWP) and Partners for Resilience (PfR) have given priority to watershed ecosystems restoration and irrigation development to reduced water scarcity for agricultural production and improved food security (Yohannes et al., 2017). Moreover, the government has identified small scale irrigation as one of the priority policies to help Ethiopian economy reach the middle-income status by 2020-2023 (MoFED, 2010).

Even though the government, NGOs and donors are investing in irrigation systems in Ethiopia, the capacity to assist smallholder farmers is still very low (Eshete et al., 2020; Haile & Kasa, 2015). This low capacity has a huge negative impact on food production and security among households who majorly depend on agriculture for livelihoods. Currently, about 18.7 Million hectares representing 16.7% of the Ethiopian landmass is under different levels of irrigation (small, medium and large) to assist farmers continuously produce food even during the dry season (Assefa et al., 2019). However, these irrigation systems are not fully operationalized due to different challenges faced such as water percolation, drying of streams, water governance conflicts among others (Dessale, 2020; Kassie, 2019). More of the challenges are presented in the summary of the SWOT analysis on water management including areas of improvement in Ethiopian water systems in Figure 4.

As a policy to transform the irrigation systems over the next two decades, the Ethiopian government has planned to irrigate 5 Million hectares more of the agricultural land with existing water sources in the country (EFCCC, 2020). This is part of the 10-year prospective plan strategy of 2021-2030, which give irrigation priority as a driver of change to building the resilience of forecasted six million households against drought and improving agricultural production in Ethiopia (EFCCC, 2020). Table 3 shows some of the key projects focused on building farmer resilience through efficient irrigation and drainage for sufficient food production in Ethiopia.

Figure 4: Summary of SWOT analyses on water management.

Table 3: Projects and programmes in water management

Resilience practice / Project Name	Diversification of Crop & Livestock	Water management	Integrated Soil Management	Agro-forestry	Conservation Agriculture	Early Warning Systems
Integrated Shallow Groundwater Irrigation Development		✓	✓			✓
Promoting Autonomous Adaptation (PAA)	✓	✓	✓	✓	✓	✓
Agricultural Growth Program-II (AGP II)	✓	✓	✓	✓	✓	
Climate Smart Integrated Rural Development Project	✓	✓	✓	✓		

3.2.4 Soil Health and Fertility

Improved Soil health and fertility is one of the key drivers to better food production, reduced greenhouse gas emission and improved climate resilience. Ethiopian soils have been subjected to soil degradation over the past 3 decades due to poor land management practices and deforestation leading to 85% and 23% of the land degraded at various levels and as hotspots respectively (Aleminew & Alemayehu, 2020; Gebreselassie et al., 2016; Hurni et al., 2015). Development institutions such as World Bank, International Fund for Agricultural Development (IFAD) and the German Agency for International corporation have been working together with the government ministries and agencies concerned to revive and improve soil fertility through sustainable land management programmes (WorldBank, 2020). The study SWOT analysis in Figure 5 points out some of the opportunity areas that can further be exploited to help in restoring the soil health and fertility in Ethiopia. In the past decade, various land management practices projects and initiatives (Table 4) have shown positive outcomes on improving the soil health and fertility status in the Ethiopian landscape through Integrated Soil Fertility Management practice (Amsalu, 2015; Hörner & Wollni, 2021). However, sustainability of the SLMP initiatives after the projects period remains a big challenge and uncertain (Schmidt & Tadesse, 2019).
To implement the CRGE strategy, practices that increase soil carbon, soil fertility and reduce emissions are of high relevance. Hence, policies that promote sustainable agriculture such as the CSA at the landscape level should be encouraged (Tadesse et al., 2018). Moreover, proper soil management and policies will help the agricultural soils to sequest the large amount of GHGs (CO_2 & CH_4) from the atmosphere to the soil thus mitigating climate change effects (Bayu, 2020).

Figure 5: Summary of SWOT analysis on soil Heath and Fertility

Table 4: Projects and programmes in soil Health and fertility.

Resilience practice / Project Name	Diversification of Crop & Livestock	Water management	Integrated Soil Management	Agro-forestry	Conservation Agriculture	Early Warning Systems
EthioSIS			✓		✓	
REDD+	✓	✓	✓	✓	✓	
SLM II Programme	✓	✓	✓	✓	✓	✓
RLL project II	✓	✓	✓	✓		

3.2.5 Promotion of CSA inputs and technologies

Ethiopia has varied ecological zones (Figure 6a) with different soil type and water regimes that call for different best-suited climate-smart adaptation practices (Chamberlin & Schmidt, 2012). These diverse agroecological zones offer both opportunities and constraints to farmers to improve their food production hence, developing and scaling area specific CSA adaptive strategies for farmers are vital for Ethiopia's agricultural growth and food security (Evangelista et al., 2013). Figure 6 gives an overview of the broad categorization of moisture regime that often are used when choosing the appropriate adaptation strategies for different regions to help farmers become resilient to climate change effects.

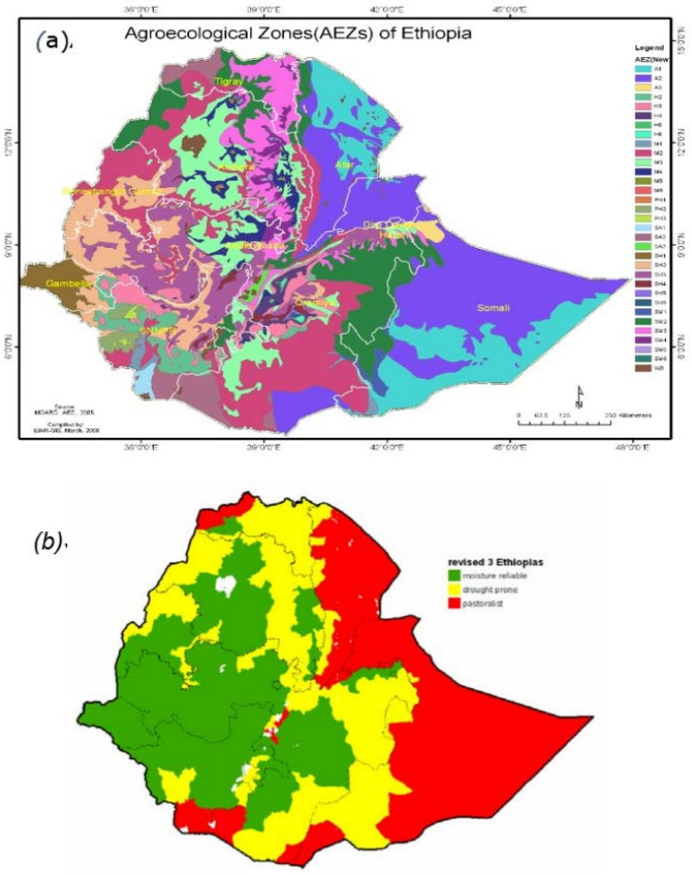

*Figure 6: (*a)*Agroecological zones (EAIR, 2008), (b)Soil Moisture Regime of Ethiopia (Chamberlin et al., 2006)*

A summary of the SWOT analysis in Figure 7 below presents some of areas of weaknesses and opportunities that can further be exploited to improve farmer resilience through promotion of CSA inputs and technologies in Ethiopia. To improve the performance of croplands and increase climate resilience among the farmer households, CSA input and practices such as drought and heat tolerant crop varieties, use of biofertilizer, crop rotation, precise chemical fertilizer use etc are being promoted and upscaled

though still facing low adoption in Ethiopia (BFS/USAID, 2017; WorldBank, 2010). Currently, several key international programmes and projects from CCAFS, GIZ, World Vision, AGRA, RTI, BENEFIT, SNV are researching and promoting CSA practices for different agroecologies to improve farmer adaptive capacities for climate change in Ethiopia. As an example, Bilateral Ethiopian Netherlands Efforts for Food, Income and Trade (BENEFIT)[9] Programme through sub-projects like CASCAPE[10] and REALISE[11] have tested different CSA technologies in different regions and determined which practices best suit a region for upscaling. Furthermore, SNV world among other programmes have also been working in the different regions through some projects (Table 5) to promote CSA practices in various value chains to enhance food production and climate resilience among farmers.

