Scaling climate services for agriculture in the Global South

An assessment of practitioners' needs

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Project: A Climate Services Menu for Southeast Asia (CliSM): tackling scaling with a diversity of end users in the climate services value chain

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About the CliSM Project

The Alliance of Bioversity International and CIAT, CARE International, and World Agroforestry (ICRAF) have joined efforts in a new project called CliSM, 'A Climate Services Menu for South East Asia'. Building on different field-tested climate services (CS) approaches across heterogeneous rural livelihoods, the project aims at improving the understanding for designing and implementing scalable CS. The project will result in a methodology to assess and implement scaling pathways for CS for decision-making institutions and practitioners of CS development, and guidelines for policy makers and practitioners.

Abstract

Several CS projects have been implemented recently to meet the increasing demand from farmers and other decision makers in the Global South for climate information and agro-advisories. This has led to two main concerns: (1) how CS products and services can be improved for the benefit of small-scale farmers at different scales; and (2) how to sustain (successful) CS projects beyond the end their lifetime. Addressing these two questions will require pathways for scaling CS projects. Hence, 20 CS projects across Asia, Africa and Latin America were reviewed through a mix of desk research and interviews (both virtual and face-to-face) with project practitioners to solicit their views of and experiences with CS projects, the provided services and products, and scaling. Results showed that the CS sector has clearly matured in recent decades. CS providers focus mainly on translation and transfer of climate date, and rely on observational data and climate and hydrological models, from national, international and private sources. There is great diversity of products in terms of format, content, way of communication, frequency, and target groups, which shows the potential to tailor CS products and their messages to the specific needs of end-users and diverse contexts. The design and implementation of CS depends on a myriad of actors working together along the CS value chain. For historical reasons many of the selected projects in the South were coordinated and/or funded by NGOs, but increasingly government agencies and/or private sector have become active partners as well. Despite these positive developments, one of the main challenges of scaling CS comes from the collaboration between different institutions. Whereas different organizations may agree on the common goals, they often do not on the way of working. Overall through the future for CS looks positive, but there are some additional concerns related to access to information, the reliability of data and the confidence people have in the services, the human resources and additional funding required for scaling CS, and the risk that small-scale farmers, and in particular the poor, women and ethnic minorities, are left out. Several recommendations are made to ensure the benefit of CS for small-scale farmers through scaling.

1. Introduction

A climate service is the provision of climate information to assist decision-making; the service must respond to user needs, must be based on scientifically credible information and expertise, and requires appropriate engagement between the users and providers (ref*). Climate Services, or CS in short, have gained global popularity. In recent years a great number of CS projects and programs has been implemented in the Global South to provide advice to end-users on the impact of climate on agricultural production and management (see Dobardzi *et al.*2019). There is also a large body of documentation on the implementation of CS, focusing on a broad variety of applications (Sivakumar *et al.*, 2014; Lechthaler and Vinogradova, 2017; Vaughan *et al.*, 2017; Dayamba *et al.*, 2018; Vincent *et al.*, 2018; Bouroncle *et al.*, 2019; Dobardzi *et al.*, 2019; Eitzinger *et al.*, 2019; Naab *et al.*, 2019; Tesfaye *et al.*, 2019; Vedeld *et al.*, 2020; Sultan *et al.*, 2020). Several researchers (Vaughan *et al.*, 2019; Tall *et al.*, 2018;) have reviewed the results of CS projects and proposed methods for evaluating agricultural CS that can be used to strengthen the evidence of transfer, use, and impacts of CS and further improve them .

Besides the question of how CS projects can be improved for the benefit of a larger group of small-scale farmers, a major concern has been how to maintain and sustain these projects beyond their lifetime. Addressing these issues will require pathways for scaling CS projects. Tall *et al.*(2014) concluded that scaling of CS for smallholder farmers is possible and proposed five guidelines to develop CS at the national scale. They include: i) involving farmers directly into the co-design, co-production, and co-evaluation of CS; ii) establishing linkages between the service providers and the farmers; iii) utilizing mass-communication channels to reach the user population; iv) improving CS products through regular updating based on need assessments; and v) engaging and targeting the needs of the most vulnerable users such as women. More recently, however, Hansen *et al.* (2019) have indicated several challenges for scaling CS from the supply side, namely the capacity and influence of decision markers, the misuse of CS projections, the usability of national climate information, fragmented knowledge and expertise, and inadequate investments. Although programs and projects have start paying attention to these aspects, they require concrete suggestions, tools and support on how to ensure successful scaling CS.

This study aims to provide project implementers a set of ideas on how to design the most suitable pathway for scaling CS. It assesses practitioners' needs through a detailed review of projects in the Global South. Besides an analysis of the design and technical aspects of CS, personal views and opinions of practitioners were taken into account to deliver an overall image of the key challenges, opportunities, and potential scaling strategies. The result of this study are not only expected to provide insights on how more beneficiaries can be reached within the predetermined livelihoods in the project design but also how they can be extended to other livelihoods and contribute to the institutional policies and framework for CS. By doing so, one can increase the efficiency of projects and programs and ensure the sustainability of the CS beyond their lifetime.

2. Methodology

Scaling pathways

The study aims at discerning the potential challenges and opportunities faced by practitioners at increasing the number of beneficiaries of actionable CS. In the scope of this study, we defined three different types of scaling pathways for CS: scaling down, scaling out, and scaling up (see Figure 1).

