8

Helping Farmers Make Better Decisions Using Climate Services

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Highlights

- Climate services (CS) and agricultural advisory services (AAS) have the potential to play synergistic roles in helping farmers manage climate-related risk, providing they are integrated.
- For information and communication technology (ICT)-enabled, climate-informed AAS to contribute towards transformation, the focus must shift from scaling access to scaling impact.
- With expanding rural ICT capacity and mobile phone penetration, digital innovation brings significant opportunities to improve access to services.
- Achieving impact requires the following actions: building farmers' capacity and voice; employing a diverse delivery strategy for CS that exploits digital innovation; bundling of CS, agri-advisories, and other services; investing in institutional capacity; embedding services in a sustainable and enabling environment in terms of policy, governance, and resourcing.
- Recent experiences in several countries demonstrate how well-targeted investments can alleviate constraints and enhance the impact of climate-informed AAS.

8.1 Introduction

Accelerating climate change is increasing the urgency of transforming food systems into sustainable, inclusive, healthy, and climate-resilient models. Yet at the farm level, the risk associated with climate variability is a serious impediment to beginning that transformation. Farmers routinely make critical production and livelihood decisions in high-risk environments with inadequate information (Meijer et al., 2015). When faced with extreme events, such as droughts and flooding, farm households are often forced to employ strategies that enable them to

https://doi.org/10.1017/9781009227216.008 Published online by Cambridge University Press

survive the immediate crisis but erode their capacity to build a better life by depleting their productive assets and human capital (Hansen et al., 2019a).

The uncertainty from climate variability is a disincentive for risk-averse farmers to adopt innovation and for investment by value chain actors whose actions enable or constrain farmers. Smallholder farmers, in particular, tend to use precautionary strategies to protect against the possibility of catastrophic loss in the event of a climatic shock; therefore, they do not optimise management for average conditions, but for adverse conditions (Meza et al., 2008). Within farming communities, the negative impacts of climate risk are borne disproportionately by the poorest members, and often by women (Davidson, 2016). The effects of climate risk on both precautionary strategies for future events and post-event coping responses contribute to the persistence of poverty and impede the transformation towards sustainable, inclusive, and healthy food systems (Hansen et al., 2019a).

Climate services (CS) – for example, seasonal and weather forecasts – and agricultural advisory services (AAS) aim to support farmers through information. Both play synergistic roles in helping farmers manage climate-related risk and are, therefore, incomplete in isolation. In most developing countries, CS and AAS exist in some form but typically fall under different government agencies, ministries, and policy frameworks (Ferdinand et al., 2021).

Information and communication technology (ICT) tools are increasingly being used to overcome the challenges of reaching diverse rural populations, although these technologies introduce new issues that must be addressed, for example, partnerships with additional stakeholders, institutional arrangements, and data governance (Ferdinand et al., 2021). At the same time, there is growing evidence that face-to-face participatory communication processes – those that empower farmers to understand and act on climate information, alongside institutional arrangements that convene national meteorological services (NMS) and relevant agricultural stakeholders to co-produce climate-related information and advisories – can substantially increase the benefits that farmers experience.

The report *Actions to transform food systems under climate change* (Steiner et al., 2020) highlights climate risk as one of four targets for urgent action. This chapter deals with the report's call to 'take climate services to scale by connecting 200 million farmers and agribusinesses to ICT-enabled bundled advisory services by 2030' (Steiner et al., 2020, p. 35) as a pathway towards de-risking livelihoods, farms, and value chains. While the outcome of this action is framed in terms of scaling up access to high-quality, actionable, and real-time information, it implies that these services must be implemented in a way that empowers farmers to make better production and livelihood decisions. Scaling up information access does not guarantee that farmers will realise benefits at scale; *how* they are implemented matters. We discuss key areas of practice to address if investment in climate-informed, ICT-enabled AAS is to substantially improve the livelihoods of 200 million farmers by 2030.

8.2 Priorities for Scaling Impact

Climate-informed, ICT-enabled AAS involve coordination among a range of public- and private-sector actors, from international funders and policy platforms to national policy and technical institutions, farming communities, and the local intermediaries and service providers that support them. It is vital to understand the major actors involved and the factors that must be in place if these services are to empower farmers to make livelihood-improving risk-management decisions.

