From pilots to systems:

Barriers and enablers to scaling up the use of climate information services in smallholder farming communities

CARIAA Working Paper #3

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Singh, C., P. Urquhart and E. Kituyi. 2016. From pilots to systems: barriers and enablers to scaling up the use of climate information services in smallholder farming communities. CARIAA Working Paper no. 3. International Development Research Centre, Ottawa, Canada and UK Aid, London, United Kingdom. Available online at: **www.idrc.ca/cariaa**.

ISSN: 2292-6798

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This series is based on work funded by Canada's International Development Research Centre (IDRC) and the UK's Department for International Development (DFID) through the **Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA)**. CARIAA aims to build the resilience of vulnerable populations and their livelihoods in three climate change hot spots in Africa and Asia. The program supports collaborative research to inform adaptation policy and practice.

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Abstract

Climate information services (CIS) have emerged as a key input for adaptation decision making aiming to strengthen agricultural livelihoods by managing climate risks. Many pilot projects have been implemented in developing countries to either strengthen existing systems or put in place new systems to deliver climate information to multiple actors. However, scaling up these pilot project-based initiatives in order to contribute further to more sustainable and institutionalized systems remains a challenge. In order to unpack the gap between piloting and successfully up-scaling CIS initiatives, this paper explores the key constraints to and enablers of scaling up CIS by drawing on case studies from research, policy and practice in Africa and South Asia. The evidence contained in this paper was collected through an extensive literature review and from expert opinions elicited during the Ninth International Conference on Community-based Adaptation (CBA9) held in Nairobi in April 2015. We find that transitioning from CIS pilots to systems is possible when scaling up is mainstreamed in the project design stage with a clear financial model for sustainability, includes multiple stakeholders through iterative participatory processes, identifies and engages with pilot-project champions and intermediaries, exploits new communication mechanisms such as information and communication technologies (ICTs), and creates and supports effective partnerships that enable knowledge co-production.

Key words

Climate information services; scaling up; climate change; Africa; South Asia

Résumé

Les services d'information sur le climat (SIC) sont devenus un élément clé de la prise de décision en matière d'adaptation pour renforcer les moyens de subsistance agricoles en gérant les risques liés au climat. De nombreux projets pilotes ont été mis en œuvre dans les pays en développement, pour soit renforcer les systèmes existants, soit mettre en place de nouveaux systèmes pour fournir de l'information sur le climat à de multiples acteurs. Néanmoins, le déploiement de ces initiatives axées sur des projets pilotes sur une plus grande échelle afin de contribuer davantage à des systèmes plus durables et institutionnalisés demeure un défi. Pour éclaircir l'écart entre la conduite de projets pilotes et le déploiement avec succès des initiatives des SIC sur une plus grande échelle, le présent document traite des principaux facteurs qui limitent ou qui favorisent le passage à grande échelle des initiatives des SIC en s'appuyant sur des études de cas émanant de recherches, politiques et pratiques en Afrique et en Asie du Sud. Les données probantes présentées dans ce document découlent d'une recension détaillée de documents et d'avis d'experts sollicités lors de la 9e conférence internationale sur l'adaptation communautaire (CBA9) qui s'est déroulée à Nairobi en avril 2015. Nous estimons que le passage de projets pilotes des SIC à des systèmes est possible lorsque l'étape de la mise à plus grande échelle est intégrée à l'étape de la conception du projet au moyen d'un modèle financier clair du point de vue de la viabilité, fait appel à de multiples intervenants grâce à des processus participatifs itératifs, désigne des champions de projets pilotes et des intermédiaires et établit la communication avec eux, exploite de nouveaux mécanismes de communication comme les technologies de l'information et des communications (TIC), et crée et appuie des partenariats efficaces et propices à la coproduction de connaissances.

Mots-clés

Services d'information sur le climat; passage à grande échelle; changements climatiques; Afrique; Asie du Sud

Acronyms

AAS	India's Integrated Agro-meteorological Advisory Service
ACMAD	African Centre for Meteorological Application and Development
ALP	Adaptation Learning Program
AMU	Agrometeorological units
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
CARIAA	Collaborative Adaptation Research Initiative in Africa and Asia
CBA9	Ninth International Conference on Community-based Adaptation
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CGIAR	Consultative Group on International Agricultural Research
CI	Climate information
CIS	Climate information services
CKW	Community Knowledge Worker
ENACTS	Enhancing National Climate Services project (Ethiopia)
EWS	Early warning system
ICPAC	IGAD Climate Prediction and Applications Centre
IDRC	International Development Research Centre
ICTs	Information and communication technologies
IGAD	Intergovernmental Authority on Development
IPCC	Intergovernmental Panel on Climate Change
KMS	Kenya Meteorological Service
NMA	National Meteorology Agency
NMHS	National Meteorological and Hydrological Services
NMS	National Meteorological Services
PSP	Participatory Scenario Planning

RCM	Regional climate model
RCOF	Regional Climate Outlook Forum
WMO	World Meteorological Organization

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Acknowledgements

The authors would like to thank the group leaders of and the participants in the Climate Information Services session organized by CARIAA at CBA9 in Nairobi, Kenya (23-30 April, 2015). Additionally, we are extremely appreciative of the valuable inputs and suggestions provided by the reviewers of this paper: Maurine Ambani and Fiona Percy (CARE International), Arame Tall (IFPRI/CCAFS), Richard Ewbank (Christian Aid), Modathir Zaroug (CSAG, UCT), Lindsey Jones (ODI), and the following members of the CARIAA Climate Science Oversight Group—Arun Shrestha (ICIMOD), Joseph Daron (UK Met Office), and Fahad Saeed (SDPI).

The report was edited by Katharine Vincent from Kulima Integrated Development Solutions (Pty) Ltd. and Marissa Van Epp.

Contents

1. Introduction

1.1 Context of climate services in developing countries

Smallholder agriculture in developing countries is an inherently risky livelihood, dictated by availability of natural resources like water and good soils, market dynamics, and fluctuations in availability of labor and inputs. Farmers in semi-arid regions in particular face multiple risks, such as natural resource degradation and growing populations, in addition to the current and projected impacts of climate variability and change (Kilroy 2014). Recognizing the need to plan for and adapt to these risks, the provision of climate information has gained traction as an important way to help manage risk, inform adaptation, and plan for uncertainty (Jones et al. 2015, Goddard et al. 2010). Consequently, there has been a rapid increase in pilot projects providing targeted climate information services (CIS). Such initiatives tend to be donor funded, short-term, and not always integrated with the work of National Meteorological Services (NMSs), which are the government agencies tasked with meteorological observations, weather forecasts, warnings for extreme events such as storms and floods, and other CIS-related functions.

While such pilot projects have been instrumental in consolidating research on, mobilizing funding for, and attracting policy attention to the application of CIS in climate change adaptation, they have tended to focus more on factoring short-term climate information into decision making, with less emphasis on medium- and long-term climate information (Jones et al. 2015). Although short-term climate information is vital for seasonal forecasts and early warnings and can serve to promote resilience, adaptation to climate change requires making decisions on all timescales, from the present to decadal scales and beyond. Short-term forecasts can nevertheless serve as a gateway to medium- and long-term scenarios (Richard Ewbank, Christian Aid, personal communication). Thus, longer-term adaptation decision making can be enabled by both facilitating access to usable short-term and seasonal CI, and improving climate data and information for longer-term projections. There is clearly a strong need to scale up pilot initiatives that focus on using short-, medium- and long-term climate information to inform decision making, in order to transition these into longer-term initiatives that are embedded in national institutions and adopted by communities. Achieving this in a sustainable manner remains a challenge (Gebru et al. 2015, Jones et al. 2014, Tall et al. 2014a, Srinivasan et al. 2011).

Despite their experimental nature and limited scale, many pilots demonstrate good practice and provide valuable insights into achieving CIS that promote adaptation. An emerging view holds that transition to scale to promote effective adaptation, for example within smallholder farming communities, requires sustained dialogue among all actors across the climate information value chain: climate information users, intermediaries and producers. There is, however, insufficient evidence on how to best enable this dialogue, and on the other key factors for success.

1.2 Research questions and structure of the working paper

This working paper seeks to understand the key constraints to and enablers of scaling up CIS, as revealed by case studies and expert opinion in Africa and South Asia. We concentrate here on CIS for agricultural decision making, typically in a smallholder, semi-arid context, and we do not cover climate information related to disasters and early warning systems (EWSs).

The paper builds on a session organized by the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA) at the Ninth International Conference on Community-based Adaptation (CBA9) in Nairobi, Kenya (23–30 April, 2015), which explored opportunities for and constraints to the sustained provision and uptake of CIS in developing countries in Africa and South Asia.[1] This information has been complemented by a review of relevant literature and further inputs from key experts (researchers and practitioners).

We base our approach to understanding CIS scaling up on the belief that a sustainable end-to-end CIS (from production to processing to communication to end user and back to producer) is necessary for climate-resilient food production in most developing country communities. We view the concept of a climate information "chain" as more of a cyclical process, given the desirability of feedback from end user to producer.

Thus, the overarching objective of this working paper is to explore the factors favoring or hindering a smooth and sustainable transition from innovative pilots to large-scale adoption of CIS among various actors. These include end users, such as communities and decision makers, as well as intermediaries, such as extension workers and organizations working with communities. We use insights from our information sources (literature review, case studies and expert opinion elicited through facilitated group discussions—see Annex 1) to explore five questions:

- What is the **role of pilot champions and intermediaries** in scaling up CIS?
- What **gaps in capacity and capacity building approaches** hinder scaling up pilot initiatives?
- What is the **role of information and communication technologies (ICTs)** in scaling up CIS?
- What are the barriers to and enablers of **sustaining effective partnerships**?
- How do we **finance the transition** from innovative pilots to large-scale initiatives?

The paper begins with a discussion of key concepts and terminology (Section 2), followed by an overview of the current state of CIS in South Asia and Africa (Section 3). This is followed by an exploration of each of the five research questions, to highlight insights into the barriers to and enablers of scaling up (Section 4). The final section discusses and

[1] This entailed presentations by keynote speakers on experiences of successful CIS, facilitated group discussions, and insights from experts discussed in a plenary. Annex 1 has further details on the session.

synthesizes the findings into a set of key messages for scaling up the provision of CIS to promote climate risk reduction and adaptation (Section 5).

2. Concepts and terminology

2.1 Climate information and climate information services

Climate information (CI) includes historical observations, short-term forecasts, and medium- to long-term projections. While short-term CI encompasses weather and seasonal forecasts with timespans of typically less than a year, medium-and long-term projections focus on changes to the climate, as opposed to weather, on decadal, multi-decadal and centennial timescales. Observations can encompass both the more formal, science-based measurements, as well as indigenous, local and traditional observations.

Climate information services (CIS) move beyond the generation of information to the institutional framework for interpreting and disseminating it, and ensuring information uptake. The World Meteorological Organization (WMO) defines climate services as *"the dissemination of climate information to the public or a specific user. They involve strong partnerships among providers, such as NMHSs, and stakeholders, including government agencies, private interests, and academia, for the purpose of interpreting and applying climate information for decision making, sustainable development, and improving climate information products, predictions, and outlooks."*[2] In this paper, we use this definition of climate services as a synonym for what we term CIS. Such a definition places an emphasis on the *processes and actors* that facilitate dissemination and uptake of climate information, as well as the integration of such information into development and risk management plans.

2.2 Barriers and enablers

In this paper, *barriers and enablers* are understood as factors that hinder or help the process of scaling up CIS from pilots that are typically program-based, to longer-term, sustainable systems where CIS are mainstreamed into decision-making processes. While barriers include factors constraining the uptake of climate information into decision making, enablers are factors that can improve the uptake of climate information and aid decision making (Jones et al. 2015). We note that barriers and enablers may be technical, infrastructural, informational, financial, socio-cultural, cognitive or capacity-related in nature.

