A Framework for Bundling Climate-Smart Agriculture (CSA) and Climate Information Services (CIS) in Ethiopia

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Abstract

Ethiopia is increasingly impacted by climate change and variability because of its greater reliance on climate-sensitive economic sectors such as agriculture. The impacts of climate change and variability are greater on a poor section of the rural community in particular because of their weak adaptive capacities. In recent years, there has been an increasing focus on promoting climate-smart agriculture (CSA) and climate information services (CIS) to improve climate risk management and adaptation of smallholders to climate change in Ethiopia. However, CSA and CIS are rarely provided to farmers in an integrated manner. Therefore, considering the current agricultural technology development and dissemination landscape and the growing digital climate agro-advisory services in the country, a CSA and CIS budling framework is developed for Ethiopia. Bundling of CSA and CIS is expected to empower farmers to make appropriate decisions on a seasonal and intra-seasonal basis, minimize 'technology failure' due to climate variability and enhance adoption of new or existing CSA technologies/practices, reduce yield loss due to climate variability, and farm costs, and increase household income and food security and enhances resilience. Moreover, the bundling framework creates an opportunity for a platform to integrate tools, technologies, and services provided by different institutions and actors. The framework is validated through stakeholder feedback, and it is expected to guide the scaling of bundled services to smallholders.

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Background

Agriculture forms the basis of rural livelihoods and the Ethiopian economy, supporting about 31-44% of GDP over the 2010-2020 period (O'Neill, 2022) and 85% of employment (Byerlee et al., 2007). Both agriculture and the economy are highly sensitive to climate variability and change. Rainfall across much of the country is highly seasonal and exceptionally variable and unpredictable, both in space and time (World Bank, 2006). Historically, strong links have been observed between rainfall variability and the overall performance of Ethiopia's economy, reflected by the high correlation between rainfall, agricultural growth, and gross domestic product (EPA, 2011; World Bank, 2006).

Most of the agricultural activity in Ethiopia occurs in the highlands. The Ethiopian highlands are dominated by a mixed crop-livestock production system, and they are densely populated (EPCC, 2015). Agriculture in the highlands is practiced under a strong influence of land degradation and climate variability. The lowlands are dominated by pastoral and agro-pastoral systems and are prone to climate extremes.

Climate change, particularly in the form of rainfall variability and associated droughts, has been a major cause of food insecurity and famine in Ethiopia (Conway and Schipper, 2011). The sensitivity of agriculture to the climate in the country arises from the fact that it is primarily rainfed and practiced by smallholder farmers who have limited capacity and decision support systems to respond to climate variability and extremes. Frequent drought events and in-season dry spells caused sharp reductions in agricultural output and rural employment with multiplier effects on the economy (Benson and Clay, 1998) and profound social impacts (Conway and Schipper, 2011).

However, this chronic problem is either not well considered or undermined in developing, promoting and scaling up/out of agricultural technologies. Agricultural technologies are usually promoted with the assumption of a 'normal' climate, which is not usually the case. Promotion of agricultural technology with a fixed set of management packages could lead to failure when the technology package fails to adjust itself to the prevailing seasonal climate conditions leading to less- or dis-adoption of technologies by farmers. As a result, climate variability usually forces farmers to become risk-averse decision-makers so that they use less risky but less profitable technologies, avoid potentially risky improved production technologies, reduce fertilizer use, and shift household labor away from farming to non-productive but more liquid assets as precautionary savings even under good rainfall years (Hansen et al., 2004).

Considering the above background, recent developments encourage farmers to engage in climate-smart agriculture (CSA). In this case, farmers are encouraged to go for climate-smart agriculture (CSA). CSA consists of achieving three objectives/pillars: (i) sustainably increase agricultural productivity to support equitable increases in incomes, food security, and development; (ii) adapting and building resilience to climate change from the farm to national levels; and (iii) reducing or removing GHG emissions whenever and wherever possible (FAO, 2013; Lipper et al., 2014). However, the wider adoption of CSA by smallholder farmers remains low because of several factors. Therefore, farmers are expected not only to increase productivity and incomes but also to adapt to climate change while reducing their contribution to the emission of greenhouse gases (GHG) whenever possible. One of the means to achieve CSA adoption at scale is bundling CSA with climate information services (CIS) to help farmers make appropriate seasonal and intra-seasonal decisions about their CSA activities.