Five key areas of action can correct existing weaknesses that might otherwise limit the services' impact, even if farmers have access to them. All these actions relate to major actors and potential bottlenecks in the provision and use of ICT-enabled, climate-informed AAS (Figure 8.1). First, farmers must have the capacity to understand and act appropriately on complex information and to drive the co-production of improved services. Second, the communication channels used to deliver services must be accessible to a wide range of farmers and appropriate for the type and timescale of information. Third, information products and services must be bundled in a manner that exploits their potential synergies. Fourth, provider institutions must have the capacity to provide usable, credible, localised, timely information that aligns with the needs of farmers. Finally, the policy and resource environment must enable public and private information and service provider institutions to work together effectively.

The five key actions are informed by three case studies in Rwanda, Senegal, and India (Figure 8.1; Boxes 8.1, 8.2, and 8.3 respectively). Drawing from these case studies, we elaborate on how the five key actions can contribute to development activities.

8.3 Key Action 1: Building Farmers' Capacity and Voice

Farmers must have the capacity to use climate-related information in their decision-making for an impact to be realised (Vaughan et al., 2019). Similarly, farmers must have a voice in the information that meteorological and agricultural extension services provide, if they are to trust and act on that information (Carr et al., 2019; Hansen et al., 2019b). Despite growing recognition of the importance of co-production in aligning services with user demand, farmers and their representative organisations may not be able to express demand for information products or services with which they have no experience, and might not know