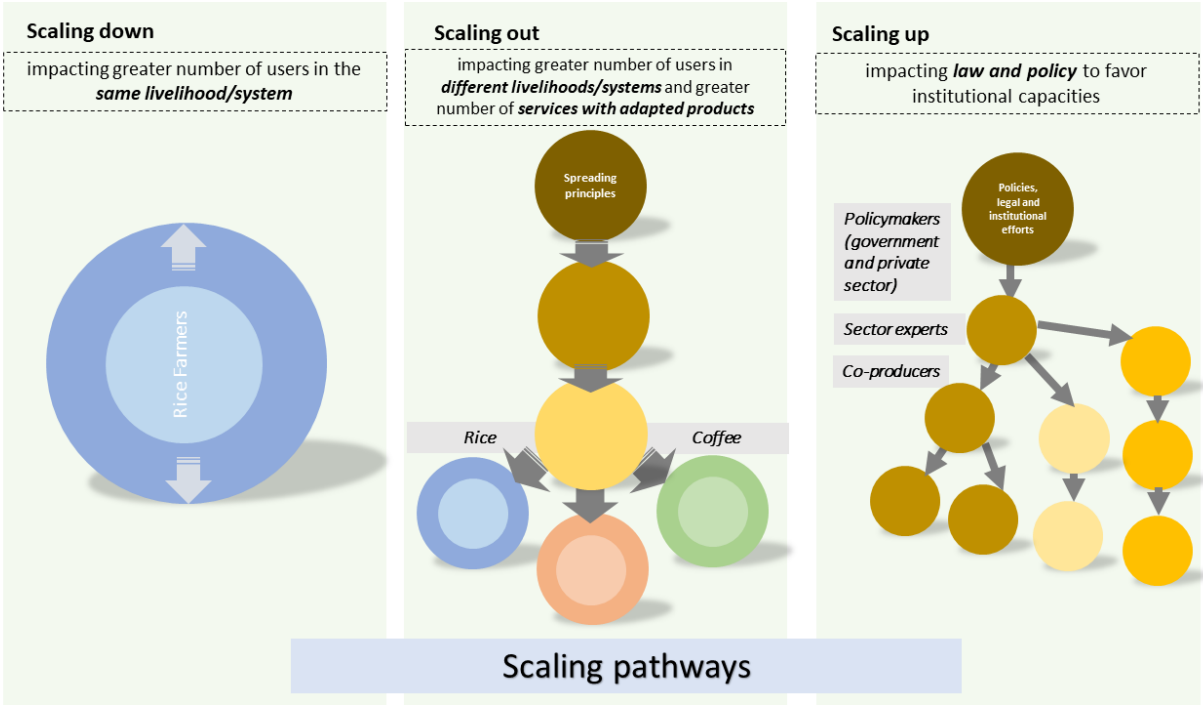

Figure 1: Three different types of the scaling of the climate services (CS)

Scaling down aims at reaching a greater number of farmers within a group or a livelihood with similar needs for CS. The scaling down pathway involves the spread of existing service(s) or product(s) to locations with similar users. Therefore, the scaling down type is only applicable when applying for the same crops with similar agricultural management and practices, and under the comparable climate and socio-economic conditions.

Scaling-out targets users in groups or livelihoods with different needs for CS or a larger range of services with adapted products. That means that the scaled project expands its application to other livelihoods by employing the knowledge, the principles, and/or results of the initial project to other livelihoods. This faces different risks, targeting CS to different response options or socio-economic contexts that require different dissemination and delivery channels, information tailoring, incentive mechanisms or interaction with different stakeholders within the CS network. This requires an adaption or modification of provided products and services, which must be determined via research or tested in pilot studies.

Scaling-up looks at challenges related to developing the institutional structures and network and enabling environment (policies, regulations, operations and capacities). This is mean to boost the reach of the provided CS at a much larger scale (e.g. to provincial, regional or national scale) in a sustainable way beyond piloting; it refers to the integration of the lessons learned at the local scale into the policy, practical agenda, and investment plans at higher levels.

In practice, the scaling of CS typically appears in a mix of two or more of the considered pathways to maximize the influence and the benefit of the provided services to the greatest possible number of users.

Selection criteria of projects for surveying

An inventory was made of 20 projects that focus on providing CS in different areas of the world (see Appendix 1). For this study, four main selection criteria were considered:

i) The project should involve smallholder farmers as end-users;
ii) The project area should be in the Global South;
iii) The project should deliver the climate-based agro-advisory as one of the products;
iv) The project should deal with scaling during its implementation.

Next to that, priority was given to larger projects, as they are expected to have a higher impact in terms of the number of localities and/or recipients. Similarly, more recent projects were prioritized as they are expected to involve more advanced and up-to-date approaches and technologies, which may help to increase their impacts.

A questionnaire with a set of detailed questions was prepared and sent to participants to fill out (Appendix 2); several open questions were included to get the richest view sand opinions from the interviewees. The questionnaire included the following sections:

- Section 1 gathers the information of the organization that is working in the field;
- Section 2 concerns the information of the implemented project related to CS delivery
- Section 3 refers to detailed information on the CS network of the project as well as the products that it provides;
- Section 4 strives to identify a pathway that can be applied more widely by revealing the challenges and opportunities that projects face when scaling CS.

If there was more than one project that was conducted by an organization, questions had to filed out for each of them.

3. Results and discussions

3.1 Climate service projects

The projects were selected from different Southern regions in the world. Their information and details of the provided CS are presented in Table 1. Although 20 projects were selected and reviewed, some projects were implemented more than one region. Despite regional differences, overall patterns were very similar. This seems to reflect similar considerations, challenges and opportunities in the development and implementation of CS projects in different parts of the world. In this section we focus on the general characteristics of the projects and CS delivery.

Most of the selected projects operated at multiple **functions and geographical scales.** Functions varied from generating data to translation and transfer of CS to next or end-users, although the emphasis seems to be on translation and transfer. Projects were implemented from community and district to provincial and national scales, although there were slightly more projects at district level.

In terms of **project duration and staffing,** more than two-third of CS projects (14 out of 20) had a project duration of less than 5 years – some had an initial duration of less than 2 years that got extended – with half of the projects requiring less than five fulltime employees for conducting the tasks. Since some of these projects were provided on a national and regional scale, the number of staff does not seem to be a critical issue for implementing CS projects at a larger scale.

In terms of the **type of climate data and services provided**, projects relied on data from climate observations, climate models, and climate-hydrological models. A majority of the projects (respectively 13 and 14) delivered short-term (daily, weekly, 10-daily, or 2-weekly) and mid-term (monthly, sub-seasonal, seasonal) forecasts. Only a fifth (4) of the projects provided a long-term (annually or longer) forecast. Although this may be due to more expensive data and calculation needs and less accurate forecasts, there may also be less demand among smallholder farmers for such services. Nearly half (9) of the projects provided more immediate drought warnings and monitoring services, with slightly less (7) projects offering other products such as extreme event warning (e.g., flooding, typhoons, and tsunamis).