Figure 7: Summary of SWOT analysis on promotion of CSA input and technologies

Table 5: Projects on the promotion of CSA inputs and technologies

Resilience practice / Project Name	Diversification of Crop & Livestock	Water management	Integrated Soil Management	Agro-forestry	Conservation Agriculture	Early Warning Systems
Veggie V4P&P	✓	✓	✓			
RESET	✓	✓	✓	✓	✓	
Responding to the In-creasing Risk of Drought project	✓	✓	✓	✓	✓	
Innovative Business Model (IBM) project	✓	✓	✓	✓		
GRAD-II	✓	✓	✓			
RAYEE	✓	✓	✓	✓	✓	
HortiLIFE	✓	✓	✓	✓	✓	
IPMS	✓	✓	✓	✓	✓	

[9] https://benefitethiopia.org/
[10] https://www.benefit-cascape.org/index.php/project
[11] https://benefitrealise.org/index.php

3.2.6 Social protection adaptive strategies

Social protection in Ethiopia has also been identified as one policy tool to protect people's livelihoods from the impacts of adverse climate shocks and a key pillar in the climate change and disaster risk management strategies. Accordingly, the government initiated the PSNP in 2005 to bring a sustainable solution to chronic food insecurity problems. The main objective of the PSNP is to smoothen household consumption through cash and food transfers to the poor and chronically food-insecure households. The program contributes to the mitigation of climate change mainly through land restoration such as the establishment of soil and water conservation structures, hill terracing and reforestation through planting trees among other public works (Woolf et al., 2015; Woolf et al., 2018).

3.3 Policies and Strategies Relevant to Climate Resilient Agriculture and Food Systems

Recent policies and strategies of the Ethiopian government advocates for more sustainable agriculture and food systems approaches to achieve better food security and nutrition for all Ethiopians (Gebru et al., 2018). The GoE has designed a number of policies and strategies to help the country to mitigate and adapt to climate change and improve sustainable production in the agricultural sector (Table 6).

The NAP-ETH[12] adopted in 2019 and the 10-year perspective plan (2021-2030) launched in early 2021 reflect on the current learning and policy developments the government is undertaking to fully transform the agriculture sector and increase farmer adaptation to climate change effects. NAP-ETH of 2019 identified 18 adaptation options with the agricultural sector being a priority area of focus to directly address climate variability risks on agriculture and livestock. The policy suggests enhancing food security through improving agricultural productivity in a climate-smart manner, improving early warning systems, strengthening drought, crops and livestock insurance mechanisms among others.

With a goal to become a middle-income country by 2025 through green economic development, the government has systematically incorporated her development ambitions in the CRGE initiative to respond to climate change effects. To realize the country's vision on the climate-resilient economy, the GoE through EPACC policy took a transition from project-based adaptation policies towards mainstreaming adaptation structure at all levels of governance[13]. Eight out of the eleven regional administration are confirmed to have developed state-level climate adaptation plan in response to achieving the country's green economic development vision (Echeverría & Terton, 2016).

Various institutional strategic frameworks guide the Ethiopian agricultural transformations. An example is a five-year economic growth plan called growth and transformation plan II (GTPII) of 2015-2020 which mainstreams the country's Climate Resilience Green Economy (CRGE) in Ethiopia. To support other sectors in the implementation of the CRGE strategy, the ministry of environment, forest and climate change and ministry of finance and economic development together with the leadership of CRGE secretariat are mandated to develop standardized guidance and provide appropriate advice (USAID, 2020). Table 6 reflects on the goals of some of the plans and strategies that were formulated within the last ten years and are being implemented to improve farmer climate resilience.

[12] https://www4.unfccc.int/sites/NAPC/Documents/Parties/NAP-ETH%20FINAL%20VERSION%20%20Mar%202019.pdf

[13] https://climate-security-expert-network.org/sites/climate-security-expert-network.com/files/documents/csen_climate_fragility_risk_brief_-_ethiopia_0.pdf

Table 6: Ethiopian policies and strategies developed between 2010-2020 on climate resilience.

Policy	Year	Policy /Strategy goal
Ethiopian 10-Year Perspective Development Plan	2021-2030	End reliance on rainfed agriculture by developing and increasing irrigation capacity, as well as expanding agricultural investments
Climate Resilience Green Economy (CRGE)	2011-2025	Build the economy to middle-income status by 2025 with zero net increase in carbon emission relative to 2010 levels.
Ethiopia National Adaptation Plan (NAP-ETH)	2019	To help in building adaptive capacity and resilience, and strengthening holistic integration of climate change adaptation in Ethiopia's long-term development pathway
Growth and Transformation Plan II (GTP II)	2016-2020	Transitioning agriculture to be more market-oriented To aid and align the agriculture sector development plan with the green economy development strategy.
The Agricultural Sector Policy and Investment Framework (PIF)	2010-2020	To Provide a strategic framework for the prioritization and planning of investments that will drive Ethiopia's agricultural growth and development
Agriculture and Forestry Climate Resilient Strategy (AFCRS)	2015	To identify the impact of both current weather variability and future climate change in Ethiopia ('challenge'), to highlight options for building climate resilience ('response') and to understand how these options can be delivered ('making it happen')
National Policy and Strategy on Disaster Risk Management	2013	Reduce potential damage and disaster risk through a coordinated and comprehensive DRM system in the context of sustainable development.
Ethiopia Programme of Adaptation to Climate Change (EPACC)	2010	To build a climate-resilient economy through adaptation initiatives implemented at sectoral, regional and local community levels

3.4 Policy Priorities to Improve Climate Resilience and Food Systems.

The policies gaps identified in this study and their potential interventions (Table 6) are very key for Ethiopia to improve her resilience against climate change effects. These identified key policies gaps can be given priorities and addressed as below to further improve the resilience of agriculture and food systems for better food security and nutrition.

Mainstreaming weather advisory in the national extension systems service – agro-weather advisory is not part of the crop technology dissemination system in Ethiopia. Moreover, the system also needs to integrate agro-weather advisory with other provisions e.g. availability or arrival of farm inputs in their nearby village shops

Ethiopia has no land use policy, as all the land in principle belongs to the state, this deters farmers to invest in long term climate resilient strategies. All the land is under government ownership and farmers only have the user rights (BFS/USAID, 2017). This makes farmers to be lenient investing long term CSA strategies on the land hence, gradual transformation of ownership to farmers is another important policy that need to be addressed to enable farmers to invest in such long-term CSA practices.

Policy support to involve private service providers. As of current, the agricultural extension is predominantly relying on a government-led extension system although the NGOs and other actors contribute to the government extension structure but currently no such private service providers. For the modernization of climate-resilient farming systems, the input of private service providers is key.

Strengthening research capacity to developed detailed content periodically to support various platforms, agro-weather advisory and extension services depending on what climate is expected or characterized for a different environment, research systems can lead the knowledge generation design.

Strengthening policies to support climate risk insurance to farmers, this should target cluster farming currently in the country assuming homogeneity in the landscape, such insurance information can serve a group of farmers and good entry points to improve farmers adaptive capacity to climate change.
Policies need to support farmer climate resilience by incentivizing improvement in soil health, efficient management of water resources and climate-smart practices such as agroforestry, integrated soil and water management etc. To improve the adoption of some of these practices and build resilience, financial mechanisms such as subsidies and agri-finance can be effective to assist farmers facing financial constraints by subsidizing the action. The agri-finance can structure loans they offer to farmers so as take care of variability in weather and economic status of the smallholder farmers for easy loan servicing. Support to the GoE to establish strategic framework and plans that addresses the gaps in various policy documents are required to successfully implement and reduce policy governance conflicts. Currently, there is little mention on ways in which policy and governance framework would need to adapt to successfully implement climate resilient agriculture synergistic policies. Additionally, there's unclear approaches on how to address governance challenges in the intersectoral focus which climate resilient agriculture systems need.