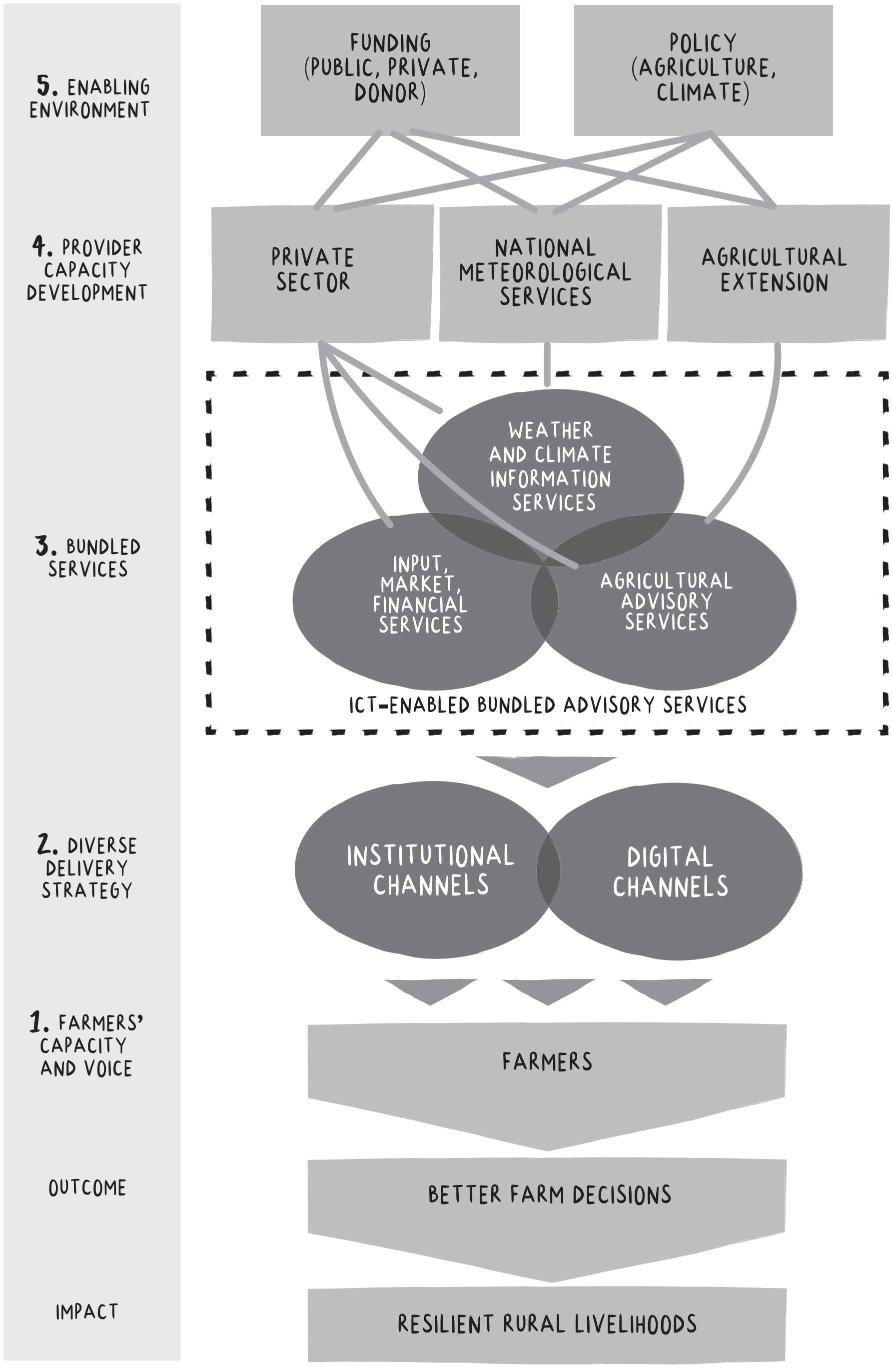

Figure 8.1 Impact pathway, key actors, and processes involved in information and communication technology-enabled, climate-informed agricultural advisory services; interventions to correct potential constraints (numbered in the left column).

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Box 8.1
Rwanda Climate Services for Agriculture Project

Farmers in Rwanda face similar climate-related challenges to those encountered in many developing countries, including widespread droughts and heavy rainfall, which triggers flooding and landslides in upland regions. In the years 2016–20, the Rwanda Climate Services for Agriculture Project (RCSA) developed climate services for agriculture by strengthening both the capacity of the NMS to provide actionable information, and the agricultural sector's capacity to communicate and use climate information to manage risk. A participatory climate communication, training, and planning process, PICSA supports farmer decision-making with local climate information. The RCSA trained over 2000 extension staff and volunteer Farmer Promoters in PICSA, who then trained and facilitated 112 767 farmers to use climate services. A community radio network brought climate service programming to its estimated 3.1 million farmer listeners. Building on PICSA groups, Radio Listener Clubs (RLCs) were piloted and combined the benefits of radio programming with group participatory processes. Using the Enhancing National Services approach, Meteo Rwanda reconstructed its lost climate history – which was lost because of the destruction of assets during the 1994 genocide – by merging available station observations with satellite and reanalysis data. The resulting gridded temperature and rainfall data now serve as a foundation for a suite of historical, monitored, and forecast products, including the formatted graphs used in PICSA workshops, available for any location through online 'Maprooms'.

what could feasibly be provided, even if they would benefit from these services. This situation calls for increased investment in farmers' capacity both to use climate information and to engage in the co-production of improved services. Co-production approaches must be iterative, encourage joint learning, and allow for boundary organisations engaged in both climate science and agriculture to help negotiate improvements in NMS products.

Participatory processes are effective for building farmers' capacity to understand and use climate information. The Participatory Integrated Climate Services for Agriculture (PICSA) approach accomplishes this through a combination of training, participatory resource mapping, and calendar and budgeting activities that relate climate information to farm and livelihood decisions (Box 8.1).