As **sources of climate data**, most projects made use of climate data obtained from the National Meteorological Service (or the National Meteorological-Hydrological Service or in short, NMHS). Since this is the main and official source of the observed climate data, the quality of the data strongly depends on the capacity of the NMHS. About half of the projects (9) involved international modeling centers to acquire global datasets that can be downscaled and be used for improving the quality of point (local) observations or to obtain long-term projections of climate conditions. A few (6) of the investigated projects used privately owned climate data. For example, some private sector projects provided handy manual rain measure devices to farmers or install farm-level sensors to collect in-situ data.

Table 1. General information on selected projects and programs providing climate services (CS) in different regions of the world

Information*		Africa	Asia	Latin America	Total
		n=7	n=9	n=5	N=20¥
Functions	Generation	4	7	3	14
	Translation	6	8	4	18
	Transfer	7	8	4	19
Duration of the project	2-5 years	4	5	5	14
	> 5 years	2	4	-	6
Number of staff	< 5	4	4	2	10
	5-10	1	3	-	4
	>10	2	2	2	6
Geographic extend	National-wide	6	3	3	12
	Province	2	7	2	11
	District	5	7	2	14
	Community	4	4	3	11
Provided climate data	Observation	3	5	2	10
	Climate models	2	5	2	9
	Hydrological models	3	7	1	11
Provided services	Short-term forecast	5	7	1	13
	Mid-term forecast	4	6	4	14
	Long-term forecast	2	2	-	4
	Drought Warning & Monitoring	5	3	1	9
	Others	4	3	-	7
Sources of climate data	International centers	4	3	2	9
	National Meteorological Service	5	9	4	18
	Privately owned	3	1	2	6
	Others	3	5	2	10

* Some projects covered more than a single implemented location or provided more than one function of CS.
¥ Some projects were implemented in more than one region

Additional information was obtained on agro-climate advisory and its delivery. In terms of the **spatial scale and format,** services and products supplied by projects were usually downscaled to the village-scale while some were downscaled only to the district-scale. Two private sector providers (AgriMedia in Vietnam[1] and Farmerline in Ghana) even aimed at location-specific farms by installing weather stations at the location of interests. Products are typically represented in the following **formats**: text, voice message, bulletins, online webpage, and image. Some projects provided training, meetings, and workshops to educate stakeholders and users about the CS products and transferred the climate agricultural advisories directly to them.

[1] Also known as WeatherPlus

The main **content** that providers transferred to users is climate information itself, but then tailored to the receivers. They also provide agricultural advisories on management and practice based on predicted weather conditions. These advisories include the selection of the crop (or its variety), land allocation, the crop agenda, actions required at different crop growth stages, market information, agricultural and risk maps, etc. The more detailed the provided information is, the more resources the implementation requires. It appears rather difficult for projects to come up with tailored information at fine resolution scale[2], which is constrained by technical and human resources.

Depending on the type of the provided service, the **frequency of delivery** could be real-time or on a half-daily, daily, 3-daily, weekly basis or coarser. All projects provided climate information and agro-advisories at the start of the crop season. The provided values are assessed and validated at the end of the season or at the beginning of a new season. Most of the projects also send information to the users in the middle of the season.

The **channels of communication** were rather diverse and abundant. They include dissemination through face-to-face meetings, discussions, or workshops and through to the employment of user-organizations (e.g., farmer organizations, women organizations, or local farmer groups). Also public services, such as extension systems or other local government units can be mobilized. Mass-media such as radio and sometimes television are often used in projects in Africa and Asia to reach farmers dispersed over large and sometimes difficult to access areas; traditional mass-media, however, do not always seem suitable to transfer tailored and detailed information to end users. Where people have access to mobile phones, projects utilize more advanced methods such as SMS, call centers, mobile apps, websites, online platforms, or social media networks. Although the face-to-face approach is often considered more expensive and resource intensive, it is also believed to be most effective. Moreover, it creates trust between the users, providers and other stakeholders.

The **number and type of beneficiaries and target crops** also varied strongly between projects. For example, 'Climate-smart villages in Latin America', a project that generates evidence on gender-sensitive climate-smart agriculture to inform policy in Nicaragua and Guatemala benefitted 400 households; this project uses PICSA[3], a Participatory Integrated Climate Services for Agriculture approach to transfer knowledge on decision making to farmers. While the impact of face to face meetings at a local level may be high, the limitation of on sharing information more widely may lead to modest numbers of impacted users. On the other hand, projects that made use of alternative communication methods such as SMS or websites reach hundreds of thousands of users, although the impact of these may be more difficult to assess. There seems to be trade-off between the number of beneficiaries and the quality and detail of information shared. This is also apparent when different type of farmers and target crops are considered. The investigated projects put more emphasis targeting groups of poor smallholder farmers, who mainly grow low-value food crops, such as rice, maize, bean, sorghum, and cassava. Two private companies,

[2] Fine (spatial) resolution scale can be village or farm or even smaller.
[3]https://research.reading.ac.uk/picsa/

however, focused on farmers who grow high-value cash crops (such as coffee). These farmers often demand more detailed climate information for their production and are often more willing to pay for accurate and reliable forecasts and advisories.

3.2 The climate service network

Most of the CS projects were funded by NGOs that have a historical record of investigating or working within the climate service sector. Hence, they employ their own staff to implement the projects and also provide internal technical support. Moreover, as these organizations are highly experienced in implementing CS projects, they can reduce the risk of uncertainties and difficulties during execution. Lessons from previous experience enable them to set up the project from the early beginning, which includes the identification of stakeholders in the project country. Some of these NGOs, but also private companies that have focused on the CS sector, may require further technical support and training from research institutes.

For the **generation** of climate data, projects typically collaborate with the NMHS. They also work with the research institutes and experts to obtain global climate datasets and predictions. This information can be used to be downscaled to the area of interest for (long-term) forecasts or to enhance the quality of observation data of the local country.