[2] https://www.wmo.int/pages/themes/climate/climate_services.php [Accessed on 26.07.2015]

2.3 Users and producers of climate information

Users of climate information include (i) individuals or groups of people using climate data and information to manage risks; and (ii) people translating information on climate variability and change and its impacts to inform decision making (for example, policymakers). *Climate information producers* include meteorologists, climate modelers, sectoral scientists using model outputs to run hydrological or crop models, and translators modifying weather and climate forecasts into information suitable for various users (Goddard et al. 2010).

It is worthwhile to note that researchers are beginning to distinguish the binary "users-producers" from the emerging process of climate services "co-production"; i.e. processes in which the artificial barriers between "those who have information" and "those who do not" are dissolved (Tall et al. forthcoming). Farmers and climate forecasters are thus brought together in climate knowledge co-production, building on both scientific and local/traditional knowledge to co-produce localized climate services that meet the needs of local communities vulnerable to the impacts of a changing climate (Tall et al. 2014a).

Intermediaries and boundary organizations also play a role in creating demand for climate information and facilitating its delivery. In the context of this paper, *intermediaries* refers to the actors who occupy the space between users and producers of CI and facilitate their interaction. We note also that there is overlap between these different groupings along the CIS value chain or system. Intermediaries include agricultural extension officers, local NGO workers, community mobilisers and leaders, diverse pilot champions, and actors such as shopkeepers and farmers' groups. These intermediaries serve as "the missing link" – an essential but often missing junction between local and national levels, vulnerable communities and forecasters. *Boundary organizations* constitute a particular subset of intermediaries that cross practice, policy and science boundaries, and serve as knowledge brokers, as well as agents of capacity building and network building.

3. State of climate information services in Africa and South Asia

3.1 National meteorological services across both regions

Most countries in Africa and South Asia provide agrometeorological information[3] to farmers through NMSs and agricultural extension systems. These systems for providing CIS vary across countries with respect to the timescale of information, process of developing advisories and their presentation, and targeted end users (Table 1).

[3] Meteorological information processed to help people understand agricultural impacts, manage risk and make informed decisions.

Table 1 National Meteorological and Hydrological Services in Africa and South Asia

Aspect of CIS	Africa	South Asia
Timescale	10-day or monthly agrometeorological bulletins and advisories from NMHA, supplemented by the Southern African Development Community (SADC) Climate Services Centre. Some NHMAs issue a seasonal forecast with applied advice[4]	Issue agrometeorological bulletins and advisories, ranging from 5-day forecasts at district level (India) through 10-day agrometeorological forecasts and one-month forecasts for agricultural planning (Bangladesh) to seasonal forecasts
Presentation of data	95% of agrometeorological units (AMU) present their data in the form of text, tables and graphics	Mix of text, graphics and verbal advisories
Process of building advisories	Agricultural research and extension agencies are not generally involved in the preparation or dissemination of agrometeorological bulletins, although a few are involved in data collection. However, this varies across countries[5]	Agricultural research and extension agencies are involved in the preparation and dissemination of agrometeorological bulletins
Target audience/end user	Most agrometeorological bulletins target government agencies, NGOs, and regional and international organizations, whilst only 20% target researchers, farmers, agencies responsible for EWSs and the general public	Products target government agencies, large farming and industry companies, and farmers
Feedback mechanism	80% of the AMUs have not made any effort to obtain feedback from users; where feedback is sought, the process is not regular or systematic	No systematic effort is made by the Asian National Meteorological and Hydrological Services (NMHSs) to obtain feedback from users
Additional information	Most of Africa's NMHSs (90%) have not attempted to assess the economic value and benefit of the information provided in agrometeorological bulletins; about 70% make an effort to issue specific bulletins to address extreme events	Some limited efforts are made to assess the economic value and benefit of the use of information provided. Early warnings are given and distributed to the authorities

Source: Collated from Sivakumar (2006), Ziervogel and Zermoglio (2009), and expert opinion from our reviewers

[4] For example, the Kenya Meteorological Department (KMD), NMA Ethiopia, and Department of Climate Change and Meteorology (DCCM) Malawi, supported by their respective Regional Climate Outlook Forum (RCOFs); in Kenya, seasonal advisories are developed for the whole country, while agrometeorological advisories are developed only for high production zones.

[5] Kenya has a formally mandated role for CI dissemination, but the linkage from NHMA to agricultural extension staff is weak given poor staffing in meteorological stations (with respect to numbers and capacity).

International networks and initiatives aimed at providing better CIS also play an important role. One of these is the Global Framework for Climate Services (GFCS), launched by the WMO at the World Climate Conference in 2009 in Geneva. A UN-mandated initiative that is accredited by more than 150 governments, the GFCS's main aim is to coordinate the development, delivery and implementation of climate services worldwide.[6]

With the emergence of more relevant and timely climate information, there is growing recognition of the potential of CIS to assist farmer decision-making, which has led to changes in traditional agrometeorological information services (Jost 2013). Agricultural extension services have evolved into a range of models that spans decentralized extension services (e.g. in Uganda), state-controlled information delivery (e.g. Ethiopia), and state-led models that use private and NGO actors for service delivery (e.g. India's Integrated Agrometeorological Advisory Service (AAS) program). The following sections provide additional regionally differentiated information on the state of CIS in Africa and South Asia.

3.2 Africa

NMHSs have been operational in most African countries for approximately 20–25 years (Sivakumar 2006). Additionally, there are several regional centers that provide climate information:

- The **Global Framework for Climate Services (GFCS)** has launched the Climate Services Adaptation Program in Africa. This partners with the Consultative Group on International Agricultural Research (CGIAR) Research Program on Climate Change Agriculture and Food Security (CCAFS) to help develop user-driven climate services for food security, health, and disaster risk reduction in Malawi and Tanzania. The GFCS is also working with National Meteorology Agencies (NMAs) to support the development of climate services across Africa.
- The **African Centre for Meteorological Application and Development (ACMAD)**[7] based in Niger is a continental institution that prepares and disseminates climate products and services across Africa. These include monthly and seasonal forecasts, and warnings on extreme events. In addition, ACMAD is facilitating the exchange of information and expertise between NMHSs, and working to build a critical mass of African climate scientists. The Centre does not, however, produce climate predictions from models.
- The **IGAD Climate Prediction and Applications Centre (ICPAC),**[8] which was set up in 1989 with headquarters in Nairobi and a sub-center in Botswana, provides climate monitoring and early warning prediction services to the Greater Horn of Africa (GHA) region: Burundi, Djibouti, Ethiopia, Eritrea, Kenya, Rwanda, Somalia, Sudan, Tanzania

[6] The GFCS aims to enhance the quality, quantity and application of climate services across the globe. The four priority sectors of the GFCS are agriculture and food security, water, health, and disaster risk reduction. A fifth sector being added is energy since it a mediator (and often constraint) in all other sectors.
[7] http://www.acmad.net/new/.
[8] http://www.icpac.net/

and Uganda. ICPAC provides ten-day, monthly and seasonal climate/weather bulletins, El Niño updates, and annual climate summaries.

- The **Southern African Development Community (SADC) Climate Services Centre** [9] in Gaborone, Botswana, releases medium-range (10–14 days) and long-range (3–6 months) climatic outlook assessments that are disseminated to local communities by NMHSs in 15 member countries.

The ICPAC in Eastern Africa and SADC Climate Services Center in Southern Africa have set up knowledge sharing platforms such as regional climate outlook forums (Greater Horn of Africa Climate Outlook Forum (GHACOF) and Southern African Regional Climate Outlook Forum (SARCOF)) to produce and distribute regional seasonal climate information, with a primary focus on seasonal forecasts.

The donor attention received by Africa in the field of climate change adaptation (Ziervogel and Zermoglio 2009) has indirectly helped finance institutionalization and strengthening of CIS. However, as noted in the Intergovernmental Panel on Climate Change's (IPCC's) Fifth Assessment Report, making climate information more reliable and accessible remains a pressing and cross-cutting adaptation need, related *inter alia* to the under-resourcing of meteorological agencies and a lack of in-country expertise on climate science and modeling (Niang et al. 2014).

Currently, there are several multinational, donor-driven initiatives operational across Africa (Table 2).

Table 2 Multinational initiatives to provide climate information services across Africa

African institution	Other partners	Products/services	Operational in
ICPAC	Rockefeller Foundation	Agro-meteorological products in easily understandable formats	Africa
Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA)	• International Development Research Centre (IDRC) • Rockefeller Foundation • International Crops Research Institute for the Semi-Arid Tropics/CCAFS	• Evaluation of the usefulness of forecasts in farm-level decision making • Agrometeorological advisory services • Communicating probabilistic seasonal climate forecasts	• Kenya, Tanzania, and Ethiopia • Ethiopia, Kenya and Uganda • Kenya

[9] www.sadc.int/

Regional Centre for Training and Applications in Agricultural Meteorology and Operational Hydrology (AGRHYMET)	CCAFS	Strengthening the capacity of farmers and NMHS on seasonal forecast communication and evaluation	Kaffrine (Senegal), Segou (Mali), Yatenga (Burkina Faso), Lawra-Jirapa (Ghana) and Kollo (Niger)
West African Regional Climate Outlook Forums (RCOF), Prévision Saisonnière en Afrique de l'Ouest (PRESAO)	WMO and other international climate centers (e.g. the International Research Institute for Climate and Society (IRI), UK Met Office, Météo-France)	Developing, distributing, and discussing potential applications of a consensus forecast of rainfall and sometimes other variables for the coming season. PRESAO releases forecasts that target the monsoon season of the Sahelian belt, and produces monthly updates	Sahelian belt

Source: Adapted from Sivakumar et al., 2014; Ziervogel and Zermoglio, 2009

Although studies in Africa have revealed a demand from farmers for CIS, widespread uptake is constrained due to knowledge gaps[10] (Dinku et al. 2014, Jones et al. 2014), communication failures (Jost 2013, Hansen et al. 2011), lack of integration of climate into policy and practice (Dinku et al. 2014) and the large gap still existing between forecasters and community needs (Tall 2010). This is true despite increased funding and focus in Africa in recent decades on the provision of timely and effective CIS. While Table 2 indicates several regional and international research collaborations, particularly with a climate science focus, efforts towards improving the uptake of information to shape decision making are more recent, and largely led by boundary organizations. This is further discussed in Section 3.1.

3.3 South Asia

In South Asia, the development of advanced modeling capabilities, a long history of robust data collection, and well-established extension services have resulted in CIS with a strong institutional architecture and well developed research capacity, particularly in India and Bangladesh.

[10] These gaps include discrepancies between observations and model outputs, lack of regional climate forecast at scales relevant to decision makers, and estimates of local economic impacts of climate change.

India's AAS program, led by the National Centre for Medium Range Weather Forecasting (NCMRWF), was initiated in 1988. Today it reaches more than three million farmers (Sivakumar et al. 2014). In 2008, the District-level Agro-meteorological Advisory Service (DAAS) began to generate 5-day district-level agro-meteorological advisories based on weather forecasts, and to disseminate this information in English and a local language through radio, television, newspapers and telephones. The DAAS is often showcased as a model for integrated agrometeorological advisories that can influence farmer decisions making because it has a 4-tiered system: meteorological (weather forecasting), agricultural (identifying how weather forecasts affect farming), extension (two-way communication with users) and information dissemination (media, IT and others).