To build farmers' capacity to understand and use CS in Rwanda, PICSA was scaled up. In 2020, a quantitative and qualitative evaluation showed that the participatory PICSA and Radio Listener Club (RLC) processes were effective in strengthening farmers' capacity to act on climate information. These methods led to a substantial increase in the proportion of farmers that reported changing crop,

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Box 8.2

Climate Information Services for Increased Resilience and Productivity in Senegal

Running from 2016 to 2019, Climate Information Services for Increased Resilience and Productivity in Senegal (CINSERE) was developed with the Agence Nationale de l'Aviation Civile et de la Météorologie (ANACIM), the country's NMS, and aimed to increase the resilience of farmers, pastoralists, and fishers through climate services. It did this by focusing on building national capacity for the production, delivery, and use of climate services, and developing a sustainable framework for scaling up climate service use. Under CINSERE, 25 local MWGs were set up to analyse climate information and produce advisories based on local contexts (Ouédraogo et al., 2020). The MWGs have been operating in Senegal since 2008 and are a model of co-producing climate services at both the national and local levels. The national MWG is represented by government ministries, research institutes, insurance companies, extension agencies, and ANACIM, generating climate information and advice to be communicated to local users. Local MWGs – represented by farmer organisations, local administrative authorities, the media, non-governmental organisations, and farmers themselves – collect information from ANACIM and disseminate it to farmers. Advice from MWGs is intended to assist farmers in decisions about cropping operations and farming calendars. Pastoral committees were created in 2020 to provide information related to climate and the environment to livestock breeders.

livestock, and livelihood management practices. Women experienced increased participation and influence in household decision-making and better social standing in their communities (Hansen et al., 2021). One farmer was quoted as saying, 'I can take care of my kid because of higher production from the knowledge I obtain from the weather forecast' (women's focus group, Rwanda, RCSA project, Hansen et al., 2021). Another stated, 'I used to harvest two sacks of Irish potatoes, but now I harvest four sacks on the same plot' (men's focus group, Rwanda, RCSA project).

The Climate Information Services for Increased Resilience and Productivity in Senegal (CINSERE) project enlarged the number of local Multi-disciplinary Working Groups (MWGs) and used them as a mechanism to bring farmer and pastoralist organisations, local governments, and other local institutions into the co-production of CS (Box 8.2). The MWGs meet regularly throughout the growing season to interpret climate information, translate it into actionable advisories, and deliver it to users (Lo & Dieng, 2015). Through knowledge exchange, the success of the MWG model inspired the creation of Local Technical Agro-climatic Committees (LTACs) in Latin America and the Caribbean (Howland et al., 2016). LTACs are now used by over 190 institutions in the region, where they play a

Box 8.3
Meghdoot Mobile Application and the District-Level Agrometeorological Advisory Service in India

The crop-specific District-level Agrometeorological Advisory Service (DAAS) that serves farmers' needs is produced by Agro-Met Field Units (AMFUs) and disseminated through District Agro-Met Units (DAMUs), all operated by the India Meteorological Department (IMD). The DAMUs use local information, historical climate data, and weather forecasts from IMD and regional centres. They communicate the DAAS through radio, television, newspapers, the Internet, SMS, and interactive voice response, reaching around 42 million farmers across India. The efficacy of dissemination from AMFUs to farmers is variable, however, and depends on farmer networks and local extension institutions. While ICT and mass media provide improved dissemination pathways, they show suboptimal convenience, timeliness, and equity, resulting in limited success in communicating the gains made in meteorology to the agricultural sector. Additionally, none of the existing dissemination channels collects data about advisory uptake, the quality of information, or other farmer feedback (Dhulipala et al., 2021).

To overcome the challenges faced in the DAAS programme, a mobile application named Meghdoot was developed along with back-end technology support. Meghdoot takes advantage of the increasing smartphone penetration and mobile internet usage occurring in rural communities. The application offers forecasts, weather observations, and warnings generated by the IMD and the Indian Institute of Tropical Meteorology. It has been downloaded over 211 000 times and improves farmers' access to agri-advisories from AMFUs (Dhulipala et al., 2021). Meghdoot overcomes barriers to communicating AAS to farmers and applies user feedback to update the application and ensure its legitimacy.

similar role, translating climate information into relevant actions and facilitating co-production of improved services (Loboguerrero et al., 2018). In addition, CINSERE recognised the role of indigenous climate knowledge in farmers' risk management strategies and the need to understand how this shapes farmers' demand for climate information. Indigenous knowledge is commonly used by farmers in Senegal to adapt to climate variability. As such, biotic indicators present an opportunity to explain how scientific forecasts work, to build their trust in CS, and to engage them as partners in co-production.