For the **translation** of the climate data into actionable agro-advisories, the projects normally ask for support from the Ministry of Agriculture or the related governmental agencies. The NMHS, next to its role to provide the raw data, is also accounted as a member of the translation group. Some projects involve the users as a source whereby farmers provide agricultural data based on their experience with local (climate and production) conditions. Research institutes are considered as important stakeholders to provide updated knowledge and advanced tools for the translation of climate data into agricultural advisory. Knowledge and lessons obtained from previous projects in the same area are also a key source of information to get a better understanding of the climate regime and the production practices of the inhabitants in the project area.

For the **transfer** of the climate information and the agro-advisories to the next or end-users, the mobile network operators (MNO) appear the most efficient partner that can transfer the information to millions of users in a short time (for example, the AgriMedia in Vietnam). One main advantage of the MNOs is that they can determine the location of the users and classify them based on their subscription data. By doing that, they can tailor the information to the correct users. However, the fee of using their system is a limitation. Next to that, the percentage of people having a mobile phone is not so high in many countries in the South. Hence, the application of this partnership is conditional to the specific location. The NMHS and the Ministry of Agriculture with their own infrastructure and structures are also an important channel to provide information at a larger scale. They normally partner with television and radio broadcast stations to provide climate information and management decisions from the government to the farmers as a part of their official mandate. Also extension officers, local working groups (farmer cooperatives, producer associations, and social groups formed by projects, such as

women's groups, and field schools or farmer networks) within the project or neighboring areas are good channels for disseminating CS to farmers. Providers of information and communications technology (ICT) seem to be a potential partner once the physical (infrastructure) barrier is cleared.

Methodologies across functions for generating, translating, and transferring climate-based agro-advisories were less common. Methodologies that were successfully applied in some projects and efficiently up-scaled within the country or to neighboring countries are PICSA and Technical Agro-climatic Committees (MTAs)[4]. Other reported initiatives or approaches were PSP[5], decision trees, decision-making processes, agro-climatic roundtable, and need-based approach, but most of these seem to focus more strongly on certain functions and do not seem to provide an overall comprehensive methodology.

3.3 Scaling of Climate Services (CS)

Different opportunities and challenges in terms of scaling are explored, before discussing different type of pathways and strategies to scale CS. Equity is a particular concern for scaling CS and will be discussed separately.

Opportunities and challenges

Table 2 provides an overview of the main opportunities and challenges of scaling CS as identified by the selected projects based on key areas of concern: network structure, information characteristics, supply-demand harmony, and operation and management.

In terms of **network structure**, many implementers considered stakeholders' perceptions of CS as an important opportunity for scaling CS. The noticeable impacts of climate change in the last decade have led to increased awareness among decision makers of the need for agro-climatic advisory and the development of tailored CS. In addition, a larger number of researchers and organizations have started to invest in researching, providing, and implementing CS globally. This has also provided strong support to government, but also non-government and private sector actors to build the capacity, support and infrastructure for the generation, translation, and transfer of CS. Therefore, the identification of the stakeholder in the climate service value chain has become easier.

At the same time though, the collaboration between institutional structures or agencies was perceived as a challenge. While agencies or stakeholders put their effort in the same direction to mitigate the impact of climate change, they seem too often focused on their own tasks and activities without working together for the benefit of the end-users. In many countries, this issue hinders the implementation and scaling of CS projects.

[4]https://ccafs.cgiar.org/publications/technical-agroclimatic-committees-mta-detailed-guide-implementing-mta-step-step

[5]https://careclimatechange.org/practical-guide-to-participatory-scenario-planning-seasonal-climate-information-for-resilient-decision-making/

Table 2.The opportunities and challenges in scaling climate service projects

Criteria	Indicator	Opportunity	Challenge
Network structure	Identification of stakeholders in CS value chains	8	2
	Perception of stakeholders about CS	12	1
	Collaboration between institutional structures	4	8
	Others	1	2
Information characteristics	CS products (content, format, dissemination frequency, spatial coverage, timing)	7	4
	Upstream support & feedback	4	2
	Information access (languages, infrastructure barriers…)	3	10
	Integration (with other products, e.g. climate smart agriculture, business models, agro-advisories or larger framework)	3	2
	Salience (tailored info; user-centered product)	5	7
Supply & Demand	Confidence in the value chain elements (technical skills, data and information sources, process transparency…)	3	10
	Perception of users (awareness of the concept and benefit)	9	5
	Needs of users	8	2
	Support from users (willingness to pay)	3	7
Operation & Management	Human resources	2	8
	Funding	0	11

Another aspect to be considered in case of scaling are the **information characteristics.** CS products, with its diversity in content, format, dissemination frequency, spatial coverage, timing etc., are generally perceived as an opportunity by practitioners. Although they can be much improved, providers start developing more diverse services and products in order to serve their users. Increased upstream feedback and support and integration with other services may further enhance this.

Information access though, was perceived as a challenge. The access of the users to information was rather limited in many project areas, especially in terms of poor infrastructure and communication channels. Narrow coverage of loudspeakers or the unfamiliarity with mobile phones or the internet may limit access to the services. Language is also a barrier. Projects are typically conducted in remote areas, where a large percentage of inhabitants cannot read or speak the official language. This demands for linguistic translation of the information, driving up costs. Costs in general, can be a barrier. For example, in many countries, third parties cannot freely access national climate data from the NMHS (who invested in installing weather stations). Moreover, collecting data for downscaling information accurately to locations of interest is difficult and costly.

Although some implementers were positive about the quality of information provided to users, some were worried about the timing, accuracy and location-specifics. The downscaled values for a specific location (district or smaller scale) – especially when based on global satellite data – often contain large uncertainties. Also forecasts sometimes include too many uncertainties, with events occurring at a different time frame, and causing agricultural production to fail. The lack of location-specific information to validate and improve advisory should be addressed. The advancement of new technologies, may help to (partly) overcome these challenges.

Practitioners were also asked to assess about the **harmony between supply and demand**. They considered the awareness of users about the concept and benefit of CS an important opportunity for scaling CS. Linking CS to user needs and demand were seen as a good starting condition. Actions based on agro-climatic advisory directly influence farmers' situation and therefore help to increase the knowledge and understanding of users about climate impacts and the different approaches to cope with them. The higher awareness among farmers and the demand for tailored CS puts decisions makers into the position of seeking for an approach to meet the requirements, or to scale existing (successful) projects to other areas.