In Pakistan, the Pakistan Meteorological Department (PMD) is responsible for weather advisories for different sectors. The PMD operates on a wider scale by providing services related to different areas including surface weather data, earthquake data, astronomical data, and flood forecast and warning. The National Agromet Centre (NAMC), established in 1988, is the PMD's dedicated agricultural division, which manages the agrometeorological station network, processes and publishes data, predicts weather-based crop yield, estimates production for central planning and food production strategies for agrometeorological advisories, and conducts research.

In Bangladesh, the Bangladesh Meteorological Department (BMD) issues one-month forecasts for agricultural planning and 10-day agrometeorological forecasts for regular agricultural operations. Related initiatives include the Regional Integrated Multi-Hazard Early Warning System for Asia and Africa (RIMES), the South Asian Association for Regional Cooperation (SAARC) research program, and the WMO-supported countrywide climate service development initiative in Bangladesh.

Nepal's Department of Hydrology and Meteorology (DHM) collects, manages and analyses weather data. However, information delivery infrastructure is poorly developed in the country and the use of innovative channels such as ICTs is negligible. Other actors have stepped in to fill some of these gaps: National Information Technology institutes are issuing agricultural advisories by telephone or on the Internet in 21 villages in eastern Nepal (Ramakrishna 2013); and the Asian Disaster Preparedness Centre (ADPC) and RIMES develop weather forecasts through monsoon forums and seasonal forecast applications.

Several multinational initiatives in South Asian countries are working on different aspects of CIS (Table 3).

Table 3 Multinational initiatives to provide CIS in South Asia

Products/services	Operational in	Asian institution	Other partners
Finnish-Nepalese Project for Improved capability of the Government of Nepal (FNEP)	Nepal	Nepalese Dept. of Hydrology and Meteorology;	Finnish Meteorological Institute
SHSB (Strengthening Hydro-Meteorological Services for Bhutan)	Bhutan	Bhutanese Dept. of Hydro-Met Services	
Building Resilience to Climate Hazards (BRCH) project to transition Nepal's NMHS into a modern service-oriented system Establishment of an Agriculture Management Information System (AMIS)	Nepal	Government of Nepal	World Bank
Scaling up Climate Services for Farmers in Nepal	Nepal		CCAFS

Source: Adapted from Sivakumar et al., 2014

In countries like India and Bangladesh, which have advanced agrometeorological extension systems, current challenges include providing locally relevant information that can inform farmer decision making. In countries such as Nepal, where CIS are not well developed, agrometeorological infrastructure, services, and human capacity are current barriers to expanded use and impact of CIS (Tall et al. 2013). Thus, for example, forecasts are given for the next two days in Nepal without advice on the impacts of these forecasts on agricultural output.

In conclusion, while CIS are developed to varying extents within South Asia, issues of reliability of information and its uptake by decision makers (both farmers and policy makers) remain. India has demonstrated a relatively successful model of upscaling CIS by mainstreaming it in the national extension network, engaging multiple actors at multiple scales, and utilizing a multiplicity of communication channels to reach the last mile and ensure farmers receive tailored climate services in support of their farm decisions (Tall et al. 2014). The CCAFS has contributed to this landscape by introducing innovative models such as "climate-smart villages";[11] understanding the factors that enable such models to work in a certain context is critical.

[11] Recently, the Department of Agriculture, Government of Haryana, in India has supported scaling out climate-smart agriculture from 28 to 500 villages across the state. https://ccafs.cgiar.org/blog/haryana-says-yes-more-climate-smart-villages [Accessed on 25.07.2015]

3.4 Summary: state of CIS in Africa and South Asia

The past decade has seen a growing recognition of the role of climate science in informing adaptation decision making and a simultaneous increase in sophistication of models and instruments used to understand climate and climate change impacts. However, the translation of model outputs into information that can be used to inform risk management at different levels remains a challenge (Goddard et al. 2010, Ziervogel and Zermoglio 2009). To address this, a variety of initiatives has been instituted, strengthened and fostered in Africa and South Asia. While South Asia (especially India) has a strong tradition in providing agrometeorological services through a large agricultural extension network, provision of CIS in Africa has been led by a range of actors, including donors, international research organizations, INGOs, governments, and regional networks.

However, it is important to note that within large countries like India, variation in CIS delivery is high. For example, CIS in West Bengal is characterized by the absence of specific NGO initiatives, lack of access to CIS other than cyclone early warnings, and limited use of government- or private sector-generated climate information, a condition not much different from that in much of Africa. In both regions, there has been a focus on providing short-term forecasts with lower emphasis on medium- and long-term information and integrating such information into decision making (Jones et al. 2015). Most critically, across both regions, feedback from end users to information providers and producers is limited (Sivakumar 2006), which leads to the information being supply-driven and not demand-led. In the following sections, we provide a discussion of promising case studies that provide an alternative through their incorporation of a feedback loop from end users back to producers of climate information.

Some innovative pilot studies are now experimenting with integrating historical data with short-term and long-term forecasts and embedding it in local knowledge systems to build scenarios in a participatory manner (e.g. Dorward 2013). Recognizing the need for climate information to be locally relevant and of use to decision making, CIS have now expanded to some extent to include value-added services such as climate impacts on agriculture, and bundling CI with market and crop information to issue farmers' advisories. The best way to facilitate the transition of such promising pilots to longer-term sustainable CIS that are embedded in national governments and are not externally driven remains to be understood and institutionalized. The following section draws together emerging insights and lessons from the literature, case studies and expert opinions elicited for this working paper, towards answering the five key research questions posed in section 1.2.

4. Scaling up pilot initiatives: lessons from case studies and expert opinion

Key issues identified in the literature that constrain the scaling up of CIS pilot projects include difficulties in regular capacity building for intermediaries (Mantilla et al. 2014, May and Tall 2013), sustaining effective long-term partnerships among multiple stakeholders, and funding beyond the pilot phase (May and Tall 2013). These and other constraints are discussed in this section, together with enabling factors and new developments such as the innovative use of ICTs for delivery of CIS. We provide examples from several projects that include the feedback loop mentioned above. The Participatory Scenario Planning (PSP) example in Kenya (Box 1) enables producers and end users to interpret CI together, as well as allowing end users to communicate their information needs directly to providers. One of the key factors for successful piloting and ultimately scaling up of CIS identified from our information sources is the strong role played by champions and intermediaries, discussed next.

4.1 Role of pilot champions and intermediaries

Champions from within the community, local civil society, and policy actors have frequently been identified as catalysts for scaling up and spreading the adoption of specific technologies and processes. Examples of such champions include community actors who support existing government extension services and widen their reach among target beneficiaries (Arnold et al. 2014, Srinivasan et al. 2011), actors within NGOs and governments that facilitate the scaling up successful pilot projects on community-based adaptation (Reid et al. 2010), and people not directly involved in a particular intervention but who are nonetheless influential through their decision-making powers (Chaudhary 2014).

With respect to CIS, research and practice have highlighted the role of pilot champions identified by the community in engaging other community members in the processes of information collection, interpretation, and utilization of climate information, as well as in driving the CIS scaling-up process (Tall et al. 2012). Community-based pilots can not only ensure face-to-face interactions after the project scales up, but also involve multiple stakeholders in the engagement process.

Moreover, as noted in the expert-led group discussions at CBA9, “development champions” can design pilots to ensure effective transition to scaled-up climate services. This entails understanding how and when researchers and developers should optimally exit project leadership without interrupting the unfolding process leading to effective long-term adaptation.

In addition to champions, the role played by intermediaries and boundary agents—such as agricultural extension officers, local NGO workers, and in some cases shopkeepers, retailers, community mobilisers and leaders, and farmer groups—can be decisive in the delivery and scaling up of CIS (Christian Aid 2015, Vogel and O'Brien 2006). These intermediaries not only serve as brokers between providers and users of information but also interpret scientific CI to inform farmer decision making.

- **Extension workers** are effective intermediaries because they are embedded in the extension system and are often highly trained (May and Tall 2013). Former extension workers are also important intermediaries, since they have developed a relationship of trust with community members, and have experience and knowledge of the use and scope of climate information. However, extension workers may face issues of acceptance and be mistrusted, for example in situations where they are tied to government policies promoting blanket agricultural practices that do not reflect farmer priorities, or local agro-ecology and resilience needs. In the face of inadequate relevant training courses (discussed further in Section 4.2), extension workers tend to be weak on participatory methods designed to understand farmer priorities.
- **Boundary organizations,** such as the Asian Disaster Preparedness Centre (ADPC), prioritize mainstreaming climate information into existing institutional systems and processes and facilitate a two-way, multi-stakeholder dialogue of interpreting and using climate information (Srinivasan et al. 2011). Organizations such as the Stockholm Environment Institute, CGIAR, and START International also function as boundary organizations and traverse the science–society boundary (Ziervogel and Zermoglio 2009).[12]
- **Local NGOs** also act as boundary bodies since they can bridge the gap between farmers and other actors, and have a good understanding of wider economic and political dynamics as well as local issues. They tend to use participatory methodologies that focus on a demand-led agenda for project deliverables. However, NGO coverage remains a drawback; for example, even in areas of India that are relatively densely populated with local NGOs, coverage rarely exceeds 5–10% of farmers (Richard Ewbank, Christian Aid, personal communication). Moreover, NGO staff may face issues of continuity since they are locked into project deliverables, funding availability, and organizational agendas. Local NGOs face additional difficulties in retaining their highly skilled meteorological and agricultural extension staff. This is exacerbated by fluctuating availability of funds (Christian Aid 2015).

As women's access to climate information is significantly lower than men's, especially through ICTs (McOmber et al. 2013), there is need for structural changes in potential intermediary institutions providing CIS and agriculture extension services. Interestingly, there is a gendered aspect to trust in intermediaries: work in Malawi, carried out under the Global Framework for Climate Services Adaptation Program in Africa, showed that while

[12] For example, START International fosters regional researcher networks, facilitates information flow to policymakers, and builds capacity for young researchers.

farmers tended to trust information from government extension agents, radio presenters and NGOs, women farmers particularly trusted NGO staff (Coulibaly et al. 2015).

In addition to the roles of champions and intermediaries—key *actors* in the promotion and sustainability of CIS—the nature of engagement and knowledge creation *processes* help to determine the reach and uptake of CI. For instance, innovative processes of engagement can help to bring in to the CIS value chain previously marginalized groups of people or those previously unable to use climate information or see its relevance for their decisions. Box 2 below highlights the ongoing two-way dialogue between farmers, scientists and international and local technical experts employed in the R4 Rural Resilience Initiative. Furthermore, expert opinion voiced during the CBA9 workshop emphasized the necessity of innovative ways of linking local knowledge to scientific climate information. Approaches such as that of the R4 Initiative not only promote dialogue, but are also instrumental in bringing together multiple sources of climate information, from farmers' experiences of extreme events to satellite-based climatological products.

Several other examples of the success of bringing together diverse sources of CI and using participatory approaches to help users interpret it can be found. Using an innovative participatory workshop process in rural Tanzania, Girvetz et al. (2014) have demonstrated that it is possible to transfer climate change expertise from external experts to people living in the region. They used different types of climate information, such as historical information and future projections, to facilitate stakeholder engagements that helped communities understand future climate impacts and chart out potential adaptation strategies. Pilot programs of the Participatory Integrated Climate Services for Agriculture (PICSA) initiative in Zimbabwe and Tanzania have shown that providing a combination of historical climate data, seasonal forecasts and participatory planning approaches works well to help users understand existing stressors and plan for near-term future changes (Dorward 2013).

However, participatory knowledge sharing with groups of farmers and interpretation of CI by extension officers or NGOs is essential from the outset. Once this builds a working relationship and familiarity with the use of climate CI, scaling up can begin. The case study below, on PSP in Kenya, highlights the importance of the **co-production of actionable and meaningful CI** by the meteorological services and local users, as well as the creation of **new and non-traditional relationships** that allowed for climate-informed and coordinated planning to support community adaptation actions.