3.5 Stakeholder Mapping and Policy Network for Climate Resilience.

3.5.1 Stakeholder map for climate resilience

The funding and advice linkages between various stakeholders active in climate resilience in Ethiopia was mapped (Figure 8). While the network structure is highly centralized, meaning that many actors have few links while few have many links, there is still no centre to the network. Dependent on the number of links to other stakeholders in the network, most influential stakeholders are donors and multilateral agencies who support different programmes in climate resilience in agriculture. Among international institutions, AGRA shows to have wider social network influence while Government Ministries are also seen to be influential in their respective areas.

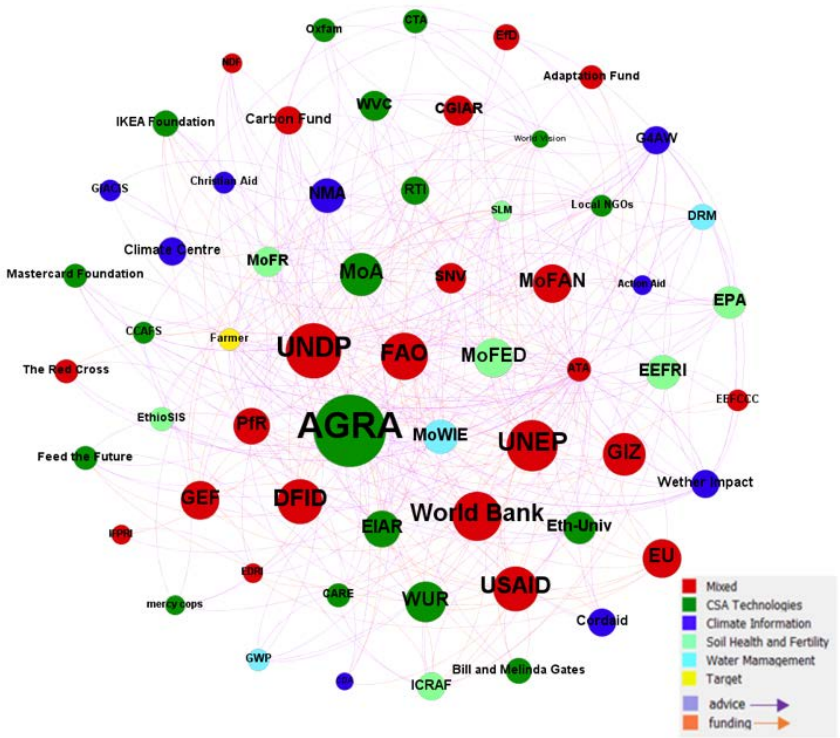

Figure 8: Stakeholders map with main areas of focus for climate resilience

3.5.2 Policy Network and Influence for climate resilience in Ethiopia

The position and influence of some of the key stakeholders in policy design and advocacy for climate resilience in Ethiopia was identified (Figure 9). The analysis shows that government ministries, commissions and agencies such as ATA, MoA, EPA, EEFCCC, MoWIE, MoFE, EPA and STCs (sub-technical committees) have a high influence on policy design in the federal government. Other stakeholders through different capacities also do have influence especially stakeholders involved in research through the provision of advice and policy briefs e.g. IFPRI (Figure 10).

The MoA through its significant capacity under the climate change task force and wider agricultural extension service to work closely with farmers is seen as influential in improving the ability of farmers to adapt to climate change. With a mandate to manage water resources, the MoWIE is influential on policy issues related to water and irrigation infrastructure. MoFE, mandated to work on environment and adaptation issues, is seen as influential in managing climate adaptation under the natural resource Directorate. It's worth noting that as much as these Government ministries remain influential on policy matters, they face lots of setbacks due to lack of capacity especially manpower and other resources as a result of high turnover rates of the workforce due to low salaries and luck of means of transport, inadequate digitalization infrastructures and establishment of government agencies and commissions which coordinate most of their roles. As an example, under MoA and MoFE, the establishment of ATA, EEFCC and EPA which now coordinates Government activities highly affect the ministries operations. According to the experts, these commissions are seen as important stakeholder as they play an important role in coordinating climate change and resilience activities in the government.

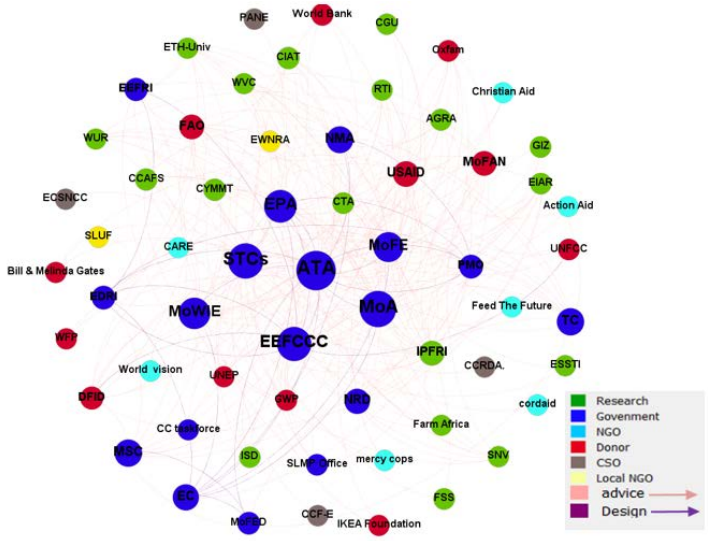

Figure 9: Influence of stakeholders on policy design in Ethiopia

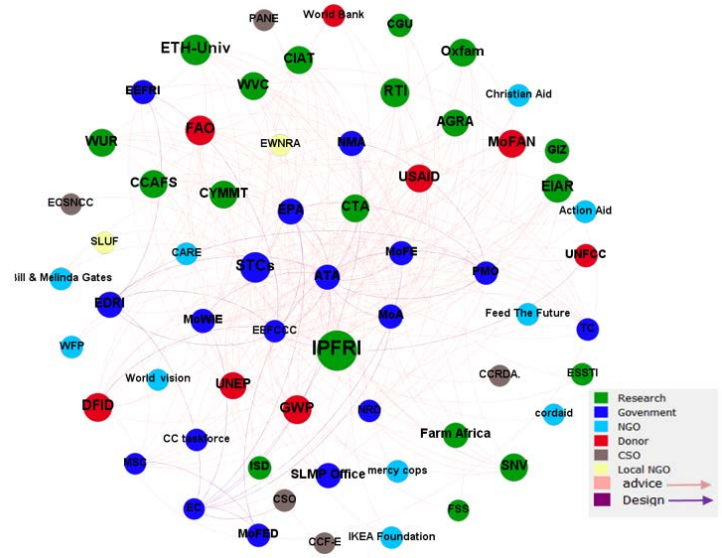

Figure 10: Influence of stakeholders on policy lobby and advocacy to the government

4 Conclusions and Recommendations

Climate change is a key concern for the Ethiopian government in response to building a climate-resilient green economy. Through her climate-related policies and strategies such as CRGE, 10 Year perspective Development Plan and EPACC to mitigate and adapt to climate change, the government has shown to be taking climate change seriously. Despite the government prioritizing climate issues, there remain challenges and limitations to improve climate resilience for sustainable agriculture and food systems in Ethiopia. Some of these challenges include lack of linkages for networking between stakeholders, lack of digitalization of agricultural extension and networking systems, inadequate tailored climate information coupled with short term general agro-weather predictions, land policy issues, among others.