8.4 Key Action 2: Employing a Diverse Delivery Strategy for Climate Services that Exploits Digital Innovation

A diverse delivery strategy can strengthen existing meteorological and agricultural advisory institutions, address the differences between weather and climate

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timescales, build the capacity of farmers to understand and use probabilistic climate information, and foster access and use for disadvantaged populations (Hansen et al., 2019b). In some contexts, ICT tools are a key part of diverse delivery strategies; ICT infrastructure, including mobile phone connectivity, is expanding in most countries and offers an opportunity to reach more end users. Ideally, ICT tools will be part of a suite of digital and institutional communication channels appropriate to farmers and institutions. Digital tools can fortify institutions and complement other communication processes, instead of bypassing institutional communication processes or social learning.

In Rwanda, the broadcast and print media channels used to disseminate general forecasts did not equip farmers to understand complex information and concepts or voice their questions or concerns, and they provided little information about farmers' local conditions. The Rwanda project (Box 8.1) sought to establish which channels were suited to the local context and considered the potential role that gender might play in accessing channels and decision-making. The result was that broadcast media, mobile phones, and participatory communication processes embedded in agricultural extension improved farmers' access to climate information. For example, RLCs played a role in empowering farmers, and farmer promoters were trained to lead their village groups in weekly meetings. Farmers would listen to and discuss the radio programmes, participate in call-in programmes on a rotating basis, discuss and record plans to act on what they heard, and share the information with their village groups. The RLCs benefited women, eliminating the significant disparities in awareness of, access to, and use of climate information between male and female smallholder farmers in the general population.

Mobile phone-based advisories that disseminate weather and farming-related information can lead to enhanced yields, lower costs, and heightened knowledge among farmers (Baumüller, 2018). While ICTs can expand the reach of CS, however, their use requires consideration of who can access and use them, and of their potential to complement other communication channels. In India, mobile phone ownership is high and offers an effective communication channel for agri-advisories. The District-level Agrometeorological Advisory Service (DAAS) disseminates advisories to farmers through mass media and ICT, including Short Message Service (SMS) and voice messaging (Box 8.3). The Meghdoot app aimed to expand the reach of the DAAS by using smartphones, which have shown greater penetration in rural communities (Dhulipala et al., 2021). A caveat of communicating CS and agri-advisories is that often different channels have no mechanisms for soliciting feedback on the usefulness, uptake, or quality of information. Meghdoot allows users to provide feedback on forecasts and advisories, increasing their legitimacy and relevance.

8.5 Key Action 3: Bundling of Climate Services, Agri-Advisories, and Other Services

At the state level, CS and extension services typically fall under different ministries and policies. A country's NMS will usually be under its own meteorological ministry or a transport ministry, given the value of climate information in the aviation sector. Extension services typically fall under each country's ministry of agriculture, which results in siloed CS and AAS and an underexploited potential for integrating the two services. Addressing the siloed nature of extension and CS would improve the impact of both but requires a coherent national policy framework that enables co-ownership by the NMS and ministries of agriculture. Also key are the formal integration of weather and CS into agricultural extension – in the public, private, and non-governmental organisation sectors – and appropriate investment in extension capacity to address climate information, subject to the existing capacity of the national agricultural extension system. There are further opportunities for bundling CS with other services, for example, credit or insurance; with inputs such as improved seeds and fertiliser; or with data like market information (Bird et al., 2016). Bundling similar services aimed at agricultural risk management takes advantage of potential synergies and economies of scale, which in turn reduce scaling costs (Steiner et al., 2020).

Progress towards creating dialogue and breaking down silos between CS and extension services can be seen in Ethiopia, where the National Digital Agricultural Extension and Advisory Services Stakeholder's Forum was recently established. The Ministry of Agriculture and the Agricultural Transformation Agency collaborated with government partners, national and international research institutions, development partners, and private-sectors actors, with the primary objective of coordinating the resources, experiences, and capacities of different digital agricultural extension services and AAS in Ethiopia. Another Ethiopian example of breaking down silos is the bundling efforts of Lersha. This privately led digital platform supports Farm Service Centres and provides agroclimatic advice to smallholder farmers, as well as a call centre in Addis. The platform has incorporated a mobile banking service, named 'CBE Birr', to promote financial inclusion in rural areas. These public–private partnerships contribute to both sustaining CS and improving farmers' climate-risk management while generating an income for the NMS. Their feasibility and sustainability, however, require some years of operation before becoming apparent. The Senegal case also includes bundling based on public–private partnerships, such as that with an ICT-based company, myAgro, which aims to bundle CS with agricultural inputs, agri-advisories, and crop insurance (Box 8.2).