Box 1 Case Study 1: Participatory Scenario Planning in Kenya

At the IDRC/CARIAA-organized parallel session at CBA9 on CIS for effective adaptation, Maurine Ambani of the ALP—implemented by CARE International—discussed how pilot projects in Africa have been focusing on multi-stakeholder, multi-sector interactions to access and understand seasonal climate forecasts, and translate them into information that is useable and relevant for adaptation decision making, especially in agriculture. Two notable initiatives are CCAFS's work in Mali and Senegal, and CARE International's implementation of PSP in Kenya, Ghana and Niger. The PSP entails a multi-stakeholder forum, bringing together national and local meteorological services, local forecasters, community representatives, government departments, research institutions, NGOs/CBOs and other local stakeholders to discuss and interpret seasonal climate forecasts for a local area. Piloted in one county in Kenya, the PSP has now been up-scaled to all 47 counties in Kenya, through collaboration between ALP, the Kenya Meteorological Service (KMS) and the Agriculture Sector Development Support Programme of the Kenyan Ministry of Agriculture, Livestock and Fisheries. The PSP approach has also been out-scaled/adopted/ replicated by a range of actors together with NMHS in Ghana, Ethiopia, Niger, Malawi and Tanzania. The enablers identified for scaling up from one county in Kenya to other counties and African countries are:

Multi-stakeholder interaction and dialogue: Involving government departments (e.g. agriculture, water, and disaster management authorities), intermediaries (NGOs, community leaders, media) and users (farmers and pastoralists) in a joint implementation of the approach resulted in effective and collective CIS delivery. Partnerships were built between the KMS and the UK Met Office to downscale national seasonal forecasts to the sub-national level.

Better interpretation, packaging and communication of climate information so that the community can understand it and relate it to decisions on actions needed to take to manage climate risk, uncertainty and opportunities in a given season. For example, developing scenarios to interpret what "above normal", "normal" and "below normal" rainfall means in a local area in terms of climate hazards, risks, opportunities and impacts (Ambani and Percy 2012).

Championing integration of CIS into policy, plans and practice: In the policy sphere, CSOs in Malawi are champions of the PSP approach, and their work has resulted in a draft Meteorological Policy recognising PSP as an adaptation planning approach that influences policy towards supporting community resilience. In the planning realm, close collaboration, partnership with and capacity building of local governments in different sectors, in particular local planners and agriculture services, has seen PSP becoming a locally owned and driven approach. This has resulted in the approach being written into County Integrated Development Plans in Garissa County, Kenya and receiving budgetary allocation from two District Medium-Term Development Plans in Northern Ghana. In the practice domain, champions are promoting integration of the PSP approach into existing DRR, adaptation and agriculture projects in Uganda, Mozambique, Ethiopia, Rwanda and Somalia.

As a result of the above approach, two key transformations in the CIS delivery process were observed. First, there was focus on co-production of actionable and meaningful CI between the meteorological services and local users. This built acceptance of the meteorological services and helped communities appreciate the value of climate information in developing innovative solutions for managing risk and identifying opportunities. Second, new and non-traditional relationships were created, which opened up space for a diverse number of actors, who would not normally sit together to plan, to engage in climate-informed and coordinated planning to support community adaptation actions.

Source: Maurine Ambani, CARE International

Making participatory engagement iterative is also important. For example, in a pilot project in Uttar Pradesh, India, Gorakhpur Environmental Action Group (GEAG) implements a project where farmers have a monthly feedback session with GEAG staff and a GEAG meteorologist. This enables farmers to provide feedback on forecast reliability and the usefulness of the accompanying advice, to clarify any misunderstandings, and to register new users for the SMS service. The participatory and iterative approaches implemented by GEAG, and those discussed in Box 1, are important not only in terms of increased efficacy and ownership, but also with respect to community agency and shifting what may have been expert- or elite-heavy power relations in the development process towards a more equitable process that is likely to also promote sustainability. Such approaches also promote the fair inclusion of women, as well as other vulnerable and marginalized groups. The proviso is that adequate investments into capacity development that build necessary participative and other skills are made over a sufficiently long period, discussed next.

4.2 Capacity building

Expert-led discussions at CBA9 identified inadequate capacities at all scales as a significant bottleneck to disseminating, using and scaling up CIS. To overcome this, experts suggested that:

- extension officers need to understand and interpret information to relate to decisions and activities on the ground;
- meteorological departments need to supply demand-driven information and communicate it in a user-friendly manner that is contextual; and
- communities need to be trained in interpreting climate information and advisories and drawing links to action.

The lack of sufficient numbers of well-trained staff is repeatedly identified as a bottleneck to improving CIS provision (Gebru et al. 2015). A number of studies point to the need for sustained training for intermediaries, such as extension officers and NGO workers, in order to scale up pilot CIS initiatives (Visman 2014, May and Tall 2013, Venkatasubramanian et al. 2012). Reviewing the state of CIS, Goddard et al. (2010:81) find that to enable effective dissemination, uptake and application of climate information, it is necessary to establish and/or strengthen “chains of experts and communications”. Moreover, capacity development initiatives need to understand why certain groups within communities are able to access climate information and advisory services and others are not; very often, this differential has to do with issues of power and privilege, and is present along gender lines (Tall et al. 2014c). Where this is the case, tailored approaches to CIS that accord with local cultural contexts need to be implemented, supported by the necessary capacity development along the CIS system.

An important aspect of addressing capacity gaps concerns understanding the inherent uncertainty of probabilistic forecasting and combining this with local climate knowledge. Climate scientists tend to provide deterministic advisories based on probabilistic forecasts, under the impression that providing users with more accurate information on the uncertainty in a forecast will confuse them. However, since communities usually have their own forecasting systems based on local knowledge, which are themselves probabilistic, relating scientific forecasts to local knowledge can result in them being understood and aiding in decision making, as opposed to triggering understandable skepticism of forecast utility when it inevitably proves not to be 100% accurate (Richard Ewbank, Christian Aid, personal communication). These kinds of insights need to be built into capacity development approaches, to ensure that service providers and boundary agents are able to reach and assist the poorest and most vulnerable groups to use CIS to build the resilience of their livelihoods.

Using innovative and varied methods to build capacities, such as in the case of Ethiopia's R4 Rural Resilience Initiative (Box 2), can help to achieve project objectives and pave the way for future scaling up. In addition to developing tailored approaches to capacity building, the R4 Rural Resilience Initiative carried out training for farmers through hands-on exercises using real case study data and employed a play- or games-based approach, using scenarios on climate information sharing and collaborative development.

Box 2 Capacity building through participatory techniques: illustrative case of the R4 Rural Resilience Initiative, Ethiopia

The R4 Rural Resilience Initiative, launched by Oxfam America and the World Food Program, is a climate change resilience project. In Ethiopia, R4 entailed collaborating with local partners and farming communities to develop and provide rainfall-based index insurance for farmers. This project relies heavily on a foundation of climate services that the International Research Institute for Climate and Society (IRI) of Columbia University has helped develop in East Africa, to enable end-user driven processes. The project has successfully scaled up from 200 farmers' transactions in 2009 to over 19,000 in 2012, and has been expanded to include Senegal and is being piloted in Malawi and Zambia. The reasons noted for successful scaling up are:

- **Participation of multiple stakeholders:** local NGOs (e.g. the Relief Society of Tigray), government agencies (e.g. the Ethiopian Ministry of Agriculture and Ethiopian NMA), financial institutions and farmer communities
- **Innovative use of different types of information:** multiple sources of climatological information, including Africa Rainfall Climatology (ARC) satellite rainfall estimates and satellite-based climatological products (e.g. ENACTS), NMA's rain gauge network, and local expert and farmer experience of extreme events and agro-ecological characteristics.
- **Two-way communication through participatory processes:** continuous dialogue between international and local technical experts, scientists, and farmers, making climate information demand-driven.

Capacity development: **training for farmers through hands-on exercises using real case study data, playing through scenarios involving climate information sharing and collaborative development, and tailoring of capacity building materials with help from IRI.**

Source: Adapted from Dinku et al., 2014

Capacity building at multiple scales may be required. For example, India's successful AAS program has shown that providing climate information at scale, to 3 million farmers, is possible only if significant investments are made in building capacity in agricultural research centers and meteorological services at national, sub-national and local levels (Venkatasubramanian et al. 2012).

Participatory training workshops and informal exchanges are effective in facilitating communication between farmers, extension workers, and scientists as well as in building continuity and trust (Girvetz et al. 2014, May and Tall 2013). Participatory interpretation of climate information is also important before upscaling, as without consensus building, information uptake can be limited (Gakuru et al. 2009). Although it is often argued that lack of relevant climate information impedes its uptake for decision-making, research in Tanzania has shown that even in data-sparse areas, climate change adaptation planning is possible if appropriate scientific analyses are complemented by engaging stakeholders through facilitated processes (Girvetz et al. 2014).

Another example of using facilitated dialogue to build capacity and enable access across actors and scales lies in the CCAFS-led national multi-stakeholder workshops. These workshops bring providers face-to-face with users across Africa to determine the most relevant CIS to co-develop in order to meet the information needs of vulnerable communities.[13] From 2009 to 2012, Early Warning-Early Action workshops were held across Africa (Senegal, Kenya, Uganda, Ethiopia, Niger, Burkina Faso and Mali), to help bridge the gaps between national CI providers, boundary organizations and community users, and to provide a framework for developing user-driven CIS at multiple scales (Visman 2014).

Even where capacity development initiatives for CIS have been implemented, they may not necessarily have accommodated the needs of women. For many years, there has been an assumption that the negative impacts of climate change and the efforts to mitigate them have similar effects on both women and men. However, the world has progressively recognized that women and men experience climate change differently, and that gender inequalities worsen women's coping capacity. It has also been acknowledged that women are important actors of change and holders of significant knowledge and skills related to adaptation, mitigation and the reduction of risks in the face of climate change, making them crucial agents in this area. Yet women usually have the least input into planning, policy development and decision making. Gender has gained increasing recognition as an important issue to consider in designing and implementing CIS initiatives. Since men and women tend to have different risk profiles, they tend to have different types of demand for CIS (McOmber et al. 2013, Roncoli et al. 2009). As Tall et al. (2014c) point out, gender-specific climate service needs encompass both the type of climate information required as well as the nature of communication channels required to reach the most vulnerable in a

[13] For examples of how these workshops are bringing stakeholders together, see https://ccafs.cgiar.org/blog/scaling-climate-services-tanzania#.VdaT97Kqqko [Accessed 20.08.2015]

given cultural context. Coverage of these issues needs to be strengthened in both the content and delivery of capacity development initiatives.

The above discussion underlines ongoing capacity development along the CIS value chain as a critical factor in successful upscaling. The nature of the capacity development process is also identified as crucial, with participatory capacity building approaches that bring together different actors in a continuous, iterative manner being favored over more top-down, linear or one-off interventions. Such empowering and integrative approaches can also promote increased trust between communities and other end users, intermediaries, and producers of CIS. Positive capacity development examples are both multi-actor as well as multi-scalar, as is the case for India's AAS; they also employ innovative approaches such as training for farmers through hands-on exercises using real case study data and employing a play- or games-based approach. The PICSA example from Zimbabwe and Tanzania cited above further highlights the need for sufficient time: while building the capacity of communities to understand and process climate advisories can assist faster scaling up, the process must not be hurried, but rather undertaken at "a realistic pace" (Dorward 2013). There are doubtless additional lessons to be learned about why capacity building efforts in the past failed to yield sustainable results. Attention to the monitoring and evaluation of capacity building efforts is required to assist with building the empirical evidence base for sustainable and effective capacity building approaches for CIS.