While there is ample emphasis to enhance climate resilience in agriculture and food systems in Ethiopia, some of the key barriers noted were lack of strong linkage and coordination of climate resilience activities between stakeholders. Poor linkages between stakeholders were also linked to the type of technologies being used in the extension service which are not digitized yet in Ethiopia with exception of project-related cases. Weak linkages due to lack of technological capacity make it difficult to handle institutional networking considering agricultural decisions are operated in a narrow window that needs quick action. The call was to enhance digital communication between stakeholders from the level of decision making to development agencies and the farmers. Secondly, the knowledge gap to implement the climate technologies which are new and not the same as crop technologies was noted. Moreover, lack of institutional capacity to implement policy in Ethiopia is a big problem as local services e.g. extension, inspection, etc are under resourced and do not have the means to support farmers due to lack of funds, high staff turnover. There is insufficient capacity on the ground to implement and enforce the policies. Experts emphasized that enhancing the knowledge capacities of stakeholders and increasing resource availability to implement climate-related technologies is key for future responses.

In Ethiopia, there are a number of research stakeholders' networks already formed to share and disseminate research issues related to climate change. These networks include Ethiopian academic institutes, Civil Society Organizations (CSOs), (Inter)national NGOs, international and regional research organization. The institutions are sometimes approached by or approach government ministries, department and commissions for advice however, most of the research institutions do not play key influential roles at the policy level. Some of the influential institutions at the policy level include EDRI, EEFCCC, ATA, EPA and the government ministries.

Experts emphasized that enhancing dissemination of tailored climate information to both farmers and extension agents who play a key role in disseminating timely, accurate and evidence-based climate change information and trainings to farmers is urgently required to improve climate resilience. Currently, a large number of farmers do not receive tailored climate information. Experts affirmed that response from those who have benefited from receiving projects agro-weather information were very positive as the information helped them to reduce the losses that could have occurred due to increasing climate variability. In Ethiopia, general climate information broadcasted on national media platforms are not helpful to farmers due to the diversity of agroecological landscape systems. To support and build household climate resilience, long-term tailored climate information required and need to be downscaled for different regions for decision making, this is currently lacking in Ethiopia. Additionally, access to other climate smart options is also essential and need to be integrated with weather information to achieve success.

Based on the findings in this study, we recommend the following as policy response to improve climate resilience in in agriculture and food systems for Ethiopia;

- Mainstreaming weather advisory in the national extension systems.
- Policy support to involve private service providers whose inputs are key for the transformation of the climate resilient agricultural systems.
- Support to farmers by subsidizing costs of agricultural insurance, climate information, CSÁ promotion and implementations.
- Strengthening capacities of research institutions to develop detailed content periodically to support various platforms, agro-weather and extension services.
- Support government to establish strategic frameworks and plans that addresses the gaps in policy documents to successfully implement and reduce policy governance conflicts.

References

Adela, F. A., Aurbacher, J., & Abebe, G. K. (2019). Small-scale irrigation scheme governance-poverty nexus: evidence from Ethiopia. *Food Security, 11*(4), 897-913.

Agegnehu, G., Vanbeek, C., & Bird, M. (2014). Influence of integrated soil fertility management in wheat and tef productivity and soil chemical properties in the highland tropical environment. *Journal of soil science and plant nutrition, 14*(3), 532-545.

Aleminew, A., & Alemayehu, M. (2020). Soil Fertility Depletion and Its Management Options under Crop Production Perspectives in Ethiopia: A Review. *Agricultural Reviews, 41*(2).

Amare, D., Wondie, M., Mekuria, W., & Darr, D. (2019). Agroforestry of smallholder farmers in Ethiopia: practices and benefits. *Small-scale Forestry, 18*(1), 39-56.

Amsalu, A. (2015). Institutional context for soil resources management in Ethiopia: a Review.

Aragie, E. A. (2013). *Climate change, growth, and poverty in Ethiopia*. Retrieved from

Arslan, A., McCarthy, N., Lipper, L., Asfaw, S., & Cattaneo, A. (2014). Adoption and intensity of adoption of conservation farming practices in Zambia. *Agriculture, ecosystems & environment, 187*, 72-86.

Assefa, T., Jha, M., Worqlul, A. W., Reyes, M., & Tilahun, S. (2019). Scaling-Up Conservation Agriculture Production System with Drip Irrigation by Integrating MCE Technique and the APEX Model. *Water, 11*(10), 2007.

Aune, J. B. (2020). The Prospects for Conservation Agriculture in Ethiopia. In *Climate Impacts on Agricultural and Natural Resource Sustainability in Africa* (pp. 23-39): Springer.

Bacha, D., Namara, R., Bogale, A., & Tesfaye, A. (2011). Impact of small-scale irrigation on household poverty: empirical evidence from the Ambo district in Ethiopia. *Irrigation and Drainage, 60*(1), 1-10.

Bayu, T. (2020). Review on contribution of integrated soil fertility management for climate change mitigation and agricultural sustainability. *Cogent Environmental Science, 6*(1), 1823631.

Bekele, M., Bezabih, M., Elias, H., Fisker, P., Gebrehiwot, T., Kuma, T., Mekasha, T., Mekonnen, A., Tarp, F., & Teklewold, H. (2020). Development Economics Research Group.

BFS/USAID, C. (2017). Climate-Smart Agriculture in Ethiopia. CSA Country Profiles for Africa Series. *International Center for TropicalAgriculture (CIAT); Bureau for Food Security, United States Agency for International Development (BFS/USAID)*.

Canevari-Luzardo, L. M. (2019). Value chain climate resilience and adaptive capacity in micro, small and medium agribusiness in Jamaica: a network approach. *Regional Environmental Change, 19*(8), 2535-2550.

Chamberlin, J., Pender, J., & Yu, B. (2006). *Development domains for Ethiopia: Capturing the geographical context of smallholder development options*: Intl Food Policy Res Inst.

Chamberlin, J., & Schmidt, E. (2012). Ethiopian agriculture: A dynamic geographic perspective. *Food and agriculture in Ethiopia: progress and policy challenges*, 21-52.

Chavarría, J.-Y. D., Baudron, F., & Sunderland, T. (2018). Retaining forests within agricultural landscapes as a pathway to sustainable intensification: Evidence from Southern Ethiopia. *Agriculture, ecosystems & environment, 263*, 41-52.

Dessale, M. (2020). Determinants and Food Security Impacts of Small-Scale Irrigation in Ethiopia.

Dessie, A. B., Abate, T. M., Mekie, T. M., & Liyew, Y. M. (2019). Crop diversification analysis on red pepper dominated smallholder farming system: evidence from northwest Ethiopia. *Ecological Processes, 8*(1), 1-11.

DFID. (2012). Building Resilience in ethiopia. *Department for International Development* Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/191903/Approach_to_disaster_resilience_-_Ethiopia_case_study.pdf

Drechsler, M., & Soer, W. (2016). *Early warning, early action: the use of predictive tools in drought response through Ethiopia's productive safety net programme*: The World Bank.

Duriaux-Chavarría, J. Y., Baudron, F., Gergel, S. E., Yang, K. F., Eddy, I. M., & Sunderland, T. (2021). More people, more trees: A reversal of deforestation trends in Southern Ethiopia. *Land Degradation & Development, 32*(3), 1440-1451.

Echeverría, D., & Terton, A. (2016). Review of current and planned adaptation action in Ethiopia.

EFCCC, E. F. C. C. C. (2020). ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT GUIDELINE FOR IRRIGATION SECTOR. Retrieved from https://library.partnersforresilience.nl/filestore/6/1/8_affbbb3849ff691/618_dadcad8b86de8f5.pdf

Eshete, D. G., Sinshaw, B. G., & Legesse, K. G. (2020). Critical review on improving irrigation water use efficiency: Advances, challenges, and opportunities in the Ethiopia context. *Water-Energy Nexus*.

Evangelista, P., Young, N., & Burnett, J. (2013). How will climate change spatially affect agriculture production in Ethiopia? Case studies of important cereal crops. *Climatic change, 119*(3), 855-873.

Ewbank, R., Perez, C., Cornish, H., Worku, M., & Woldetsadik, S. (2019). Building resilience to El Niño-related drought: experiences in early warning and early action from Nicaragua and Ethiopia. *Disasters, 43*, S345-S367.