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8.6 Key Action 4: Investing in Institutional Capacity

There is a need to engage and strengthen public institutions, particularly those that work on the upstream generation of information. When it comes to climate information, various institutions are responsible for its generation, namely NMS and the National Agricultural Research System; its translation, typically the National Agricultural Research and Extension Systems; its communication; and its use. These institutions can closely collaborate towards effective climate-informed AAS. The capacity of NMS to produce actionable information has some gaps, as does the agricultural sector's capacity to translate that information into AAS, communicate it, and use it to manage risk. These gaps are mutually reinforcing and best addressed in parallel. Both the Rwanda and Senegal cases included significant capacity development, both at national levels and more local levels, as with the MWGs in Senegal (Boxes 8.1 and 8.2).

Improving the technical capacity of NMS is an important step towards ensuring that climate information is relevant, salient, and legitimate. For example, NMS must improve their capacity to understand agricultural users' needs. Similarly, public extension agencies require capacity building that targets their ability to translate climate information into useful agri-advisories. The capacity of Meteo Rwanda was strengthened in the Rwanda Climate Services for Agriculture Project (RCSA) partly by using the Maproom portal, which is a product of the Enhancing National Services initiative (Dinku et al., 2018). Maprooms provide access to high-resolution climate information and products such as the season start, the risk of dry spells, and extreme rainfall events in the growing season. In the Rwanda project (Box 8.1), the Maproom is made available through Meteo Rwanda and benefits farmers indirectly through extension personnel accessing the portal, which includes the formatted graphs used in the PICSA process. Two of Meteo Rwanda's Maproom tools are aimed at government decision-makers who were trained in their use during workshops. The positive benefits for farmers include the provision of a maize-hybrid seed that was better suited to the local climate, and the pumping of water into a reservoir to offer supplemental irrigation to farmers, protecting them from prolonged dry spells.

A similar effort to improve technical capacity involves the Colombian meteorological service, the Instituto de Hidrología, Meteorología y Estudios Ambientales, (IDEAM) and its goal to improve co-production of climate information for the agricultural sector. It involved the implementation of the CS platform AClimate Colombia, which is available to farmer organisations like the National Federation of Rice Growers (Fedearroz) and the National Federation of Cereal, Legume and Soy Growers, (Fenalce) and to the Ministry of Agriculture and Rural Development. Based on the AClimate Colombia platform, Fedearroz co-designed a climate information portal to support farmers in climate-smart decision-making. The collaboration between farmer organisations, meteorological services, and ministries in co-designing and co-creating services has increased the capacity of each and extended the reach of these services to more farmers (see Chapter 6 for further details on AClimate Colombia).

8.7 Key Action 5: Embedding Services in a Sustainable and Enabling Policy, Governance, and Resourcing Environment

Effective institutional arrangements and accountable governance processes are vital to sustaining demand-led, effective, equitable services (Vaughan & Dessai, 2014). They should be developed to include private-sector actors, continued co-production, monitoring, evaluation, and learning. Relevant public-sector institutions can be sustainably supported through a combination of public investment and private-sector business models that are appropriate for each country's context. Influencing policy is a lengthy process that often extends beyond the lifetime of projects; it is, however, an important aspect of ensuring that CS and their impacts are sustained and that there is ownership over the policies and governance arrangements. The National Framework for Climate Services (NFCS) is the national-level implementation of the Global Framework for Climate Services and goes through several stages of planning and consultation before being launched, all to provide advanced CS to all sectors in each country. Senegal has launched its NFCS, which is expected to provide the policy framework and political buy-in necessary to support and sustain CS across all sectors. This high-level approach to influencing the availability and sustainability of CS is likely to manifest throughout the next few years, contributing to the enabling environment of other CS-based endeavours.