4.3 The role of ICTs

Participatory methodologies that facilitate an ongoing process of experiential learning, as described in section 4.1, are increasingly being complemented by new and innovative uses of technology to expand and enhance dissemination of CI. More studies now highlight the role of ICTs and other technological advancements in providing exciting new ways to not only improve dissemination and uptake of CIS, but in so doing to also move beyond traditional agricultural extension services towards more integrated service delivery (Tall et al. 2014b, Hansen et al. 2011). For example, in Pakistan, the University of Agriculture Faisalabad (UAF) launched a mobile phone android application in 2014 called "Horticulture UAF". Realizing that lack of awareness among farmers was the main hurdle to increased production, this application provides information on different crop and fruit diseases, including solutions and ways to increase productivity.

Media (television, plays, bulletins) and ICT-based communication (radio, cell phones, and the internet) are attractive forms of communication since they can provide timely delivery of climate information to rural communities at relatively low cost (Hansen et al. 2011). Mobile phones have shown promise with increasing penetration into inaccessible areas such as with Maasai pastoralists in Kenya. In Tamil Nadu, India, the M. S. Swaminathan Research Foundation has demonstrated the value of internet-based village knowledge centers to provide agrometeorological information services (Rengalakshmi 2007). In Malawi and Tanzania, the utility of interactive radio and mobile phones to deliver climate services for farmers and pastoralists has been recognized (Hampson et al. 2014). In Uganda, it was found that supplying data collectors with mobile phones to send daily rainfall readings and other weather information directly to the national meteorology department for analysis improved data collection and also expanded the menu of services offered, as the phones were also used to collect market price information for local crops and livestock (Gebru et al. 2014).

Scaling up ICT-based delivery systems can be done by integrating different platforms (mobile phones, internet, radio) and exploiting the "benefits of individual platforms while avoiding their limitations" (Gakuru et al. 2009:9). Some successful scaling up transitions have demonstrated the importance of using communication channels imaginatively to make climate information delivery and uptake effective. Examples of successful use of ICTs include Mali's agrometeorological program (Moussa et al. 2012); India's AAS, which uses a mix of bulletins, face to face interactions, and mobile advisories (Tall 2012); and the Grameen Foundation's smartphone-based initiative in Uganda (Box 3). The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), based in India, is also working on South-South partnerships through which they train multiple stakeholders virtually, by knowledge sharing between India and African nations (Tall et al. 2014b).

Box 3 Use of mobile phones for providing short-term climate information: the case of the Community Knowledge Worker initiative in Uganda

In 2009, the Grameen Foundation launched the Community Knowledge Worker (CKW) initiative in Uganda to provide 10-day, monthly and seasonal weather forecasts to farmers on their mobile phones via SMS. Funded by the WMO and Bill & Melinda Gates Foundation, the project was extended to Colombia in 2013 to provide market information, and to Ghana in 2011 to provide health information.

In Uganda, Community Knowledge Workers providing weather information services to over 16,000 farmers through smartphones have found that mobile phones are an effective channel of communication due to increasing penetration into areas not accessible to extension workers.

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Source: Adapted from Grameen Foundation, n.d.

Notwithstanding these positive experiences, scaling up ICT-led pilot-scale successes has been challenging (Gakuru et al. 2009, Hansen et al. 2011). Currently, the potential of using ICTs for delivery of climate information and agrometeorological advisories is constrained by insufficient infrastructure (poor network coverage in remote villages, lack of mobile ownership), low capacity (poor computer and scientific literacy, inadequate understanding of how to access and use SMS-based advisories) and poor institutional linkages (Hansen et al. 2011, Sivakumar 2006). For instance, there are relatively few resources that employ the capability of ICTs in the preservation of indigenous knowledge (World IT Forum 2005). As Adam (2007) has noted, the challenge of applying ICTs to the management of indigenous knowledge include is that collecting information from diverse indigenous sources is often a difficult, time-consuming and costly process; and furthermore, that those with knowledge may not be willing to share it. There are often no adequate frameworks for capturing and making the knowledge available in usable formats to the people who need it, and moreover, they may not have access to ICTs (Modathir Zaroug, CSAG, UCT, personal communication). Even where people own mobile phones, they tend to be mobile phones that have small, often monochrome screens that can deliver limited information, usually in short text messages. Smartphones, on the other hand, offer much more potential but are more expensive so less widespread, although their prevalence is growing (Richard Ewbank, Christian Aid, personal communication). In Africa, of the 120 ICT-enabled farmer advisory services operational (in 2008), 39% used Internet, 32% used mobile phones and SMS services, and 14% used radio (Gakuru et al. 2009). Discouragingly, most were donor-funded pilot projects and were not sustained beyond the project duration.

However, some initiatives are using multiple methods to overcome these barriers:

- In India, the national AAS SMS service reaches 2.5 million farmers across 16 states and voicemails via an Interactive Voice Response System (IVRS) reach 30,000 farmers across five states (Venkatasubramanian et al. 2014). Web-based services have been greatly improved and expanded to provide agrometeorological information to users. However, the most vulnerable still lack easy access to web-based information services. There are 25 physical internet centers across different agro-climatic zones in the country, through which farmers can access “Crop Weather Outlook”, a website launched by the All India Coordinated Research Project on Agro-Meteorology (AICRPAM). In several states, bi-weekly district-wise advisories are made available online.
- Grameen Foundation’s partnership with service provider MTN-Uganda to develop the “Village Phone” model demonstrates how ICT-enabled advisory services can be scaled up by building effective partnerships with private companies (Grameen Foundation 2005).
- The African Farm Radio Research Initiative (AFRRI), initiated in 2007, is operational in Tanzania, Uganda, Kenya, Malawi, Ghana and Mali. It uses rural radio to package and communicate seasonal climate information to 40 million farmers. Participatory Radio Campaigns provide low cost and effective agricultural information services. In Africa, networks of rural radio providers, such as Farm Radio International, serve as platforms for sharing information, experience, training and opportunities for funding.[14]

[14] http://www.farmradio.org/.

Group discussion participants at the CBA9 CIS session cited several additional cases of ICTs being used as powerful vehicles for delivering CIS, but also noted some cautionary caveats. In a Ugandan pilot implemented within the existing system by local staff, a range of communication channels (mobile services, internet, radio, community radio, loudspeakers in markets and newspapers) helped to ensure timely information provision and completeness of information, as well as allowed for feedback (Edith Ofwona Adera, IDRC, personal communication). On the other hand, ICTs should not be regarded as a panacea; we need to first ask what information is needed and at what scale for adaptation planning, and then ascertain whether ICTs can play a role and how (Bettina Koelle, Red Cross/Red Crescent Climate Centre, personal communication).

Another question to pose is whether the application of ICTs is overrated: for example, concerning pastoralists, having phones does not translate into them being used for CIS (Nicholas Abuya, Christian Aid, personal communication). Thus, we need to constantly ask whether *our information speaks to the existing knowledge systems.* Radio may in some cases be a more interactive system that should be used in upscaling activities. For example, in Maasai communities, men go with cattle in the morning and take radios with them, while in the evening, women milk cows and keep the radios with them (Carolyn Manei, University of Nairobi and IDRC, personal communication). Therefore, keeping local practices in mind while providing information and deciding on information delivery systems is critical for upscaling CIS.

4.4 Sustaining effective partnerships

To ensure successful scaling up, experiences cited in this paper repeatedly point to the need for a project to be relevant, participatory, flexible, and successfully operational for a long period. Creating and sustaining effective partnerships along the CIS value chain is emerging as a key enabling factor in realizing these qualities.

Mali's Agromet Program (Box 4) highlights a decisive factor in scaling up: the creation of a multi-institutional framework to promote effective and sustainable partnerships. This framework involved a multidisciplinary team as well as multiple stakeholders (scientists, farmers, extension officers, NGO workers, private sector actors), and helped Mali's program to gain widespread legitimacy, ownership, and accessibility. The Agromet program demonstrates how a pilot can be successfully scaled up if national governments see value in and take ownership of it. In this program, the Government of Mali took over project planning, management and financing after lengthy support by the Swiss Agency for Development and Cooperation (SDC). Ownership on the part of users and the government contributed to the sustainability of scaling up, supplemented by financial support from Italian Cooperation and Spanish Cooperation (Moussa et al. 2012).

Box 4 Initial successes drive demand for scaling up: the case of Mali's Agromet Program

In 1982 Mali's National Meteorological Directorate launched a project to provide climate information to rural communities, especially farmers, with external funding from SDC, assisted by the AGRHYMET center, with technical support from WMO.

- **Experimental phase** (1982–1986) with 16 farmer volunteers in Bancoumana region. Focussed on **building capacity** among agricultural extension agents, establishing processes for information, and developing methods for rapid data processing and advisory generation.
- **Demonstration/extension phase** (1986–1990): the project was extended to train 80 farmers.
- **Scaling up** (1990 onwards): began with a multi-stakeholder workshop to evaluate project to date. Scaling up involved increased coverage (2,000 farmers in 5 districts), production of local rain gauges (to replace imported ones), better flow of information, provision of bicycles to facilitate the transfer of rain gauge data to meteorological stations, and eliciting regular feedback on the project from farmers.

Source: Mousa et al., 2012

Another successful transition from a project to cross-country scaling up is that of the Enhancing National Climate Services (ENACTS) project in Ethiopia (Box 5). The project employed a three-pronged approach focusing on (i) improving data availability by integrating station data with locally calibrated satellite products; (ii) improving data accessibility through an internet-based platform for accessing, querying and visualizing information; and (iii) strengthening user capacity to understand and use climate information and services to achieve success. Building capacity and partnerships with multiple stakeholders were key to achieving these outcomes.

Box 5 Collaborative partnerships are key to scaling up: ENACTS in Ethiopia

ENACTS began with funding from Google.org from 2008-2011. ENACTS aimed to support decision-makers in climate-sensitive sectors by bridging spatio-temporal gaps in existing climate observations and using innovative ICT-based delivery mechanisms (e.g. map rooms). The project was first implemented in Ethiopia and Tanzania and has now been scaled up to Madagascar, Rwanda and The Gambia. The key success of ENACTS has been sustained effort to not only improve data but also data access and use. This has been possible through:

- **Capacity building:** training users and staff at the NMS to interpret climate messages; and
- **Collaborative partnerships:** building partnerships with NMS instead of competing with them. The key partners of the project in Ethiopia were the Ethiopia NMA, the International Research Institute for Climate and Society (IRI), and the University of Reading.

Following successful uptake of the project, its model is being scaled up in Ghana and Mali and will be initiated in Burkina Faso and Zambia in 2015.

ENACTS began with funding from Google.org from 2008-2011. ENACTS aimed to support decision-makers in climate-sensitive sectors by bridging spatio-temporal gaps in existing climate observations and using innovative ICT-based delivery mechanisms (e.g. map rooms). The project was first implemented in Ethiopia and Tanzania and has now been scaled up to Madagascar, Rwanda and The Gambia. The key success of ENACTS has been sustained effort to not only improve data but also data access and use. This has been possible through:

- **Capacity building:** training users and staff at the NMS to interpret climate messages; and
- **Collaborative partnerships:** building partnerships with NMS instead of competing with them. The key partners of the project in Ethiopia were the Ethiopia NMA, the International Research Institute for Climate and Society (IRI), and the University of Reading.

Following successful uptake of the project, its model is being scaled up in Ghana and Mali and will be initiated in Burkina Faso and Zambia in 2015.