FDRE-CRGE. (2011). *Ethiopia's Climate-Resilient Green Economy: Green Economy Strategy*. Federal Democratic Republic of Ethiopia

FDRE. (2011). Ethiopia's Climate-Resilient Green Economy Retrieved from https://www.greengrowthknowledge.org/sites/default/files/downloads/policy-database/ETHIOPIA%29%20Ethiopia%27s%20Climate-Resilient%20Green%20Economy%20-%20Green%20Economy%20Strategy.pdf

FDRE. (2016). Growth and Transformation Plan II (GTP II). Retrieved from https://www.greengrowthknowledge.org/sites/default/files/downloads/policy-database/ETHIOPIA%29%20Growth%20and%20Transformation%20Plan%20II%2C%20Vol%20I.%20%20%282015%2C16-2019%2C20%29.pdf

FDRE. (2019). Ethiopia National Adaptation Plan. Retrieved from https://www4.unfccc.int/sites/NAPC/Documents/Parties/NAP-ETH%20FINAL%20VERSION%20%20Mar%202019.pdf

Gebremeskel, G., Gebremicael, T., & Girmay, A. (2018). Economic and environmental rehabilitation through soil and water conservation, the case of Tigray in northern Ethiopia. *Journal of Arid Environments, 151*, 113-124.

Gebreselassie, S., Kirui, O. K., & Mirzabaev, A. (2016). Economics of land degradation and improvement in Ethiopia. In *Economics of land degradation and improvement–a global assessment for sustainable development* (pp. 401-430): Springer, Cham.

Gebru, M., Remans, R., Brouwer, I., Baye, K., Melesse, M. B., Covic, N., Habtamu, F., Abay, A. H., Hailu, T., & Hirvonen, K. (2018). Food systems for healthier diets in Ethiopia: Toward a research agenda.

Gezie, M. (2019). Farmer's response to climate change and variability in Ethiopia: A review. *Cogent Food & Agriculture, 5*(1), 1613770.

Goshu, D., Kassa, B., & Ketema, M. (2012). Does crop diversification enhance household food security? Evidence from rural Ethiopia.

Hadgu, K. M., Mowo, J., Garrity, D., & Sileshi, G. (2011). Current extent of evergreen agriculture and prospects for improving food security and environmental resilience in Ethiopia. *International Journal of Agricultural Sciences, 1*(1), 006-016.

Haile, G. G., & Kasa, A. K. (2015). Irrigation in Ethiopia: A review. *Academia journal of agricultural research, 3*(10), 264-269.

Hin, H., & Mekonen, A. (2019). ETHIOPIA. *The Oxford Handbook of the Ethiopian Economy*, 288.

Hörner, D., & Wollni, M. (2021). Integrated soil fertility management and household welfare in Ethiopia. *Food Policy*, 102022.

Huggins, R. (2000). The success and failure of policy-implanted inter-firm network initiatives: motivations, processes and structure. *Entrepreneurship & Regional Development, 12*(2), 111-135.

Hurni, K., Zeleke, G., Kassie, M., Tegegne, B., Kassawmar, T., Teferi, E., Moges, A., Tadesse, D., Ahmed, M., & Degu, Y. (2015). Soil degradation and sustainable land management in the rainfed agricultural areas of Ethiopia: an assessment of the economic implications. *Economics of Land Degradation (ELD) Ethiopia Case Study Report for the Economics of Land Degradation Initiative, 94*.

Jirata, M., Grey, S., & Kilawe, E. (2016). Ethiopia climate-smart agriculture scoping study. *FAO, Rome*.

Kassie, A. E. (2019). Challenges and Opportunities of Irrigation Practices in Ethiopia: A Review. *Journal of Engineering Research and Reports*, 1-12.

Kebeda, B. T., Abdisa, T. O., & Berkessa, A. J. (2019). Review on The Expected Role of Climate Smart Agriculture on Food System in Ethiopia.

Kedir, N., Coninx, I., Vonk, R., Tefera, T., Descheemaeker, K., & Hutjes, R. (2021). Farmers' Perceptions and their Implications to Climate-Proof Food Security Programmes. In *Handbook of Climate Change Management: Research, Leadership, Transformation* (pp. 1-25): Springer International Publishing.

Lewis, K. (2017). Understanding climate as a driver of food insecurity in Ethiopia. *Climatic change, 144*(2), 317-328.

Liben, F., Tadesse, B., Tola, Y., Wortmann, C., Kim, H., & Mupangwa, W. (2018). Conservation agriculture effects on crop productivity and soil properties in Ethiopia. *Agronomy Journal, 110*(2), 758-767.

Lipper, L., Thornton, P., Campbell, B. M., Baedeker, T., Braimoh, A., Bwalya, M., Caron, P., Cattaneo, A., Garrity, D., & Henry, K. (2014). Climate-smart agriculture for food security. *Nature climate change, 4*(12), 1068-1072.

McCarthy, N., Lipper, L., & Branca, G. (2011). Climate-smart agriculture: smallholder adoption and implications for climate change adaptation and mitigation. *Mitigation of Climate Change in Agriculture Working Paper, 3*(1), 1-37.

Mengistie, D., & Kidane, D. (2016). Assessment of the impact of small-scale irrigation on household livelihood improvement at Gubalafto District, North Wollo, Ethiopia. *Agriculture, 6*(3), 27.

Michler, J. D., & Josephson, A. L. (2017). To specialize or diversify: Agricultural diversity and poverty dynamics in Ethiopia. *World Development, 89*, 214-226.

Minten, B., Dereje, M., Bachewe, F. N., & Tamru, S. (2018). Evolving food systems in Ethiopia: Past, present and future. *117*.

Minten, B., Dereje, M., Bachewe, F. N., & Tamru, S. (2020). Evolving food value chains. *Ethiopia's agrifood system: Past trends, present challenges, and future scenarios*, 177.

MoFAN. (2018). Climate Change Profile: Ethiopia. Retrieved from https://www.government.nl/documents/publications/2019/02/05/climate-change-profiles

MoFED. (2010). *Growth and Transformation Plan*. 2010/11–2014/15

Nagothu, U. S. (2016). *Climate Change and Agricultural Development: Improving Resilience Through Climate Smart Agriculture, Agroecology and Conservation*: Routledge.
Nciizah, A. D., & Wakindiki, I. I. (2015). Climate smart agriculture: achievements and prospects in Africa.
Norberg, J., & Cumming, G. (2008). *Complexity theory for a sustainable future*: Columbia University Press.
Nyambi, G. N.-A. (2012). *A comparative SWOT analysis of the national agricultural extension program organization to determine best-fit program model: A case study of the North West and South West Regions of Cameroon*: Texas A&M University.
OPHI. (2020). Global MPI Country Briefing 2020: Ethiopia (Sub-Saharan Africa). Retrieved from https://ophi.org.uk/wp-content/uploads/CB_ETH_2020.pdf
Schmidt, E., & Tadesse, F. (2019). The impact of sustainable land management on household crop production in the Blue Nile Basin, Ethiopia. *Land Degradation & Development, 30*(7), 777-787.
Schoeneberger, M. M. (2009). Agroforestry: working trees for sequestering carbon on agricultural lands. *Agroforestry systems, 75*(1), 27-37.
Tadesse, M., Simane, B., Ambaw, G., Recha, J. W., Abera, W., Tamene, L., Demeke, G., Mekonnen, K., Radeny, M. A., & Solomon, D. (2018). Building soil carbon stocks to enhance adaptation and mitigate climate change in climate-smart landscapes, Southern Ethiopia.
Teklewold, H., Mekonnen, A., & Kohlin, G. (2019). Climate change adaptation: a study of multiple climate-smart practices in the Nile Basin of Ethiopia. *Climate and Development, 11*(2), 180-192.
Teshome, A., Adgo, E., & Mati, B. (2010). Impact of water harvesting ponds on household incomes and rural livelihoods in Minjar Shenkora district of Ethiopia. *Ecohydrology & Hydrobiology, 10*(2-4), 315-322.
Tesso, G. (2020). Review of the Impact of COVID-19 on Economic Growth, Unemployment and Progress out of Poverty in Ethiopia.
Thorlakson, T., & Neufeldt, H. (2012). Reducing subsistence farmers' vulnerability to climate change: evaluating the potential contributions of agroforestry in western Kenya. *Agriculture & Food Security, 1*(1), 1-13.
Tsegaye, W., LaRovere, R., Mwabu, G., & Kassie, G. T. (2017). Adoption and farm-level impact of conservation agriculture in Central Ethiopia. *Environment, Development and Sustainability, 19*(6), 2517-2533.
USAID. (2020). Ethiopia profile.
WFP. (2019). Comprehensive Food Security and Vulnerability Analysis. Retrieved from https://reliefweb.int/sites/reliefweb.int/files/resources/wfp_ethiopia_cfsva_report_june_2019.pdf
Woolf, D., Jirka, S., Milne, E., Easter, M., DeGloria, S., Solomon, D., & Lehmann, J. (2015). *Climate Change Mitigation Potential of Ethiopia's Productive Safety-Net Program (PSNP)*. Retrieved from
Woolf, D., Solomon, D., & Lehmann, J. (2018). Land restoration in food security programmes: synergies with climate change mitigation. *Climate Policy, 18*(10), 1260-1270.
WorldBank. (2010). Economics of Adaptation to Climate Change. Retrieved from https://documents1.worldbank.org/curated/en/310391468340238724/pdf/686500ESW0P1130UBLIC00EACC0Ethiopia.pdf
WorldBank. (2020). Sustainable Land Management Project I and II. Retrieved from https://ieg.worldbankgroup.org/sites/default/files/Data/reports/ppar_ethiopiasustainableland.pdf
Yebo, B. (2015). Integrated soil fertility management for better crop production in Ethiopia. *International Journal of Soil Science, 10*(1), 1-16.
Yohannes, D. F., Ritsema, C., Solomon, H., Froebrich, J., & Van Dam, J. (2017). Irrigation water management: Farmers' practices, perceptions and adaptations at Gumselassa irrigation scheme, North Ethiopia. *Agricultural Water Management, 191*, 16-28.