Still, confidence in different elements of the CS value chain, such as technical skills, data and information sources, process transparency, etc. were considered a challenge. Data and information are not always reliable due to the capacity of the providers. In some projects, a quality control was applied to ensure a minimum data quality for the translation step. The project on Enhancing National Climate Services (ENACTs) proposed an approach to employ different data sources – observational data from national networks and data from international meteorological centers – to improve the quality of the dataset. Project implementers also pointed out that it is necessary to educate users about the uncertainties that are inherent in climate information and advisory. This will help users to better understand the technical meaning of the provided information, so that they do not immediately lose trust in case of incorrectly forecasted events.

Finally, we looked at **operation and management**. Human resources, especially staffing, becomes a challenge for projects that want to scale in case they make use of face-to-face approaches for translating and/or transferring climate-based advisories. For instance, some approaches (e.g. PICSA) require trainers to visit each village to transfer the knowledge to the users, which may take several days. This can be done at a small scale, but if the project needs to be scaled, the approach requires adjustments. Moreover, funding is an issue for any project that want to expand in scale and duration. This, seems one of the most difficult challenges to address. Some asked for the support from farmers, who directly benefitted from project results. However, willingness to pay (and financial status) of farmers, usually does not meet expectations.

Scaling strategies

The type of CS scaling pathways applied by projects were evenly divided over the different categories, sometimes combining different pathways.

One of the most common strategies that was applied for scaling is the development of a successful pilot project to show the potential benefit of CS. This work for all three type of scaling: **scaling down, scaling out and scaling up**. The pilot can be used to convince other groups of farmers – with either similar or other characteristics and livelihoods – about the provided services. It can also be used to convince the government at different levels, to integrate underlying principles and processes into their policies and frameworks. It is important to realize, however, that underlying principles and processes that work well at a small scale are not always suitable at a larger scale. This is most obvious in terms of communication channels for agro-climatic advisory. Next to face-to-face meetings, workshops, and trainings, projects suggested the use of media that can share information more widely, such as loudspeakers, radio, mobile phones or internet. However, each of these have their own shortcomings in terms of reach, access, affordability, and the extent to which messages can be tailored. Hence, the selection of communication channels when scaling CS projects may need to be reconsidered. While this applies to communication channels, scaling has also implications in terms of stakeholders involved, operations and management.

A strategy identified by CS projects specifically for **scaling down and scaling out** was the use and promotion of working groups in CS projects. The establishment of working groups, with representation of end-users who directly benefit from the project results, may boost scaling CS to other farmers in the same or in neighboring areas. Often, these groups have already gained trust from other people in their communities based on previous projects, and hence, there is a high chance that other farmers listen to and follow their advice. Also the involvement of trusted champion farmers or extension workers, with their own networks, may strongly contribute to this. Related to this was the proposal by Farmerline company (Ghana) to establish a partnership with local companies or others in the same sector to utilize the counterpart's distribution network and customer volume to promote their CS products

Also the concept of a roundtable or the Local Technical Agro-climatic Committees (LTACs), whereby different stakeholders share concerns and needs on CS, were perceived as important ways to enhance scaling among farmers. It was suggested that the representation of government officers in the roundtables or committees may lead to higher confidence among farmers in the conclusions and decisions made, and thereby encouraging other farmers to join CS projects.

Especially for **scaling-out** CS to farmers in a different region and/or livelihood, a need assessment is required to understand the agricultural strategies and priorities of the government in the region, the needs of farmers and the demand from the market. Based on these results, project implementers can decide whether or not to invest their resources in making modifications to the existing principles or methods that have been applied for certain livelihoods. While several projects started targeting many different crops and varieties based on crop-databases, agro-climatic advisory without practical data such as soil types and agricultural management practices at the village or farm scale is a risky business. Also critical is a thorough understanding of the typology of users to be able to tailor the information to their specific needs and the identification of proper service providers for climate information and agro-advisories. A partnership with local actors and other local users' organizations was suggested to quickly facilitate project implementation.

Strategies proposed for **scaling-up** are quite diverse but can basically be summarized as "direct involvement of the government into the CS project". Based on project experiences, scaling-up comes from a strong partnership with the stakeholders, including the government ministries and the local government units. That can be done when the stakeholders are directly involved in the project, starting from the design to implementation and evaluation. Workshops and meetings can be organized for the decision-makers to discuss and share their visions and desires to others, which at the same time help increase their understanding of CS and their benefits. In addition, understanding the needs of the government is critical to ensure effective and efficient project implementation.

Evidence from CS projects suggest that using a need-based approach, cost-benefit assessment, and successful examples at the local scale are important for the government to consider introducing the services into its agenda and policies. Once it happens to be an official activity or duty of the governmental authorities, activities may be granted funding for continuation even after the end of the project. It is important to link the activities of the project with the national or regional framework for CS. In countries, where the National Framework for Climate Services (NFCS) is not yet in place, these CS projects can be used to provide proof and support for the government to build up their own NFCS.

One major concern raised was the collaboration between government actors, which is seen as vital for the efficiency of the projects and to promote the projects to other areas. It is recommended to establish a mechanism to assign the roles, responsibilities, and mandates for different government authorities that are involved in the scaling of CS. Structural engagement, capacity building and field visits are critical to create awareness of the need and benefit of CS for agricultural production and different type of user-groups. A complication projects often have to face are changes in the government structures or staff. In that case, the implementers typically have to re-build up rapport with the new decision-makers, which sometimes requires a restart. Integration of CS into policies and frameworks may help to prevent this, but often take a long timeframe. This may explain why not all projects aimed at institutionalizing CS processes and structures, although it is considered critical to sustain CS.