Source: Adapted from Dinku et al., 2014

The Grameen Foundation's CKW initiative (Box 3) also demonstrates how partnering with three key organizations has helped to leverage existing networks and expertise, thereby increasing chances of success and future scaling up (Grameen Foundation, n.d.). The three partners are: MTN-Uganda, the country's leading telecommunications provider; the International Institute for Tropical Agriculture (IITA), a research-for-development organization working across Africa and the world; and Uganda's National Agricultural Research Organization (NARO), which provides guidance and coordination for all agricultural research activities in the national agricultural research system in Uganda.

Experts at the CBA9 workshop concurred on the criticality of participatory approaches to sustain effective partnerships, specifying further the importance of community-led problem identification and brainstorming on potential solutions; design of user-friendly climate information to meet demands; and institutionalization of processes that help to build strong partnerships with existing actors, such as national meteorological offices.

Another approach identified is the development of processes and structures at multiple levels, such as establishing multi-stakeholder committees at national, sub-national and local community scales. Such committees should comprise representatives from government departments, NGOs/CSOs, academia, media, and communities. Besides developing and implementing plans to counter negative impacts of climate change (on a 20-30 years scale), such committees would ensure the flow of seasonal and weather advisories generated by meteorological departments up to the community level in a user-friendly mode. Such committees could work closely with the private sector, encouraging it to not only invest in climate resilient development, but also facilitate the flow of information during extreme weather and climate events.

In addition to developing institutions at the local level, developing local climate centers can play an important role in upscaling, including with respect to financing the transition (discussed in more detail in section 3.5 below). As NHMAs expand, there is a need to go beyond the standard of "climate stations as a measuring point" to develop local sources of information. These should be familiar and trusted sources for early warnings and climate advisories for agriculture for the week ahead, as well as medium- and longer-term forecasts and projections that can assist users with community-based resilience planning (Richard Ewbank, Christian Aid, personal communication). Community-managed rain gauges, implemented by many pilot projects, and even more complex climate centers can be part of this process. For example, the Centro Humboldt (see Box 6) has established a Community Climate Monitoring Center, equipped with a rain gauge, hygrometer and thermometer to increase capacity to monitor climate, manage data and provide CIS to surrounding communities, thus creating sustainability at the local level. Christian Aid has partners in Cambodia and the Philippines that have established similar community-managed centers. This approach potentially also lowers the costs of expanding the formal network of weather stations in areas with sparse coverage.

The approach of the Adaptation Learning Program (ALP) at the sub-national level is to encourage local governments to link the seasonal multi-stakeholder discussions resulting in localized advisories and their dissemination—the PSP described in Box 1—to (i) the release of a seasonal forecast nationally, (ii) the annual government planning process, and (iii) any existing EWS. This helps to institutionalize the discussions and ensure their outcome leads to adjustments of the ongoing development of DRR plans. Where there are already disaster management committees, they would be involved too—for example, in Kenya, Ghana and Niger (Fiona Percy, CARE International, personal communication). These innovative approaches that involve building institutions and partnerships are important components for enabling scaling up of CIS, which may, as noted above, reduce the costs of expanding the weather station network, a priority for many developing countries. This brings us to our fifth key issue in scaling up CIS, namely, financing the transition from pilot project to wider areas, and ultimately to institutionalized CIS systems with broad coverage.

4.5 Financing the transition and beyond

The case studies and expert opinion synthesized in this paper concur that financing the shift from short-term pilot projects to longer-term, more sustainable CIS systems remains challenging. Funds are required to collect and process data, train intermediaries and end users (May and Tall 2013), and produce products for dissemination. For example, two of the issues identified from the Uganda case discussed by Edith Ofwona Adera of IDRC at the CBA9 conference were the need for institutional coordination to financially and operationally sustain projects beyond the pilot, and getting governments to appreciate the framework and therefore budget for it.

The case of the R4 Rural Resilience Initiative (Box 2) is one such example of how pilot projects can scale up and attract finances if they are proven successful. In 2012, the Rockefeller Foundation gave $450,000 towards the scaling up of the initiative to include Senegal. Positive results from Grameen Foundation's program in Uganda (Box 3), which trained 40 CKWs potentially reaching 20,000 farmers in its first year, helped to procure a four-year grant from the Bill and Melinda Gates Foundation to expand the CKW initiative across Uganda. This additional funding is helping Grameen Foundation to build strategic partnerships and ensure continued training of CKWs. However, such examples of scaling up are still dependent upon donor financing, the sustainability of which can be questioned.

Through a workshop that elicited expert opinions, May and Tall (2013) note that possible ways of financing the transition from pilot phase to scaling up include (i) accessing funds from the global Adaptation Fund[15] to reinstate extension services and re-train extension workers, and (ii) developing a network of climate centers that provide demand-driven information services such as market information and input availability, in addition to weather forecasts. Moreover, the Green Climate Fund is anticipated to grow to $100 billion per annum by 2020. Given the relevance and importance of climate information to agriculture and agricultural livelihoods, strengthening CIS is expected be high on the Green Climate Fund's list of priorities (Richard Ewbank, Christian Aid, personal communication).

Deliberations during the expert-led discussions in Nairobi identified several processes through which pilot-phase funders, such as international donors, research initiatives or multi-lateral partnerships, can play a crucial role in financing and supporting the scaling up process. These were:

- **Creating demand:** This entails demonstrating the importance, method of delivery and feedback, and format of climate information to end users, government and meteorological agencies, respectively. Once CIS demand is created, there will be incentives for governments to take responsibility and to promote subsidies for CIS.
- **Building linkages:** This entails building linkages between all stakeholders involved in CIS. It is not restricted to getting climate information from meteorological offices to end users, although this should certainly occur through various channels, including media. It ties in with the need for conversion of technical information into understandable and locally contextualized messages. Building working linkages includes forming better connections with different sectors (especially climate-sensitive sectors, such as agriculture, water, and livestock), and government departments in charge of development planning and disaster management, so that CIS is mainstreamed into government plans and processes with budgetary allocation to build and maintain effective CIS systems.
- **Capacity building**: This entails *inter alia* enhancing the capacity of community and government, including NMSs, on areas like engaging in two-way communication that is sensitive to end users, in addition to technical capacity building, during the pilot phase.
- **Processes of feedback**: This requires institutionalizing a system of feedback to ascertain whether users are receiving the information they need, whether that information is reliable, and whether there is a process for identifying gaps for future improvement.

[15] Established under the Kyoto Protocol of the UNFCCC, see https://www.adaptation-fund.org/about/ for more information.

- **Adequate project duration**: Project duration should be long enough to collect evidence on the economic value of the project as well as to allow sufficient time to develop processes that ensure uptake of the project by the government. Especially when developing and nurturing stakeholder networks, timeframes are significant because “processes for establishing relationships, learning and generating evidence, building resilience and developing sustainability can take 5 to 20 years or longer” (Ambani and Percy 2010:21).

Other financing approaches that can be explored at local, national and regional scales include engagement of the private sector to develop information products and alignment of climate information exchange mechanisms with existing government processes. This relates to a key question the expert group discussed at the CBA9 workshop: are potential end-users willing and able to pay for CIS? It was noted that small-scale farmers have not been willing to pay for private sector SMS forecast services, largely related to the cost of the service. Other reasons include the lag-time between provision of information and associated benefits, the reliability of the information, and lack of understanding of climate information. Successful private sector models seem to be based on providing highly-tailored forecast and weather risk planning services to commercial farms large enough for this kind of service to generate a positive cost-benefit. As the same approach is not viable with small-scale farmers, services provided are more generic and lack the context specificity that farmers value. Furthermore, there are questions of equity and fairness raised by the approach of requiring poor and vulnerable people farming in marginal lands to pay for CIS that are critical for their lives and livelihoods, as expressed by the following quote. Thus there are calls for the Green Climate Fund to make funding these services a priority.

> *In India, I was told that one farmer pays the fee and tells the rest of the village, which rather undermines potential profitability of the model. If the private sector wants to develop this market, it has to develop a suite of information products that are relevant to and show reliable benefit streams for potential clients. My feeling is that given the importance of climate services to saving lives as well as livelihoods, a significant part of climate service provision is “naturally” public sector, as indeed it is in all developed countries. Arbitrarily insisting that poorer, more vulnerable people in developing countries should pay just to increase private sector involvement seems rather inconsistent.*
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Some studies note that relatively low participation of the private sector can be overcome if the public and non-governmental sectors partner with local businesses to ensure post-project sustainability (Goddard et al. 2010, Gakuru et al. 2009). Thus, advocacy for funding must go beyond the pilot phase. Involvement of national government actors can help mainstream CIS in national budgets (Nicholas Maingi, WMO Regional Office Nairobi, personal communication). A positive example from Iloilo, Philippines, concerns a municipal ordinance that provides funds to support the application of climate forecasts to risk management in development planning on a continuous basis (Vogel and O'Brien 2006).

That said, pilots must work with governments/NMHSs from the outset to build ownership and commitment to institutionalizing CIS approaches in national budgets. The following case study of integrated future scenario planning in Nicaragua describes an approach to empower communities to start monitoring their climate through local weather stations, for which partnering with multiple stakeholders at the start of the project was key to sustainability and upscaling. The case study also makes the distinction between factors over which project planners and implementers have direct control, and those over which they have less control, with respect to scaling up.

Box 6 Centro Humboldt and Christian Aid: integrated future scenario planning in Nicaragua

At the CBA9 CIS session in Nairobi organized by IDRC/CARIAA, Richard Ewbank discussed a case from Nicaragua where Christian Aid's partner Centro Humboldt uses an approach to empower communities to start monitoring their climate through use of rain gauges. This approach was set up to move beyond a focus on EWSs for cyclones towards a recognition of farmers' concerns raised through participatory vulnerability and capacity assessments regarding increasing drought risk and seasonal variability in rainfall patterns. Earlier work using traditional knowledge and memory to construct timelines also reinforced this concern. Using regional climate modelling, crop models and GIS mapping, future scenarios were built for five-year periods from the present to 2040.

The scenario building exercises suggested that in the future there would be (i) shrinking of areas suitable for maize in the main western grain baskets, combined with potential expansion into eastern rainforest areas precluded by the agro-ecology; (ii) a combination of fragmentation of rice growing areas but potentially some expansion east and south; and (iii) reduced areas for beans with more acute fragmentation and shrinkage as compared to maize, raising questions as to how much longer existing varieties would remain viable. The project contributed to awareness of climate risks and improved understanding of what to sow when, as well as helped to apply climate information to farmer decision making. The key reasons for successful uptake were: (i) **involvement of multiple stakeholders**—Centro Humboldt led the process, working with other national CSOs involved in rural development, the Instituto Nicaragüense de Estudios Territoriales (INETER) for meteorological advice and data, Instituto de Meteorología de Cuba (INSMET) for PRECIS regional climate modelling training and support, and farmer groups managing rain gauges for local data and feedback, and (ii) **provision of relevant information**—avoidance of assumptions about what information farmers want (for example, coffee farmers needed long-term forecasts because coffee follows a 12-year cycle).

Factors that are **within the control of project planners and implementers** include:

- **Partnerships with multiple stakeholders from the onset**: Phase out and scale-up strategies should be planned from the start by working closely with key institutions (e.g. national hydro-meteorological agencies), intermediaries (e.g. agricultural extension officers) and other stakeholders (e.g. mobile phone companies).