Appendices

Appendix 1: List of experts

S/N	Name	position
1	Dr. Tefera Belay	Environment and Climate Change Commission
2	Mr. Berhanu Assefa	Director of climate change, MoA
3	Dr. Mezegebu Getnet	Senior Researcher, EIAR
4	Dr.Teferi mequaninte	Cross-cutting director of ATA
5	Dr. Akalu Teshome	Senior researcher, BENEFIT partnership
6	Ted Schrader	Project coordinator SBN, WUR
7	Coninx Ingrid	Environmental policy expert WUR
8	Mohammed Hassena	Expert ISSD
9	Tomaso Ceccarelli	Environment and climate expert WUR
10	Borman, Gareth	Project coordinator ISSD, WUR
11	Tewodros Amede	Project manager REALISE
12	Geremew Gashawbeza	Project manager SBN
13	Anteneh Mekuria	Expert SBN
14	Eric Smaling	Project coordinator CASCAPE, WUR

Appendix 2: Interview guideline questions

1. Could you please elaborate briefly on some of the climate resilient practices that were successful in your program and are very helpful for upscaling to farmers?
2. What are some of the key bottlenecks (what worked/not) and what could be the best way from your experience to resolve them and improve farmer resilience to climatic shocks and stressors?
3. In your own opinion what do you suggest as key areas that should further be considered if a new programme want to improve agricultural and food systems that are climate resilient in Ethiopia?
4. What do you see as the challenges and opportunities for building climate resilience in Ethiopia?
5. In your view what are the policy priorities to be considered to improve climate resilience among farmers?
6. what are the sector priority needs/type of support you could think of as way to improve farmer climate resilience in Ethiopia?
7. What level is the climate policies delegated is it a devolved policy (federal or regions to lower administration)
8. Are the implementers of the policy knowledgeable about them or have they been capacitated on the climate policy (not to struggle on how to implement the policies)
9. Which ministries and parties are involved in policy lobbying with the federal government?
10. How can WUR position itself for policy influencing for climate resilience in agriculture and food systems in Ethiopia?

Appendix 3: stakeholders Acronyms

SLUF	Sustainable Land management Forum
EWNRA	Ethio-Wetland and Natural Resource Association
CYMMYT	International Maize and Wheat Improvement Center
CTA	Technical Centre for Agricultural and Rural Cooperation
GWP	Global Water Partnership
CCRDA	Consortium of Christian Relief and Development Association
ESSTI	Ethiopian Space Science and Technology Institute
TC	Technical Committee
MoFAN	Ministry of Foreign Affairs, The Netherlands
WFP	World Food Programme
WUR	Wageningen University & Research
UNFCCC	United Nations Framework Convention on Climate Change
CCFE	Climate Change Forum of Ethiopia
MoFED	Ministry of Finance and Economic Development
PANE	Poverty Action Network Ethiopia
ISD	Institute of Sustainable Development

Appendix 4: Climate Information Projects

Project Name	Year	Region targeted	Key Partners	Focus Areas	Activities	References
Climate Forecasting and Changing Behaviours using High Impact Communication	2015-2017	South Omo Zone, Borena Zone, Arsi Zone, East Hararge ,Orimiya State	Christian Aid, BBC Media Action, Action Aid Ethiopia, King's College London, National Meteorology Agency (NMA)', Met Office (UK)	to build the resilience of vulnerable communities to climate extremes and disasters in high-risk locations.	Increase access to climate information through digital channels such as radio and text messaging. Increase the capacity of local communities to respond to climate threats through training and the development of disaster response plans. Installation and analysis of rain gauges, providing farmers with the knowledge to use rainfall records to determine appropriate planting time, based on acceptable soil moisture levels. Analysis of the full range of climate risks, including, for example, different categories of drought; integrated and participatory watershed management; Small scale irrigation; Empowerment schemes for women, providing increased understanding of crop productivity and access to markets; livestock health improvement practices."	BRACED-CISRE PROJECT
Strengthening Climate Information and Early Warning Systems	2013-2017	national	National Meteorological Agency, GEF, UNDP	Disaster Risk Management, Climate Change Adaptation	Generated high quality climate information and strengthened the capacity of national and regional offices of the National Meteorological Agency, the Ministry of Agriculture, and the Ministry of Water, Irrigation and Energy. Developed different information products to improve evidence-based decision-making for early warning, preparedness, and adaptation responses	UNDP-SCIEWS PROJECT

Climate for Development in Africa	2012–2015	National	European Union, Finland, Nordic Development Fund, Sweden, UKAID, USAID	To increase the climate resilience of Ethiopia's population by addressing the need for improved climate and strengthening the use of such information for decision-making	Research, capacity building, and knowledge communication	
Copping with drought & climate Change(CWD &CC) project	2010-2013		Global Environment Facility (GEF)	Communities sustainable and transformational change to adapt to CC effects.	-Promotion of Seeds(drought, resistant, short season variety, vegetables, fruit trees) - Drought resistant livestock - Water harvesting and irrigation systems -Integrated pest management -Early warning systems (data collection and Dissemination to farmers) - Flood control - Watershed rehabilitation and forage crops	
Geodata for innovative agricultural insurance Schemes	2014	Oromia, Tigray, SNNPR, Amhara	ATA, NMA	Insure credit taken to purchase agricultural inputs.	-Provide insurance that ensure needs of smallholder farmers	GIACIS
CommonSense	2015		ATA, NMA, MoAIR	Strengthen value chains to improve livelihoods and food security through quality weather information	Provision of weather information to smallholder farmers	Common Sense

Implementing Climate resilient and green economy plans in highland areas of Ethiopia	2015-2016		GEF-CSO, UN Environment	Mainstream climate risks into the country's planning processes to increase community's resilience against climate change in Ethiopian highlands	Creating and streathenng institutional frameworks, scaling integrated aproaches.