Benefit of bundling Climate-Smart Agriculture (CSA) and Climate Information Services (CIS)

Farming is complex and can be more complicated when managed by smallholder farmers who must optimize among competing needs while constrained by resources. Despite resource, time, and labor limitations, farmers do not apply CSA technologies in isolation; instead, they try to integrate based on the information they have. It is thus essential to support them on which combinations of practices can both suit their conditions and provide them with the utmost positive response. Bundling is, therefore, about the integration of options that can enhance farm outcomes through optimization, enhancing complementarity, and managing tradeoffs when integrating a diverse suite of practices to the maximum benefit of smallholder farmers. In an environment where smallholders' productivity has to be improved significantly under climate change, land degradation, fragmented plots, bundling best-fit CSA and CIS is instrumental.

A pilot study in Ethiopia on the provision of seasonal and intra-seasonal (10 days interval) agro-advisory service on improved crop varieties (crop maturity class, level of stress tolerance, yield potential, marketability), agronomic practices (date of planting, plant population, fertilizer management-time, rate and method of application), water management (water deficit and/or water logging management practices), disease management (expected disease incidence and prevention and control measures) and market information (inputs process such as seed, fertilizer, pesticide and feed and accessibility, and output processes such as grain and milk) using an integrated decision support system (IDSS) indicate that farmers who participated in the research have increased their productivity and income considerably (Tesfaye et al., 2016). The IDSS has been designed to provide information on seasonal outlook and intra-seasonal climate variability to help farmers make strategic and tactical (operational) decisions, respectively, and thereby increase productivity and incomes under variable climate conditions. The IDSS can be a good starting point for bundling climate-smart agriculture (CSA) and climate information services (CIS). Bundling of CSA and CIS is expected to empower farmers to make appropriate decisions on a seasonal and intra-seasonal basis, minimize 'technology failure' due to climate variability and enhance adoption of new or existing CSA technologies/practices, reduce yield loss due to climate variability, and farm costs, and increase household income and food security and enhances resilience. Moreover, the bundling framework creates an opportunity for a platform to integrate tools, technologies, and services provided by different institutions and research groups.

A framework for bundling CSA and CIS in Ethiopia

Farmers have been provided with different technologies, practices, and services to enhance their adaptive capacity in the face of climate change. However, using these technologies, practices, and services in isolation has limited the advent of holistic solutions and adoption of the technologies and practices. In recent days, bundling CSA and CIS has emerged as an effective strategy for the effectiveness and adoption of CSA technologies and increasing CIS's value among smallholder farmers.

Given the challenge of climate variability and change, the current landscape of agricultural technology development and dissemination, and the growing digital climate agro-advisory services in the country, a CSA and CIS budling framework is proposed. The proposed framework was presented to a national stakeholders' workshop on 8-9 October 2021 at Adama, and feedbacks were gathered. The feedback received from the workshop was used to improve the framework (Fig. 1).