- **Working in multi-sectoral teams**: Multi-sectoral teams that include climate scientists, computer programmers, agronomists, community development experts and local users are essential. In the Nicaraguan case, the local groups of users provided two years of rainfall data through a network of rain gauges, which helped calibrate climate models.
- **Promoting success stories through different channels**: Widespread communication of the results of interventions can help garner interest and funds for scaling up. For example, Centro Humbolt promoted the results through radio and TV spots and created the 'Climate Newsletter', which targets a network of 400 civil society organizations. They also generated demand by sharing results and opportunities with potential information users, for example on expanding the use of rain gauges.
- **Systematizing climate monitoring tools for replication** is key, and Centro Humbolt is creating a "Climate Change Adaptation Toolbox", which will include tools for monitoring rain gauges, bio-climate indicators (flora and fauna) and phenology.
- **Training producers to use multiple sources of climate information in decision making**. It was useful to supplement rain gauge information with other forecast products (weekly, seasonal), as well as long-term scenarios developed using regional climate model (RCM) information, using appropriate communication techniques (e.g. climate newsletters).
- **Generating better evidence**: There should be specific resources set aside for gathering evidence on the process and outcomes of successful scaling up. There should be evidence on quantitative and qualitative impacts. As with resilience building more generally, effectively measuring the impact of climate services involves combining both types of evidence to reliably attribute the impact of climate services and triangulate findings.

Issues that project planners and implementers have **less direct influence over** include:

- Resources to **expand meteorological coverage** to poorly covered areas. The Global Framework for Climate Services and the Green Climate Fund are two key initiatives that can help meet this need.
- **Increasing integration between institutions** producing climate information, intermediary organizations, and information users. This will help in producing more applied and tailored information that can be used to better understand climate risks (e.g. implications for crop production and, hence, agricultural livelihoods in the future).
- **Provision of better information** (e.g. detailed crop-specific hydro-meteorological and agro-ecological profiles) and improved accessibility of information. High levels of private sector involvement in crop development and biotechnology means some information is subject to corporate confidentiality, constraining information sharing and therefore building RCM scenarios for these crop varieties.
- **Expanding access to ICTs** such as smartphones will transform data access for potential CIS users. Although currently only 27% of mobile phone users in Africa have mobile broadband, this is anticipated to treble by 2018.

Source: Richard Ewbank, presentation made at CBA9, Nairobi, April 2015

The identification of barriers and enablers that project planners and implementers have control over and those they have less influence over, as done for the Nicaraguan example in

Box 6, is likely to be an important step in scaling up CIS initiatives. Thus this is a useful activity to undertake during project planning, to prepare for eventual scaling up. In addition to highlighting approaches that promote financing the transition from pilots to CIS systems, such as working in partnership with NHMSs from the outset, the Nicaraguan example touches on a number of other methods for scaling up. It thus provides a bridge to our next section, in which we distill our findings down to a number of key messages to consider in the process of scaling up.

5. Discussion

5.1 Key messages

Scaling up pilot projects is an ongoing challenge due to several issues: lack of funding beyond the pilot phase (May and Tall 2013), difficulties in sustained capacity building for intermediaries (Mantilla et al. 2014, May and Tall 2013), and sustaining effective long-term partnerships. Beyond these important, but nonetheless more general points, several specific key messages and recommendations for action to enhance scaling up of CIS can be synthesized from the experiences and lessons highlighted through the examples, case studies and expert opinion gathered together in this working paper.

Firstly, we present key lessons and recommendations for scaling up CIS pilots, synthesized from expert opinion presented at the CBA9 workshop (Box 7).

Box 7 Key lessons and recommendations for scaling up CIS pilots from expert opinion

- **Give users a voice**: Understanding changing user needs, systematic collection of feedback, and giving users a voice in the development of relevant CIS builds trust and increases demand. This includes building local agency to demand and shape information production and delivery.
- **Clear delineation of roles**: Establishing the roles that different stakeholders can play will enhance the effectiveness of the development of scaled up CIS delivery.
- Stronger **involvement of the private sector** can enable wider uptake and assist in the timely communication of relevant climate information.
- Integration of CIS into government policy and planning, and earmarking institutional and budgetary support for **sustained multi-stakeholder interaction to deliver tailored CIS** at scale, can support adaptation decision making and actions. For example, in Ghana and Kenya CIS development and delivery is written into district and county development plans (See Box 1).

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- Stronger **involvement of the private sector** can enable wider uptake and assist in the timely communication of relevant climate information.
- Integration of CIS into government policy and planning, and earmarking institutional and budgetary support for **sustained multi-stakeholder interaction to deliver tailored CIS** at scale, can support adaptation decision making and actions. For example, in Ghana and Kenya CIS development and delivery is written into district and county development plans (See Box 1).

Source: Maurine Ambani talking points at CBA9, Nairobi, April 2015

We now present a set of key messages we have developed from our examination of the literature, various case studies and expert opinion. After this, we present several recommendations arising from our analysis, which we propose would assist with scaling up and institutionalizing CIS initiatives. After this, we summarize our key points in a conclusion, set out in section 5.

- **Key message 1**: An exit strategy that includes how to implement a phased handover process for a successful pilot should be incorporated into the design stage of the pilot to enable scaling up.

The pilot project design phase should consider longer-term budgeting opportunities and constraints, the capacity building activities that might be necessary at various levels, and ways to create a clear impact pathway. For example, it could consider how a pilot project will build public or private sector buy-in for replication and upscaling. Furthermore, ensuring that government partners are engaged early on in the process can lead to longer-term sustainability and enable larger scale replicability, by building ownership and commitment to national budgetary allocations for CIS. Box 7 contains additional supporting lessons from the discussion for this key message.

- **Key message 2:** While pilot champions and intermediaries play a crucial role in scaling up CIS, they may be constrained by issues such as lack of continuity due to short project and funding cycles, multiple roles for intermediaries, and low levels of trust that affect acceptance and uptake of CI.

Pilot champions, such as community champions or motivated actors within policy, can play a crucial role in facilitating the scaling up of CIS projects. They can mobilize communities to demand CIS or make a case for fund allocation for CIS, thus facilitating scaling up. Champions also include development champions who help conceptualize and design pilot CIS projects that envision an effective scaling up of climate services, keeping in mind multiple stakeholder needs and roles.

Intermediaries facilitate CIS by providing climate information to different audiences and interpreting it in a language that is relevant and accessible. Intermediaries include: extension workers already trained to deliver services and considered familiar and trustworthy by the community, local NGOs that serve as bridges to government actors, and other boundary organizations such as research institutions. However, intermediaries also face issues of lack of continuity (in NGOs which work according to project funding cycles), multiple roles (extension officers who often have to cater to very large populations), and trust and acceptance issues (in the case of boundary organizations). Ultimately, CIS should be an integral part of regular planning processes so that its inclusion is not left up to champions. This would mean that the stakeholders involved would accept it as a normal way of working, rather than an additional task (Maurine Ambani, CARE International, personal communication).

- **Key message 3:** Capacity building programs that are tailored to specific contexts and use participatory, formal and informal processes to facilitate dialogues are likely to be more successful than top-down “directives” in enabling scaling up of CIS.

Current gaps in capacity building for scaling up can be found in training program content (degree to which it is demand-driven, context-specific and practical), process (frequency, and method), and audience targeting at different scales. Synthesizing the successful examples included in our analysis, we conclude that context-specific and participatory capacity development approaches that adopt iterative approaches that build upon people’s experiences and knowledge systems are more likely to promote successful scaling up than top-down, non-participatory approaches. This is because these attributes are more effective in creating sustainable partnerships and good communication between multiple stakeholders. A major challenge is that for participatory risk assessment and planning processes to be effective, skilled facilitation is essential, which is not easy to find at scale. This puts an emphasis on the training of sufficient numbers of facilitators along the CIS value chain and acts as a barrier to wider capacity building. To enable effective dissemination, uptake and application of climate information, it is necessary to establish and/or strengthen “chains of experts and communications”. Finally, it is important to understand and communicate the uncertainty levels inherent in forecasting and provide guidance on how to manage this uncertainty.

- **Key message 4:** For ICTs to fulfill their potential as important tools for climate information provision, they must be locally relevant, supported by trained staff, and convey accurate and timely information.

Reviewed literature and expert-led discussions note the importance of ICTs as a tool to facilitate climate information provision. Examples from diverse contexts, such as Mali’s agrometeorological program, and Uganda's smartphone-based initiative of the Grameen Foundation, demonstrate how ICTs can be used successfully. India’s AAS, which combines ICTs (e.g. SMS and voice messages) and human interaction platforms (e.g. rural extension centers, national extension services, NGOs) to form a holistic climate and agrometeorological information delivery system, is notable. However, it is clear that ICTs are primarily an instrument of information delivery and must be supported by trained staff, accuracy and timeliness of information, institutional support for service delivery, and most crucially, relevance to local contexts and needs. In a broader sense, ICTs can also be used to support dialogues and two-way interaction through online forums, and receiving and reporting of weather/climate data through SMS or smartphone apps. Furthermore, since the nature of and access to ICTs are changing rapidly, it is important to explore and anticipate the risks and opportunities associated with such changes.

- **Key message 5:** Sustaining effective partnerships to scale up CIS requires ownership on the part of multiple actors, a collaborative approach that enables knowledge co-production, and a supportive institutional framework.

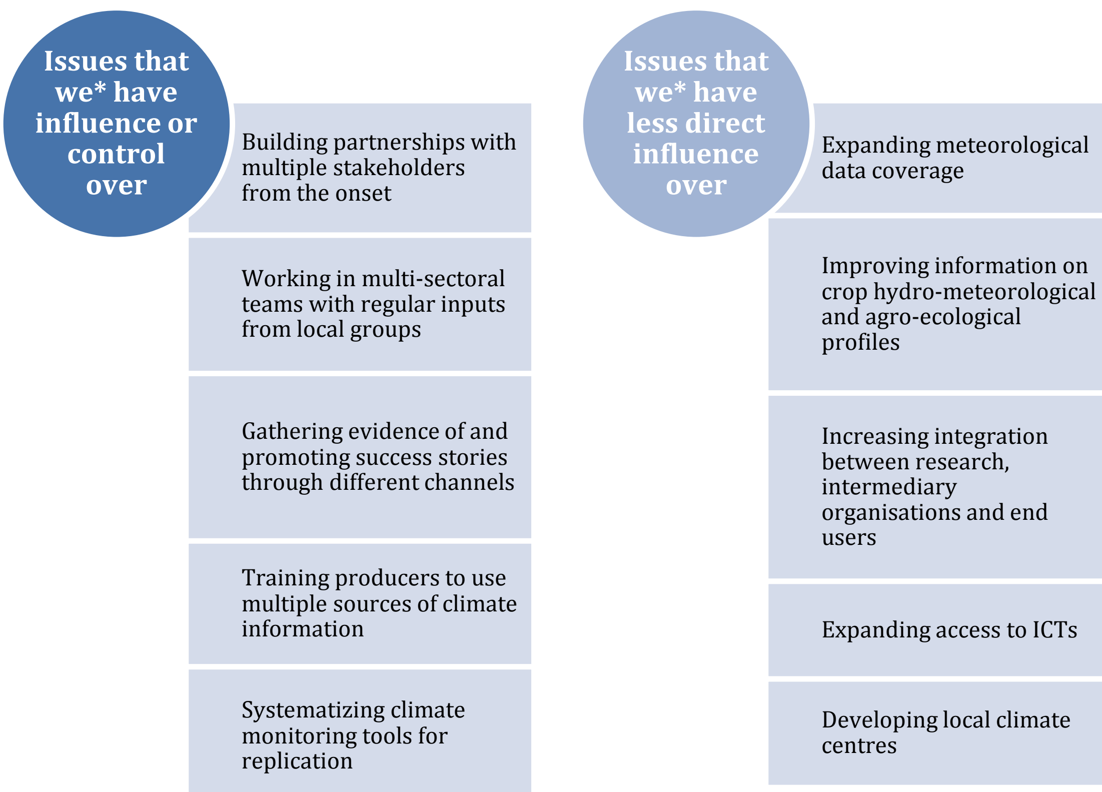
When multiple actors (government, farmers) take ownership of CIS projects and initial successes are demonstrated (e.g. Mali's agromet program), there is a proven record of sustained, effective partnerships. In Ethiopia and Uganda, engaging multiple stakeholders, each with their own strengths, enabled the leveraging of different types of expertise and networks. All this was found to be possible only in the presence of a supportive national government and with a focus on participatory problem identification and project design. Ethiopia's ENACTS program in particular has shown the importance of collaborative partnerships for scaling up CIS, which crucially involved building partnerships with the NMS instead of competing with them.