Appendix 5: Input and CSA Technologies Projects

Project Name	Year	Region targeted	Key Partners	Focus Areas	Activities	References
Veggies 4 Planets and People Project	2020-2024	Oromia	world vegetable Center, IKEA Foundation	Increase incomes for youth and women, in the vegetable sector in Ethiopia	facilitate farmer networks with access to information, business development services, input/output markets, and serve as liaisons with local governments	SNV-V4P&P
Integrated Seed Sector Development Programme (ISSD Ethiopia)	2016-2019	Amhara, SNNPR and Tigray	Bahir Dar University, Haramaya University, Hawassa University, Mekelle University, Oromia Seed Enterprise, Ethiopian Seed Association and Centre for Development Innovation of Wageningen UR	Building farmer resilience through improved seed systems	Increase the availability and use of quality seeds Boost crop production and increase biodiversity in seeds and crops that are on offer. Addressing the causes of problems through provision of quality seeds irrigation	ISSD-ETHIOPIA

CASCAPE - Capacity building for scaling up of evidence-based best practices in agricultural production in Ethiopia			WCDI, WUR, ALTERRA Agricultural Growth Programme (AGP), Universities in the project region.	identify drivers for uptake of innovations, test and disseminate these innovations and evaluate their short- and long-term effects	Support various stakeholders for promotion and scaling up of best innovations. Introduce, test and validate various CSA practices and technologies for scaling. Evaluation of short and long-term effects of selected practices on sustainability.	Cascape Projects
Responding to the In-creasing Risk of Drought: Building Gen-der-responsive Resilience of the Most Vulnerable Communities	2017-2022	Tigray, Amhara SNNPR, Oromia Gambella, Afar, Somali, Harari Dire, Dawa Benshangul Gumuz	UNDP	Build the resilience of vulnerable communities to drought that have been exacerbated by climate change	improve the water supply to populations in the targeted areas and introduce water and soil conservation measures. Improve farming practices to increase productivity and resilience including irrigation, improved seed supply, improved animal husbandry practices diversification of crops (agro-forestry). Increase access to credit facilities to allow for improved agricultural productivity.	UNDP-ESMP PROJECT
Innovative Business Model (IBM) project		Amhara and Oromia, Dire Dawa city		To increase food production and income security for smallholder farmer households	Promoting crop rotation of high-value crops and crops that meet household nutritional demands. Supplying agricultural inputs including quality seeds. Building the capacity of women to transform into Agri-entrepreneurs. Strengthening informal farmer groups organized around nucleus farms to produce and market improved seeds and crop varieties. Facilitating linkages with smallholder farmer friendly micro-finance institutions to finance the value chain.	SNV-IBM PROJECT
Feed the Future Livelihoods for Resilience Activity (GRAD-II)	2012 - date	Tigray, Amhara, and SNNPR	USAID, CARE, AGRI-SERVICE Ethiopia, ORDA, Feed the Future	Help targeted communities in achieving long term food security, increasing their	empowering the communities with improved agricultural and financial skills, access to loans and start-up capital, market information, and high-	SNV-GRAD II

				incomes, and building resilience to market shocks.	quality inputs (such as fertilizer, veterinarian products, and tools). Establishment of communities VESAs (Village and Economic and Social Associations) Trainings on improved and resilient agricultural production and food nutrition through value chain selection and development, agricultural extension innovations and climate-change resilience strategies.	
Realising Aspiration Youth in Ethiopia through Employment (RAYEE)	2020-2024	SNNPR, Oromia, Amhara and Tigray regions Dire Dawa city	The Mastercard Foundation	Create employment through agriculture and agri-business for 240,000 young people in project sites	Training the youth on agribusiness and Agri enterprise administration. Help to improved access to inclusive financial services, input supply, and market information among the youth. Create waged and meaningful employment for 60,000 young people.	SNV- RAYEE Project
Horticultural, Livelihoods, Innovation and Food safety-HortiLIFE	2016-Date	Amhara, Oromia, Tigray and SNNPR	Embassy of the kingdom of The Netherlands	To increase the involvement of smallholders in innovative and viable horticulture production systems that improve food security and food safety and with access to high-end local and export	Enhancing the capacity of farmers and extension experts for sustainable development of horticultural sector. setting up Farm Field Schools to assist subsistence farmers through trainings on GAP/improved extension service.	Hortilife-Project
Improving the Productivity and Market Success of Ethiopian Farmers (IPMS)	2002-2012	Amhara, Oromia, Tigray, and SNNPR	Ethiopian Institute of Agricultural Research	To achieve improved and sustainable rural livelihoods by contributing to improved agricultural productivity and production through	improve access by women to inputs including credit Capacity development for service providers, farmers and other value chain actors in agricultural market-oriented development.	ILRI. 2013

				market-oriented agricultural development	Promotion of high value crops such as fruits eg. avocado, irrigated vegetables, cereals e.g. rice, pulses- chickpea, coffee, oil crops, cotton. National training on water management for irrigation/NRM staff by IWM	
Strengthening National Capacities for Disaster Risk Reduction and Livelihoods Recovery (SNCDRRLR)	2010-2013	Afar, Gambella, Somali, Oromia	Disaster Risk Management and Food Security Sector (DRMFSS), UNDP-(BCPR)	Climate Change, Envt and DRM.	Building institutional capacity among household for Disaster Risk Reduction and resilience and recovery capacity of communities prone to disaster. Diversification of incomes and livelihoods through Improved seeds, farm tools and veterinary drugs and the establishment of community-based animal health workers.	UNDP-SNCDRRLR PROJECT
Resilience building in Ethiopia (RESET)	2016-2020	Oromia		find smart and effective solutions to increase resilience and maintain livelihoods	Improved access to health and food services. More options for livelihood and income. Better preparation for future disasters (Disaster Risk Management). More research into the challenges and livelihoods of local farmers	RESET-Care Project

Appendix 6: Soil Health and Fertility Projects

Project Name	Year	Region targeted	Key Partners	Focus Areas	Activities	References
Ethiopian Soil Information System (EthioSIS)	2012-2020	National	MoALR, Regional Soil Laboratories, AGP.	Mapping Ethiopian soil resources and establish information system to facilitate decision making	gather soil samples from the entire country to develop 22 different soil property maps and fertilizer recommendations for each region Conduct survey approach to generate bio-physical map of the country	EthioSIS project

AGRA-IPNI Soil Health Consortia Project	2013-2020	National	research institutes, academic institutes, MOALR & NGOs	Enhance the accessibility and dissemination of ISFM technologies for soil health management in Ethiopia	Facilitate stakeholders to discuss, share and synthesize ISFM information. Development and sharing of national ISFM technologies database with various stakeholders. Publish and distribute ISFM technologies through periodicals and newsletters	AGRA-IPNI PROJECT
Reducing Emissions from Deforestation and Forest Degradation (REDD+)	Since 2008	National major focus in Oroima		Emissions reduction from deforestation and forest degradation, and enhance the role played by conservation and sustainable management forests in climate change mitigation	-afforestation and reforestation -improving traditional activities such as beekeeping, furniture making, processing of wild coffee and production of eco charcoal from bamboo -Increase farmer resilience to climate change, and improved crop production in the region	FDRE,2015
Sustainable Land Management (SLM) Programme		Oromia; Amhara, Tigray, SNNPR		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.	conservation agriculture technologies 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	Shiferaw & Ebru, 2020
Resilient landscape and livelihood project II	2021-2025		World bank	to improve climate resilience, land productivity and carbon storage, and increase access to diversified livelihood	Land Restoration and Watershed Management; Climate Smart Agriculture; and Livelihood Diversification and Connections to Value Chains	

			activities in selected rural watersheds		
Forests4Future	2020-2024		help restore forests and productive forest landscapes		F4F project
Up-scaling Eco-DRR		UN Environment, The Netherlands Red Cross, Cordaid, the Red Cross Climate Centre and Wetlands International	generating, documenting and disseminating models for scaling-up Ecosystem-based Disaster Risk Reduction with local actors	Demonstrating: models for scaling-up Eco-DRR with local actors Mainstreaming: catalyse new investments in ecosystems and new Eco-DRR initiatives through capacity-building	Partners for Resilience
Ensuring food security and land tenure	2019-2024	EU, GIZ		Working with CSOs on environmental issues such as land rehabilitation, prevention of soil erosion as well as deforestation	S2RAI II project
Soil Protection and Rehabilitation of Degraded Soil for Food Security (ProSoil)	2014-2025	GIZ	Approaches to promoting lasting soil protection and rehabilitation are implemented	advice on agroecological practices	ProSoil
Integrated Landscape Management to Enhance Food Security and	2015-	UNDP, GEF,MEFCC	Enhancing long-term sustainability and resilience of food production systems by addressing	Mainstream biodiversity across sectors as well as in land/seascapes Manage land substantially to reduce degradation and increase land restoration rates.	ILMEFSER