Equity

Women and ethnic minorities were included in several projects with CS services. However, except for the projects of CARE international – whose mandate explicitly focuses on these groups – this was typically without a clear policy. Some of the interviewed projects were conducted in remote or mountainous areas, and focused on supporting low-income users. Therefore, they naturally involved the ethnic minorities living in these areas. While women can play a role in the generation and the translation of climate data, this was often without the effort of the projects. Some projects required a certain percentage of women to participate in the transfer of CS. One project asked a local partner (a local government unit) to convince the female staff to take part in the project. Other projects involved women organizations or the working group for women as a proactive and effective communication channel to transfer information and advisories to their neighbors in the village or in the nearby villages. In many areas, men had moved out of the village to the cities for work, while the women stayed at home and had become the main subject

of agricultural production and transfer of CS. Similarly, women can get funded and be supported to access and use CS products. However, project implementers (apart from CARE international officers) were not very optimistic about the equity of CS usage. For example, in some places, where the services can be accessed through radios, the radio was mainly used by the men and the women could only use it for a limited time. Access to communication media and resources seems more generally a challenges, which creates a barrier for women to increase their knowledge and to benefit from CS.

4. Conclusions and recommendations

Several CS projects have been implemented recently to meet the increasing demand from farmers and other decision makers for climate information and agro-advisories for better agricultural management. Agro-advisory based on climate data are considered an important and effective way to support farmers and other low-income users to adapt to the impacts of climate change. Two main concerns stood central in this study: (1) how these products and services can be improved for the benefit of more farmers at different scales; and (2) how to maintain these projects after its end to extend their lifetime for longer (even sustainable) benefit for the farmers. Addressing these two questions will require pathways for scaling CS projects.

In general, it is an exciting time for the development and implementation of CS. The sector has clearly matured in recent decades with increasingly services being developed for small-scale farmers in the global South. Different functions along the CS value chain have developed from the generation, translation, transfer and the use of products. Most of the CS providers focus on the translation and transfer, and rely on observational data and climate and hydrological models, from national, international and private sources. There is great diversity of products in terms of format, content, way of communication, frequency, and target groups. And while there is large scope of improvement, the diversity seems to point to a strength rather than a weakness, and shows the potential to tailor CS products and their messages to the specific needs of end-users and diverse contexts.

The design and implementation of CS depends on a myriad of actors working together along the CS value chain. For historical reasons many of the selected projects in the South were coordinated and/or funded by NGOs, but increasingly government agencies and/or private sector have become active partners as well. Hence, there seem large potential to scale existing services to other farmers with similar as well as other livelihood, or even for scaling-up CS. Despite these positive developments, though, one of the main challenges of scaling CS comes from the collaboration between different institutions. Whereas different organizations may agree on the common goals, they often do not on the way of working. Mechanisms to assign the roles and responsibility between stakeholders for delivering CS products requires the leadership and the coordination from the government or NGOs. Methodologies that support the coordination of different functions along the value chain may contribute to this, but eventually it will also a require a national framework for CS in which these roles and responsibilities are clarified and addressed.

Despite the challenges in institutional collaboration, CS projects and products have been growing fast. While the future for CS looks positive, there are a few additional precautions. First, access to information is perceived as a concern. While this applies mainly to end-users and is often related to language, access to communication channels (radio, television, mobile phones, internet, etc.), and affordability, this may also apply to other organizations along the CS value chain, especially in case data are being monetarized. Second, despite the increased awareness among end-users and demand of agro-climatic advisory, there are concerns about the reliability of data and the confidence people have in the services. While technologies are increasingly improving, leading to improved accuracy of predictions and improved advisory, forecasts are uncertain by nature. Third, the human resources and additional funding required for scaling CS are a challenge. Moreover, processes that worked at a smaller scale are not always suitable at a larger scale. This will require adjustments in services and creative business models that include both private and public funding. Finally, the professionalization of the sector with an increased focus on (high quality) data, new technologies, and financially profitable models, there is an increased risk that small-scale farmers, and in particular the poor, women and ethnic minorities, are increasingly left out.

Hence, to ensure that CS will benefit more small-scale farmers through scaling CS, the following recommendations are made:

1. CS projects should continue to educate end-users to ensure that they understand the climate risks they face and the potential impact, as well as the agro-climate advisory that is provided; their understanding and ability to respond to risks and assess the impact of their actions, are a requirement for sustained action.
2. CS projects need to involve end-users in the design, production and evaluation of products. End users are integral part of the CS-value chain, and their involvement and trust is critical to tailor the services to the demand.
3. While certain products and media have been encouraged to reach more farmers over larger areas, it is important to realize that all product and communication channels have their own shortcomings. Hence, a correct mixture of CS products and communication channels needs to be developed by CS projects to ensure that end-users have access to agro-advisory taking in account their specific context and situation.
4. CS projects need to encourage to use of interactive methodologies across the CS value chain, so that different type of stakeholders interacts and develop trust among each other; this includes decision makes who will be critical to scale CS projects to other farmers with the same or different livelihoods.
5. CS project need to engage with policy makers and other CS actors in order to develop policies and frameworks that integrate CS principles and processes, including specific roles and responsibilities of key stakeholders. This will be critical for scaling CS.
6. Project are simulated to develop new and creative business models that enable scaling of CS based on both private and public funding.

7. All CS actors have the moral duty and responsibility to pay attention to vulnerable groups, in particular the poor, women and ethnic groups, who may not have access to the same resources as others. Therefore, it is advised to establish a set of regulations for better distribution of CS products and benefits among beneficiaries both within CS projects, but also into policies and frameworks.

Although there are many challenges that may prevent the scaling of the CS, the existing opportunities may push the possibility for success. Understanding the major challenges and key opportunities with regards to specific conditions of a project are critical to help project designers, implementers and managers to identify the best pathway forward for scaling CS for the benefit of small-scale farmers.