Sustaining CS beyond a project-by-project basis is a common problem that can be addressed from project design (Steynor et al., 2016; Vogel et al., 2019). There are several approaches to increasing services' sustainability, including investing in public–private partnerships that feature some element of sales in their supply of CS. Several such partnerships in Senegal are evident between the Agence Nationale de l'Aviation Civile et de la Météorologie (ANACIM), the country's NMS, and four private companies: myAgro, Jokalante, the Senegalese Agricultural Insurance Company, and MLouma. The partnerships aim to design and disseminate tailored CS through multiple approaches including the bundling of NMS climate information with fertiliser, improved seeds, and crop insurance; a subscription service for NMS-based CS; and in the case of the partnership with Jokalante, both bundling and a subscription service (Ouédraogo et al., 2020). Other public–private partnerships in the CINSERE project include collaboration between

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ANACIM and the mobile phone companies Tigo and Orange to create a climate-information platform that provides specific information for fishing, agriculture, and livestock.

A strong enabling environment is essential for CS to scale and impact farmers' decisions and livelihoods and involves investment in requirements, including the capacity of institutions and farmers, institutional networking and governance arrangements, and digital infrastructure (Figure 8.1). In each country, these required investments will differ in starting points and thus the gap to be filled. The initial costs of filling major capacity gaps can be high but decrease with time. Costs per farmer also decline as services are scaled up. The nuanced estimation of investments required is difficult to generalise across contexts. A recent estimation by Ferdinand et al. (2021) in their blueprint for investment in scaling digital agroclimatic advisories suggested that a global upfront investment of US$2.2–7.5 billion is needed to reach 300 million producers. The blueprint notes that costs will be vastly different in each context.

The costs associated with the RCSA project provide a context-specific example; although this cannot be generalised across regions, this example generates a ballpark figure indicating where investments might fall. The project invested US$5 million over four years, with roughly 30 percent for strengthening farmers' capacity through agricultural extension; 20 percent for strengthening NMS capacity to provide actionable information; 10 percent for broadcast media and mobile phone delivery channels; 5 percent for strengthening climate-risk management capacity of national and local government; and the remainder for project management, monitoring and evaluation, and indirect costs. Based on the estimated US$3.9 million increase in net annual farm income from crops, attributed to the use of CS and aggregated across the 113 000 farmers who participated in participatory delivery channels, the benefit–cost ratio was 3:1 when considering the annual total project investment. In addition to costs decreasing after initial investments, costs will also vary according to the capacity and gaps evident in different contexts. For example, in Rwanda, donor investment required embedding capacity in the public sector, while in Senegal, CINSERE focused on the private sector and mobilising investment, given there were limited opportunities or capacity to engage the public sector.

8.8 Way Forward

Paired with agri-advisories, CS contribute to managing agricultural climate risk for smallholder farmers. Scaling out CS is an essential element of helping farmers to make climate-smart decisions that both capitalise on opportunity and avoid loss. Based on several projects across Latin America, Africa, and Asia, we recommend that investment in ICT-enabled CS in the future should consider some key facets that may contribute to scaling impactful, sustained services. These facets include investing in farmers' capacity, bundling CS with agri-advisories and other services, investing in institutional capacity, exploiting digital innovation as part of a diverse delivery strategy, and embedding services in a sustainable and enabling environment in terms of policy and resources. Strong partnerships (Chapter 16) are key to achieving and sustaining impact in CS.

The challenges and opportunities around climate-risk management for smallholders are context-specific and often require a concerted effort to establish how farmers operate in their circumstances before suitable strategies can be pursued. Institutional and political differences across countries and regions must also be considered in designing CS interventions. There is growing evidence that CS can improve farmers' yields, income, and well-being. We must continue to build the evidence base of CS and document quantifiable impacts, in whichever form they manifest, to show which types of information are valuable to farmers in which contexts. This goal is in line with heightened efforts in service monitoring and evaluation to assess impacts and benefits for target end users.

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