Ecosystem Resilience		environmental drivers of food insecurity

Appendix 7: water Management Projects

Project Name	Year	Region targeted	Key Patners	Focus Areas	Activities	References
Integrated Shallow Groundwater Irrigation Development	2013-2020	Oromia, Amhara, SNNPR, Tigray	Radar Tech. International (RTI) and Addis Ababa University (AAU) as sub-contractors, AGP	Enable smallholder farmers to adapt to climate change by reducing dependence on increasingly erratic rainfall.	Promotion of high value and nutrition dense crop production and marketing, Capacity building. Promotion of irrigation equipment supply chains and retailing. hallow groundwater mapping	ISGID PROJECT
Promoting Autonomous Adaptation (PAA)	2012-2016	Benishangul-Gumuz, Tigray, Oromia, Gambella, Addis Ababa City	Ministry of Environment and Forest, Regional and District Environmental Protection Offices	Climate Change Adaptation	Establishment of new technologies (such as automatic weather stations, solar pumps, modern irrigation technologies). scaling of high yielding, early maturing and drought resistant crop seeds and delivering assistance in irrigation from rainwater harvest to conducting trainings to teach the farmers how to rehabilitate the degraded watershed.	UNDP-PAA Project
Agricultural Growth Program-II (AGP2)	2015-date.	Amhara, Oromia, SNNPR, Tigray, Benishangul-Gumuz, Gambella, Harari and Dire Dawa city		to increase agricultural productivity and of small holder farmers targeted by the Program and also contributes to dietary diversity and consumption at HH level	Farmer training and demonstrations leading to adoption of Climate Smart Agriculture technologies. multiplication of land and water resource technologies. Helping farmers in Common Interest Groups, to benefit from small scale irrigation. Technology pre-extension demonstration and popularization; Establishing and strengthening of Farmers' Research Groups	AGP II PROJECT

Climate Smart Integrated Rural Development (CSIRD)Project	2017-2021	Oromia; Amhara; Tigray, SNNPR, Harari Dire Dawa	MoFEC-ETH Adaptation Fund"	To increase resilience to recurrent droughts in seven agro-ecological landscapes in Ethiopia	Increase capacity to manage current and future drought risks through improved adaptation planning and sustainable management of agro-ecological landscapes Enhanced and secure access to potable water supply, and small-scale irrigation in drought affected areas. Strengthened institutional capacity to reduce risks associated with climate-induced socioeconomic and environmental losses.	CSIRD Project

Appendix 8: Policies and Strategies

Policy Name	Year	Policy Focus	Policy Target	Policy Approach	References
The Agricultural Sector Policy and Investment Framework (PIF)	2010-2020	Provides a strategic framework for the prioritization and planning of investments that will drive Ethiopia's agricultural growth and development	Increasing agricultural productivity and production Improving management of natural resources Commercialization of rural activities. Food security and disaster risk management, Setting strategic objectives and outcome correspondences.	Advocates for 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 is also advocated	MoARD-PIF, 2010
Climate Resilience Green Economy (CRGE)	2011-2025	Improving crop and livestock production practices for higher food security and farmer incomes. Reducing carbon emissions; protecting and re-establishing forests for their economic and	Build the economy to middle-income status by 2025 with zero net increase in carbon emission relative to 2010 levels.	The policy has 4 pillars. However, to build resilience in Ethiopian agriculture it works with 2 on;. a). Improving crop and livestock production practices for higher food security and increased farmer incomes while reducing emissions.	CRGE, 2011

		ecosystem services (including as carbon stocks).		b). Protecting and re-establishing forests as carbon stocks.	
Ethiopia National Adaptation Plan (NAP-ETH)	2019	To reduce vulnerability to the impacts of climate change by building adaptive capacity and resilience, and strengthening holistic integration of climate change adaptation in Ethiopia's long-term development pathway	Targets sectors that has been identified as most vulnerable like agriculture, forestry, health, transport, power, industry, water and urban.	Enhancing food security by improving agricultural productivity in a climate-smart manner. Improving access to potable water. Strengthening sustainable natural resource management through safeguarding landscapes and watersheds. Improving soil and water harvesting and water retention mechanisms. Improving ecosystem resilience through conserving biodiversity.	NAP-ETH, 2019
Growth and Transformation Plan II (GTP II)	2016-2020	Transitioning agriculture to be more market oriented. Channeled focus on markets, agribusiness, and the private sector, and institutional capacity-building. It was to further aid and align agriculture sector development plan with the green economy development strategy	16.8 Million smallholder farmers 2.06 million Metric tones fertilizer 31.6 quintals/ha yields 406 millions quintals of food crop	Engaged all key stakeholders were in a deeply consultative process to identify the most important systemic bottlenecks and necessary interventions to unlock each of them. The implementation was done by ATA and overseen by Agricultural Transformation Council which included senior Federal and Regional government stakeholders across the agricultural, trade and industry sectors	GTP II

Agriculture and Forestry Climate Resilient Strategy (AFCRS)	2015	To identify the impact of both current weather variability and future climate change on Ethiopia ('challenge'), to highlight options for building climate resilience ('response') and to understand how these options can be delivered ('making it happen')	To reduce the impact of climate change on Ethiopia's agriculture and forestry ecosystems through various portfolios.	The policy work with 3 strategy blocks to build resilience in Ethiopian agriculture. a). Analyses the current CCV and projects the future CC on Ethiopia's Agric. b). Identifying options to build and reduce the CCV effects. c). mapping of steps necessary for funding and implementing efforts to build resilience	AFCRS, 2015
National Policy and Strategy on Disaster Risk Management	2013	provide a framework that focuses on mult-hazard and multi-sectoral approaches as well as on measures that need to be taken before, during, and after the disaster period.	Reduce significantly damages caused by disasters by 2023	-Development plans and programmes as well as by focusing on and implementing activities to be carried out before, during, and after the disaster period to address underlying factors of recurrent disasters -Save lives, protect livelihoods, and ensure all disaster affected population are provided with recovery and rehabilitation assistances. -reduce dependency on and expectations for relief aid by bringing attitudinal change and building resilience of vulnerable people.	NDRM, 2013
Ethiopia Programme of Adaptation to Climate Change (EPACC)	2010	Climate resilient economy through adaptation initiatives implemented at sectoral, regional and local community levels	To create the foundation for a carbon-neutral and climate resilient path towards sustainable development. Local solutions to new problems, solutions to CC at executing bodies, activities ensure successful implementation Finance and technology provision	Takes more programmatic approach to adaptation planning to mainstream CC within government policies and plans. links CC adaptation with economic and physical survival of the country and identifies key CC adaptation measures, and strategic priorities and intervention areas to address the adverse CC effects	EPACC, 2010

Wageningen Centre for Development Innovation
Wageningen University & Research
P.O. Box 88
6700 AB Wageningen
The Netherlands
T +31 (0)317 48 68 00
www.wur.eu/cdi

Report WCDI-xx-xxx
ISSN 0000-0000

Wageningen Centre for Development Innovation supports value creation by strengthening capacities for sustainable development. As the international expertise and capacity building institute of Wageningen University & Research we bring knowledge into action, with the aim to explore the potential of nature to improve the quality of life. With approximately 30 locations, 5,000 members of staff and 10,000 students, Wageningen University & Research is a world leader in its domain. An integral way of working, and cooperation between the exact sciences and the technological and social disciplines are key to its approach.