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Appendix 1: Projects selected for this study

No	Name of project	Country for implementation
1	Agro-Climate Information Services for Women and Ethnic Minority Small Scale Farmers in South East Asia (ACIS 2015-2018)	Cambodia, Lao PDR, Vietnam
2	Aloweather	Vietnam
3	Information for Adaptation in Vietnam (InfoAct)	Vietnam
4	Connecting the unconnected - increasing innovation and livelihoods in agriculture in Ghana	Ghana
5	Specialized Expert System for Agro-Meteorological Early Warning for Climate-Resilient Agriculture (SESAME)	Bangladesh, Cambodia, Fiji, India, Myanmar, Papua New Guinea, Sri Lanka, Bhutan
6	Capacitating Farmers and Fishers to manage climate risks in South Asia (CaFFSA) - Innovative and contextual agromet advisory services for climate smart agriculture	India, Bangladesh
7	Resilient Central America - Honduras / Building national capacity for provision of agricultural climate services in Honduras	Honduras
8	Tailored agro-climate services and food security information for better decision making in Latin America	Colombia, Guatemala, Honduras
9	Rwanda Climate Services for Agriculture	Rwanda
10	Climate information services for increased resilience and productivity in Senegal	Senegal
11	Strengthening Weather and Climate Information Services in Uganda	Uganda
12	Prototype for climate change adaptation in rainfed rice areas of Southeast Asia (WeRise)	Philippines, Indonesia *(field testing on WeRISE prototype)*
13	Climate Resiliency Field School (CrFS)	Philippines
14	Smart climate villages in Latin America (Generating evidence on gender-sensitive climate-smart agriculture to inform policy in Nicaragua and Guatemala)	Guatemala, Honduras
15	Adaptation Learning Programme (ALP)	Ghana, Kenya, Mozambique, Niger
16	Enhancing National Climate Services (ENACTS)	Bangladesh, Ethiopia, Ghana, Kenya, Guyana, Mali, Madagascar, Rwanda, Senegal, Tanzania, Zambia
17	AgriMedia company	Vietnam
18	Farmerline company	Ghana
19	Climate Services for Resilient Development (CSRD) in Colombia	Colombia, Ethiopia, Bangladesh
20	ACToday for Vietnam	Vietnam, Bangladesh, Colombia, Ethiopia, Guatemala, Senegal

Appendix 2: Assessment of Scaling Pathway of delivering Climate Services (CS)

Introduction

This interview is part of the CCAFS Project called, "A climate services menu for Southeast Asia: tackling scaling for a diversity of end-users" which aims to provide guidance on designing and implementing scalable approaches for delivering climate services (CS). The objective of the assessment is to document the lessons learned and to identify the scaling pathway for CS approaches based experiences from the past and ongoing CS implementation across several regions in the world.

Part I. General information of your organization and identification of past and/or ongoing CS initiatives across regions of your organization

1. Name of organization
2. Organization's mandate
3. Does your organization work on specific climate service functions (generation, translation, transfer of climate/weather-related information)?
   Yes ☐ No ☐
4. Have your organization provided agro-advisories to farmers, cooperatives and/or other agricultural producers?
   Yes ☐ No ☐
5. Were those agro-advisories developed based on climate/weather information?
   Yes ☐ No ☐

Part II: General information of the past/ongoing project that is related to the delivery of the CS: Identification of practitioners, experts with leading, coordination and/or field-level experience

1. Project name
2. Project goals
3. Identify the functions related to climate services and/or agro-advisories. Please provide additional information if needed.
   ☐ Generation of climate forecast and weather information
   ☐ Translation of this data into actionable advice(s)
   ☐ Transfer of the advisory to provide access to next- and end-users of CS information
   ☐ Others
4. When did your project start working on climate service? Please provide the year.
5. How many staff are currently working on this topic/area?
6. What is the geographic extend of you CS work? (multiple choices if applicable)
   ☐ Nationwide
   ☐ Agro-ecological zone
   ☐ Province

- ☐ District
- ☐ Villages
- ☐ Communities

7. Please specify the target areas/locations of you CS work.
8. Please specify the type of your end/next users of your CS work.

Part III. Describing the climate service project

Description of the CS network

1. Identify your technical partners that provide training program to enhance your knowledge and skills in this topic.
2. Identify and describe your major partners in generating the climate and weather information.
3. Identify and describe your major partners in translating the climate and weather information into agro-advisories.
4. Identify and describe your major partners in transferring climate-based agro-advisories.
5. Describe briefly any methodologies used for generating, translating, and transferring climate-based agro-advisories.
6. Is there an existing mechanism for CS in the country(-ies) that your projects working on? If yes, please describe.

Description of the climate services provided by the project

1. Please identify the climate data that you generate/translate/transfer (if applicable)
   - ☐ Observations
   - ☐ Climate models
   - ☐ Hydro-meteorological information / models
   - ☐ Short-term forecast (less than 10 days)
   - ☐ Seasonal forecast
   - ☐ Long-term forecast (annually)
   - ☐ Drought warning & monitoring
   - ☐ Other extreme events
   - ☐ Others, please specify
2. Please describe the sources of climate data that you used in developing the climate-based agro-advisories.
   - ☐ International modeling Centers
   - ☐ National Meteorological and Hydrological Service
   - ☐ Private sector providers
   - ☐ Local private or public observation networks

☐ Farm level sensors

☐ Others, please specify

3. Please describe the agro-advisories that you generate (i.e. the spatio-temporal scale, format, design, content and frequency of the delivered products or others).
4. How do you transfer climate-based agro-advisories (with regards to the content, channel, frequency, and format of the transfer)?
5. How many farmers are directly benefitted from your CS work?
6. What are the major crops and/or livestock that your beneficiaries are growing and/or raising?
7. How do you target women across all CS functions? Please, describe in details

   ☐ Generation: _____

   ☐ Translation: _____

   ☐ Transfer: _____

   ☐ Access: _____

   ☐ Use: _____
8. How do you target ethnic minorities to benefit from CS? Please, describe in details.

   ☐ Generation: _____

   ☐ Translation: _____

   ☐ Transfer: _____

   ☐ Access: _____

   ☐ Use: _____

Part IV. CS scaling pathways

In this study, we represent three main types of scaling pathways that are popular for scaling the climate services (see Figure below). They may appear in a mix of two or more types for a certain product in reality. They include:

- **Scaling down**: which replicates or spreading the products/services/programs geographically and to a greater number of users.
- **Scaling out**: which disseminates the principle of a certain project/program to a different livelihood (e.g. new services / products to different classes of end-users using the principle that was applied in the existing study/project)
- **Scaling up**: which involves the development of new policy or the institutional collaboration to the advance legal framework and institutional framework.