- **Key message 6:** While financing the transition from innovative CIS pilots to large-scale initiatives remains challenging, potential ways forward include creating linkages for mainstreaming CIS into government budgets, enhancing demand for CIS along the value chain, and engagement of the private sector.

Literature and expert-led discussions both conclude that climate information must be relevant to the local context, crops and cultivars; pilots should be used as spaces to test innovation; and upscaling processes should be designed into the project from the start. Financing the transition was discussed as being difficult, especially in the absence of adequate demand. Many of the positive examples of scaling up still rely solely on donor funding. One way forward lies in creating linkages for mainstreaming CIS into government budgets, through *inter alia* involving government stakeholders from an early stage in the design of pilot projects. This is also dependent on project duration, which should be long enough to collect evidence on the economic value of the project as well as to allow sufficient time to develop processes that ensure uptake of the project by the government, as in the positive example from Iloilo, Philippines, mentioned above. Other financing approaches that can be explored at local, national or regional scales include engagement of the private sector to develop information products, and alignment of climate information exchange mechanisms with existing government processes, where appropriate. Enhancing demand for CIS along the value chain entails demonstrating the importance, mode and form of climate information to end users, government and meteorological agencies respectively. The reasoning is that once CIS demand is created, there will be incentives for governments to take responsibility and to promote subsidies for climate information delivery. This assumption requires further testing.

Thus, successful scaling up of CIS depends on several factors from designing a project and envisioning its potential impacts and bottlenecks, to engaging multiple stakeholders and using multiple innovations such as ICTs to make climate information delivery efficient and relevant. Some of these are within the control of project planners and implementers, while others are not (Figure 2). As highlighted by the expert-led discussions, two key enablers of successful CIS delivery and scaling up are a focus on co-production of actionable and meaningful climate information and the creation of new forms of relationships, which allow diverse actors to come together. The role of multi-stakeholder interaction and dialogue, as well as co-production of knowledge that draws on climate science and local knowledge systems, was another critical finding that emerged. The uptake of information is enabled by proper packaging of climate information in a readily understandable form that is relevant to the target scale and context. Finally, having champions that promote integration of CIS into policy and practice is crucial to wider acceptance, demand creation and the sustainability of CIS pilots.

Figure 2 Issues for promoting scale up of climate services innovations



**In this case, "we" refers to the project planners and implementers*

Source: Synthesized by authors from Richard Ewbank's presentation

5.2 Challenges and recommendations for successful scaling up

Challenges to scaling up pilot CIS initiatives include inadequate data collection networks to provide context-specific climate information; a mismatch between the information being delivered and the needs of end-users; the need for translating advisories into local languages for better uptake; a lack of adequate capacity to develop, communicate, interpret, and use CIS at all levels; and recognizing the limitations of ICTs.

Based on the evidence gathered from the literature and the experts in the CBA9 meeting, recommendations to address these challenges include:

- **Improving project design:** It is necessary for project design to begin with a clear hypothesis of what the provision of climate information should achieve (e.g. an x% increase in crop yield, or x% decrease in disaster risk). Projects should be designed to be participatory: they should identify problems and potential solutions with communities, and design user-friendly climate information to address these in a targeted way. Projects should additionally be designed in a manner that includes strong partnerships, including partnerships with appropriate technical experts (such as the national meteorological office) to provide the climate information required.
- **Recognizing plural knowledge systems:** It is imperative to understand local knowledge systems and practices (through, for example, seasonal calendars) so that CIS can be designed to be sensitive and relevant. From the outset, projects should blend scientific and indigenous knowledge.
- **Improving climate information production and communication:** Limits and uncertainties associated with weather and climate predictions must be clearly communicated to the end user, though the approaches will differ across spatial and temporal scales, as well as for different user communities. Participatory processes can be used to support the communication of uncertain climate information. CIS should be communicated using varied channels (voice mails, SMS, and toll-free numbers for mobile phones; television channels; printed advisory bulletins with text and pictures; and radio) and using language that can be easily interpreted.
- **Ensuring women's engagement** in receiving and disseminating agrometeorological information by carrying out trainings and discussions targeting women (Venkatasubramanian et al. 2014). Since men and women tend to have different risk profiles, they tend to have different types of demands for CIS (McOmber et al. 2013, Roncoli et al. 2009). As women's access to climate information is significantly lower than men's, especially through ICTs (McOmber et al. 2013), there is a need for structural changes in potential intermediary institutions providing CIS and agriculture extension services.
- **Champions of change:** Develop capacity to use and effectively demand climate information, perhaps beginning with champions within national agricultural research systems (Hansen et al. 2011).

- **Adequate time:** Conducting extended pilots over several years and across different geographic locations could provide useful information and build sufficient capacity for scaling up.
- **Planning an effective exit strategy:** This entails consideration of how to implement a phased handover process, which should be incorporated into the design stage of the pilot. Should the pilot be successful, this will facilitate scaling up. It will involve budgeting beyond the project in project design, including a clear impact pathway in project design (for example how a pilot project will build public or private sector buy-in for replication and upscaling), and ensuring that government partners are on board early on to bring in longer-term sustainability and enable larger-scale replicability.

6. Conclusion

This working paper has sought to understand the key constraints to and enablers of scaling up CIS through case studies, practice and expert opinion in Africa and South Asia. This approach is based on the realization that a sustainable climate information value chain (production, processing, communication, end use) is necessary for strengthening agricultural livelihoods and climate-resilient food production in most developing country communities. Such a chain is only possible if the network of actors, constituting the climate information innovation system, is involved during the pilot phase in such a way that dialogue and interaction can be can be sustained. Identifying and integrating the key ingredients of a successful scale up strategy during the design stage of pilots should enhance the chances of effective transition to higher uptake of CIS innovations.

Growing recognition of the value of CIS has led to decentralization of extension services (e.g. in Uganda), introduction of multiple actors (e.g. using private and NGO actors for climate service delivery in India), and increased funding for training and capacity building (Jost 2013, Ziervogel and Zermoglio 2009). However, insights from the literature review and group discussions during the CBA9 meeting demonstrate that CIS are predominantly still implemented as project-based activities and only in some countries (e.g. India, Kenya, and Uganda) are they well integrated with NMSs. Although there are several documented insights on how CIS should be designed and implemented, as well as examples of some pilot projects being scaled up, there is still insufficient evidence on successful processes for upscaling. Additionally, while barriers to and enablers of scaling up have been identified in literature and by experts, empirical evidence on this is often case-based and needs to be examined thoroughly to understand best practices. Case studies often highlight how scaling up in practice is a complex and often contested process. Our synthesis has identified that successful scaling up CIS depends on several factors, from designing a project and envisioning its potential impacts and bottlenecks, to engaging multiple stakeholders and using multiple innovations such as ICTs to make climate information delivery efficient and relevant. Some of these are within the control of project planners and implementers while others are not (Figure 2).

The key messages derived from our synthesis are the following:

- Key message 1: An exit strategy that includes how to implement a phased handover process for a successful pilot should be incorporated into the design stage of the pilot to enable scaling up.
- Key message 2: While pilot champions and intermediaries play a crucial role in scaling up CIS, they may be constrained by issues such as lack of continuity due to short project and funding cycles, multiple roles for intermediaries, and low levels of trust that affect acceptance and uptake of CI.
- Key message 3: Capacity building programs that are tailored to specific contexts and use participatory, formal and informal processes to facilitate dialogues rather than top-down "directives" are likely to be more successful at enabling scaling up of CIS.
- Key message 4: For ICTs to fulfill their potential as important tools for CI provision, they must be locally relevant, supported by trained staff, and convey accurate and timely information.
- Key message 5: Sustaining effective partnerships to scale up CIS requires ownership on the part of multiple actors, a collaborative approach that enables knowledge co-production, and a supportive institutional framework.
- Key message 6: While financing the transition from innovative CIS pilots to large-scale initiatives remains challenging, potential ways forward include creating linkages for mainstreaming CIS into government budgets, enhancing demand for CIS along the value chain, and engagement of the private sector.

We make a number of recommendations for enhanced scaling up of CIS, which encompass improving project design; recognizing plural knowledge systems; improving climate information production and communication; ensuring women's engagement; developing champions of change; ensuring adequate time; and planning an effective exit strategy.

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Annex I: List of speakers and presentations at CBA9 CARIAA CIS working session

The Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA) organized a session at the Ninth International Conference on Community-based Adaptation in Nairobi, Kenya (23-30 April, 2015) to explore opportunities for and constraints to sustained provision and uptake of CIS in developing countries in Africa and South Asia.

The session began with insights from presentations on experiences from Africa (Maurine Ambani Kasuvu, CARE Kenya) and Latin America (Richard Ewbank, Christian Aid). Drawing on their broad experience in the application of weather and seasonal forecasts (including indigenous knowledge), as well as the use of modeled climate predictions, the experts discussed what constitutes a useful and sustainable climate information value chain, and the challenges and critical factors for success which are broadly applicable to scaling up pilot initiatives. Nicholas Maingi (WMO Regional Office, Nairobi) synthesized the two cases and contextualized them within broader international efforts to improve climate information production, delivery, and uptake. He then opened the round table discussions, which were guided by pre-identified themes and led by domain experts. The session closed with summaries of the discussions at each table and closing remarks from Lindsey Jones (Overseas Development Institute).

Topic	**Discussant**
Project on climate information services in Latin America	Richard Ewbank (Christian Aid)
Projects on climate information services in Africa	Maurine Ambani Kasuvu (CARE Kenya)
Broader international efforts at improving climate information production, delivery, and uptake	Nicholas Maingi (WMO Regional Office, Nairobi)
Role of intermediaries: what factors favor or hinder strong participation of appropriate intermediaries such as NGOs, the media, private sector, government agencies, etc., in the climate information value chain? How can this role be restructured or improved for enhanced community-based adaptation beyond the pilot phase?	Deus Bamanya (Uganda National Meteorological Authority)
Sustaining effective institutional arrangements: what institutional framework is mandatory for effective transition and wide-scale use of climate information services? What incentives are necessary to hold these institutions together during transition and beyond?	Fahad Saeed (SDPI Pakistan)
Investing in capacity building: what are the common capacity needs, issues and concerns among the key actors along the climate information value chain? How best may these key capacity needs be met to ensure sustained, effective use of CIS during transition and	Henry Muchedzi (Practical Action Zimbabwe)

beyond?	
Financing the transition and beyond: what activities need to be considered for funding for an effective transition from pilot to scale? Are potential end-users willing and able to pay for climate information services? What should be the role of pilot-phase funders in the transition? What innovative financing approaches may be explored at local, national and even higher level for impact at scale? How should pilot-phase funders be involved?	Dinanath Bhandari (Practical Action Nepal)
Role of ICTs: what have been the successes and failures of ICT-mediated climate information services for adaptation? How may the opportunities presented by ICTs be best harnessed in the transition from pilots to scale?	Modathir Zaroug (UCT South Africa)
Closing comments	Lindsey Jones (ODI)

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