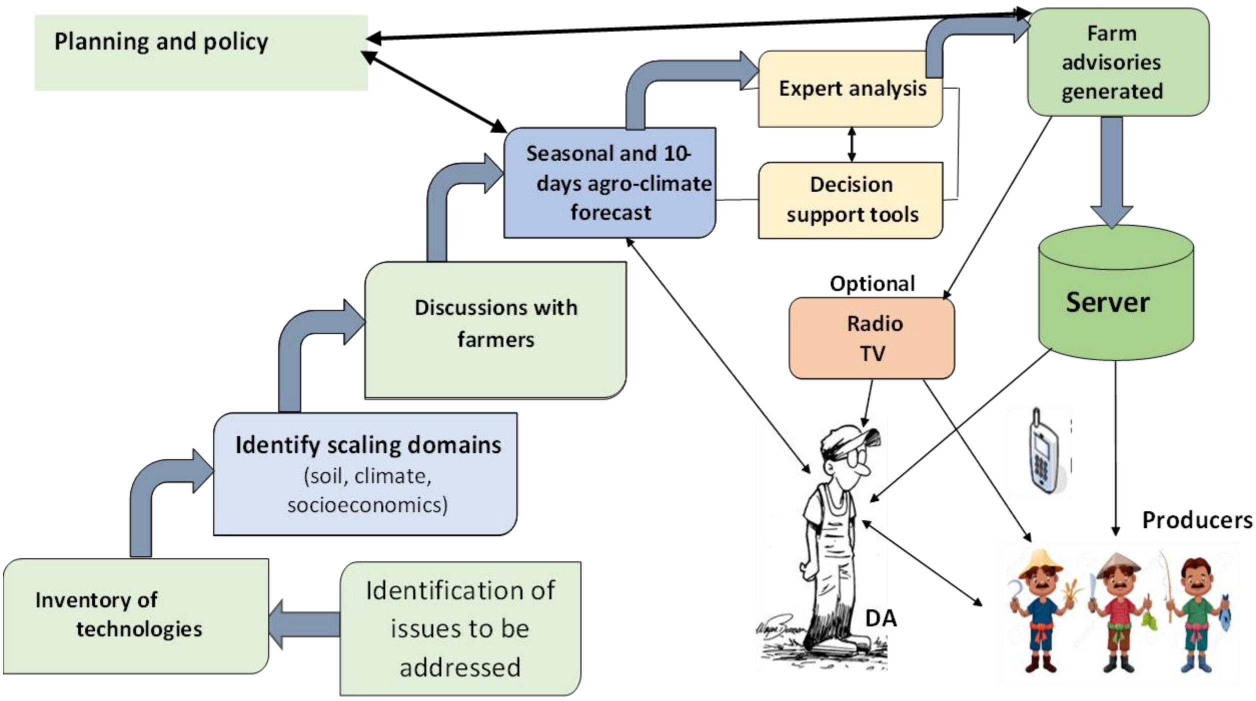

Figure 1. A framework for bundling Climate Smart Agriculture and Climate information Services in Ethiopia.

Objectives of the framework

The overall objective of the framework is to improve the income and food security of smallholders in Ethiopia through the scaling of bundled services that enhance climate-resilient farming systems and livelihoods. Specifically, the framework aims to: (i) empower smallholders to make informed decisions on their farm activities by providing seasonal and intra-seasonal farm advisories on specific CSA technologies and practices; (ii) provide an integrated CSA scaling approach at a national level, and (iii) improve the knowledge and capacity of implementers on bundled/integrated services to smallholders.

Components of the framework

The framework is an integrated system designed to provide a scaling mechanism for CSA bundled with climate agro-advisories, and it has the following components.

1. **Identifying the issues to be addressed**: the first activity of the bundling processes starts with identifying climate-related issues that need to be addressed with the CSA approach in a given administrative unit, landscape, watershed, or community.

2. **Inventory of scalable technology package:** After the issues to be addressed are identified, the second step is to go for an inventory of climate-smart technologies that can address the issues identified and can be scaled up/out (e.g., new stress-tolerant crop varieties with agronomic management packages, new forage seeds with full management package, etc.). This can be done in consultation with researchers who developed the technology, the extension system and/or a service provider involved in technology scaling.

3. **Identification of scaling domain:** The technologies identified in step (b) cannot be taken everywhere as they have their own recommendation domains. Before making scaling decisions,

the technologies will be assessed and assigned to a scaling domain using biophysical and socioeconomic criteria.