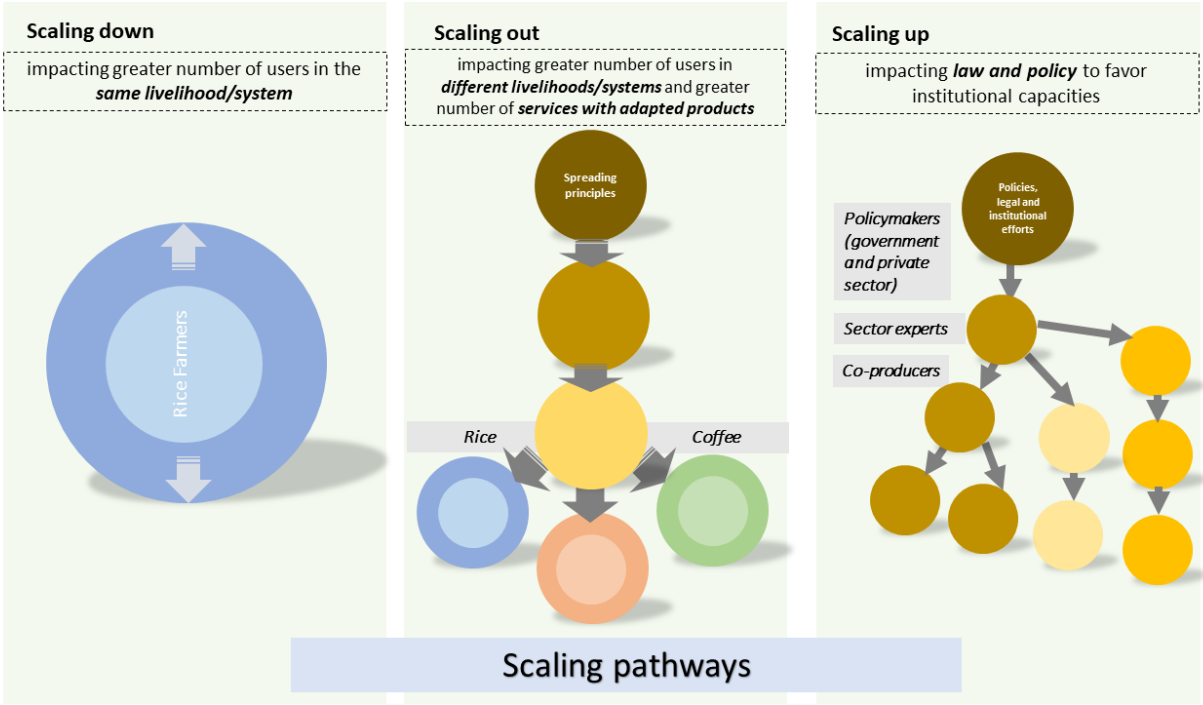

Figure: Definition of different types of CS scaling strategy that are used in this survey

1. Which type of scaling pathways that your project focus on?
   - ☐ Scaling down
   - ☐ Scaling out
   - ☐ Scaling up
   - ☐ Mix of two or three types
2. *Scaling down strategy*: If you want to approach more farmers (i.e. 10x the original) in the target area, what would be your strategy?
3. *Scaling out strategy:* If you want to replicate your initiatives in other areas (i.e. three more locations with different demands of the CS products), what would be your strategy?
4. *Scaling up strategy:* How can you develop and sustain the operational network from national level to local level to perform each CS function?
5. Opportunities and challenges:
   - **5.1.** Indicate the major possible opportunities (+) and challenges (-) of your scaling strategy (Table A)
   - **5.2.** Describe/explain 1-3 most important opportunities and challenges
6. Which type of development or support do you need to utilize the top 3 opportunities and to address the top 3 challenges identified in Table A? Please indicate in Table B below.

Table A. Opportunities and challenge for CS scaling pathway

CRITERIA	SUB-CRITERIA	INDICATOR	CS functions			
			Generation	Translation	Transfer	Use
Network structures	CS-VC maturity	Identify existing and potential stakeholders & their roles				
		Identify network & operational structures in the target area(s)				
		Identify partnerships across climate services value chain (CS-VC)				
	Shared views of stakeholders	Understand values, concerns and needs of stakeholders				
		Assess current process and stakeholders' bias towards common goals				
	Others	Others: (specify)				
Information flow	CS products	Improve information content: weather/climate forecast, agro-advisories or a combination of both agro-met advisories				
		Improve format (i.e. visually or graphically) of information product				
		Improve frequency of dissemination				
		Improve spatial coverage of information				
		Improve financial/business model for sustainability				
	CS services	Improve supports and upstream feedback				
	Information access	Improve language and terminology				
		Improve physical/infrastructure barriers				
		Improve timing of CS delivery				
	Integration	Integration into larger support package (e.g. climate smart agriculture, business models, agro-advisories…)				
	Others	Others: (specify)				
Supply – Demand harmony	Credibility	Confidence in stakeholders technical skills, roles and goals				
		Confidence in data and information sources				
		Confidence in process transparency				
		Others:				
	Social and political relevance	Information products tailored for CS sectors (i.e. health, agriculture, disaster risk reduction, energy)				
		Information products tailored for end-users				
		Targeting of women, ethnic or young groups				
	Users characteristics	Understanding of CS information				
		Additional resources or information for decision making (for example: Indigenous knowledge)				
		Awareness of benefits				
		Willingness to pay				
	Others	Others: (specify)				
Operation	Human resources	Technical capacities and training				
	Human resources	Staffing				
	Funding	Operational, research, others				

Table B. Development and support for scaling the CS work

CRITERIA	SUB-CRITERIA	Yes/No	DETAILS
Delivery of CS	Data collection		
	Information		
	Methodology (Please specify objective and target users)		
	Tool (Please specify type and target users)		
	Awareness raising and evidence building (Please specify type and target users)		
	Training and capacity building		
Institutional support	International agenda support		
	Political support from national level		
	Political support from local level		
	Integration of government agencies (Please specify the type)		
	Local or national networks		
	Local or national assessments		
Operation & management	Human resources		
	Fundraising		
Others	(Please specify)		