4. **Discussions with communities and selection of beneficiaries:** Once the scaling domain is identified, a discussion will be held with the target community, including local level administrators, and briefings will be given on the CSA technology(ies) to be scaled out. After the discussion, beneficiary households will be selected voluntarily.

5. **Seasonal and intra-seasonal climate forecasts:** Seasonal and intra-seasonal climate forecasts are downscale to the desired spatial and temporal scale by forecast developers (e.g., National Meteorology Agency, ICPAC, etc.).

6. **Farm-level agro-advisories:** Using the climate forecast provided in step 'e' above, a team of experts or automated systems (e.g., EDACaP) develops a climate agro-advisory for each CSA identified for scale-up in step '3'.

7. **Delivery of advisory service to beneficiaries and feedback**: The farm advisories developed in step (f) above for each CSA are uploaded to a server so that beneficiaries can access them mainly through Interactive Voice Response System (IVRS) and SMS in the local language. For those beneficiaries who have no cell phone or cannot read text messages, the information can be delivered to them by Development Agents (DAs) stationed around the target beneficiaries. The information can also be available on a website for anyone who can use the information. If there are interested mass media outlets (T.V. and Radio), the advisory can also be available to them. Feedbacks on the weather conditions and useful of the advisory is collected from the D.A.s a feedback mechanism and from the beneficiaries by regular but targeted visits.

Note that steps '1-3' can be taken as one step if the issues and associated CSA are known and their scaling domain is well defined.

Benefits of the Framework

The bundling framework is expected to provide the following benefits:

i) ***Enhancing CSA adoption:*** *Bundling of CSA and CIS empowers farmers to make appropriate decisions on a seasonal and intra-seasonal basis and minimizes 'technology failure', thereby enhancing the adoption of CSA.*

ii) ***Reaching diverse and many farmers:*** *The framework provides a platform for scaling up/out of CSA technologies and practices by reaching a wider and diverse group of farmers quickly.*

iii) ***Economic benefit:*** *Informed and dynamic decision making on CSAs not only increase farm productivity but also allows farmers to optimize farm resources and reduce farm costs (e.g., farmers apply lower rates of fertilizer during dry seasons whereas they can apply higher rates during the wet season and hence maximize fertilizer use efficiency). This increases the income of households.*

iv) ***Managing climate variability****: Bundling of CSA and CIS reduces yield loss due to climate variability in areas where climate variability is the major cause of low productivity and food insecurity.*

v) ***Targeting women farmers:*** *Women farmers are not benefiting from extension services as much as expected (Saito and Weidemann, 1990). Women, more than men, are exposed to a range of challenges that prevent them from accessing extension and advisory services, and some of the positive efforts made so far have not been scaled for significant impact (Mbo'o-Tchouawou and Colverson, 2014). Therefore, the framework allows an innovative approach to specifically target women farmers (e.g., on selection of CSAs and customized delivery of CIS) and provide them tailored advisory services that will improve their income and livelihoods. Thus, reducing gender inequalities in access to productive resources and services could increase yields for women's farms of between 20 percent and 30 percent, which could raise agricultural output in developing countries by 2.5 percent to 4 percent (FAO, 2011).*

vi) ***Climate change adaptation and food security:*** *the framework allows for better awareness of CSAs and capacity to make informed decisions and help increase farmers' resilience against climate variability and change and improve their food security.*

vii) ***Provide a platform for decision support tools:*** *The framework can facilitate efforts on bringing together and consolidating decision support tools on bundling of CSA and CIS that different actors are trying.*

Partnership for Implementing the Framework

The National Framework for Climate Services (NFCS) could also be used to partner and co-produce bundled agricultural services to smallholder farmers. Implementation of the framework will require strong partnership among the different actors working in the areas of CSA and CIS. The major partners include the different directorates in the Ministry of Agriculture and Regional Bureaus of Agriculture, Ethiopian Institute of Agricultural Research (EIAR) and Regional Agricultural Research Institutes, National Meteorology Agency (NMA), CGIAR centers, the private sector, and NGOs involved in CSA scaling and digital agriculture.

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