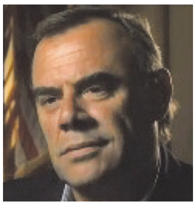
Climate services and insurance: scaling climate-smart agriculture

Ana María Loboguerrero Rodríguez, Jim Hansen, Walter E Baethgen and Deissy Martinez-Baron

Dr Ana María Loboguerrero Rodríguez is the Latin American Leader of the CGIAR Research Programme for Climate Change, Agriculture and Food Security (CCAFS), based at the International Centre for Tropical Agriculture (CIAT), Cali, Colombia. She holds a Masters and a PhD in Economics from the University of California, Los Angeles (UCLA). She has previously worked at the Central Bank of Colombia, the Inter-American Development Bank, and of the National Planning Department of Colombia as Coordinator of Climate Change. a.m.loboguerrero@cgiar.org

Dr Jim Hansen works with the CGIAR research programme on Climate Change, Agriculture and Food Security (CCAFS) where he leads the Flagship on Climate Services and Safety Nets. He is also a Senior Research Scientist at the International Research Institute for Climate and Society (IRI), at Columbia University, New York. jhansen@iri.columbia.edu



Dr Walter E Baethgen is Senior Research Scientist and Director of the Regional and Sectorial programme in the IRI, Columbia University. He is also Acting Director of the Agriculture and Food Security Centre, Earth Institute. He was an author in the IPCC's Second, Third and Fourth Assessments Reports. baethgen@iri.columbia.edu

Deissy Martinez-Baron has worked with the CGIAR research programme on Climate Change, Agriculture and Food Security (CCAFS) as science officer for the regional programme in Latin America since 2013. d.m.baron@cgiar.org

Abstract

One of the main challenges of climate-smart agriculture (CSA) is finding ways to promote the adoption at scale (*Editor's note: 'scaling', 'at scale' or 'to scale' are used throughout this article to mean 'scaling-out'*) of CSA practices and technologies. Climate services and insurance can constitute a tool to scale CSA by providing an enabling environment that can support the adoption of CSA practices while protecting against the impacts of climate extremes. By using a definition of climate services which includes the production, translation, transfer, and use of climate knowledge and information in climate-informed decision-making and climate-smart policy and planning, this paper aims to discuss how climate services and insurance can bring CSA to scale. Three case studies are presented. It is recognised that understanding the knowledge networks through which information flows, and affects the use of climate information, is critical for promoting CSA at scale.

Introduction

Climate-smart agriculture (CSA) is defined as agriculture that (i) sustainably increases agricultural productivity and incomes, (ii) adapts and builds resilience to climate change, and (iii) reduces and/or removes greenhouse gas (GHG) emissions where possible (FAO, 2013). Framing the second pillar of CSA in terms of 'resilience' reflects the evolution of thinking about climate change adaptation – from what agriculture needs to look like in a future climate scenario, to greater focus on what can be done now to start the journey towards adapting agriculture to climate challenges. CSA extends beyond on-farm practices to include landscape-level interventions (*eg* management of farm-forest boundaries), services (particularly information and finance), institutions (mainly market governance and incentives for adoption) and the food system (mostly consumption patterns and wider climate-informed safety nets).

Efforts to promote the implementation of CSA at scale include the development of climate information and advisory services that support farmer decision-making, weather-related insurance that protects farmers and increases investment in CSA, food security early-warning and safety net systems that protect livelihoods from extreme events, and climate-informed planning by governments. These interventions, which are implemented beyond the farm, provide an enabling environment for CSA by supporting the adoption of climate-smart practices and the transition towards more climate-resilient livelihoods, while protecting against the impacts of climatic extremes.

Climate change adaptation and climate-resilient development goals have stimulated demand for more types and time-scales of climate information. While the foundations of climate services have been under development since the 1980s, the concept was formalised through the *World Climate Conference-3 (WCC-3)*, held in Geneva in 2009, which called for an *"international framework for climate services that links science-based climate predictions and information with the management of climate-related risks and opportunities in support of adaptation to climate variability and change"* (GFCS, 2017). This led to the establishment of the *Global Framework for Climate Services (GFCS)* (WMO, 2014). The term 'climate services' is used to describe activities and processes that can be quite diverse (Vaughan & Dessai, 2014), but can be understood in terms of four pillars: *"(i) production; (ii) translation; (iii) transfer; and (iv) use of climate knowledge and information in climate-informed decision-making and climate-smart policy and planning"* (Climate Services Partnership, 2017).

In index-based insurance, payouts are based not on farmers' actual losses, but on an objectively measured index such as rainfall or satellite vegetation data, that is correlated with losses. Index-based insurance has overcome obstacles, such as moral hazard, adverse selection and high transaction costs, all of which made traditional loss-based crop insurance unfeasible for smallholder farmers. This has led to a surge of interest, over the past decade, in using insurance to contribute to climate change adaptation and climate-resilient development goals. Agricultural insurance complements the use of climate information for farm decision-making, and is emerging as a major user of climate services.

This paper discusses how climate services, and their use for insurance and related safety net interventions beyond the farm, can contribute to bringing CSA to scale. The following section presents the evidence of how climate services and climate-related insurance provide an enabling environment for implementing CSA at scale. The third section brings this discussion into reality by presenting three case studies where climate services and their use have contributed to adoption of CSA practices. The fourth and final section complements the analysis by discussing how, not only the production, but also the translation, transfer and use of climate knowledge are key in order to implement CSA practices and technologies at scale.

Providing an enabling environment for scaling Climate-Smart Agriculture

There is growing recognition that adapting to climate change requires developing resilience to the risks associated with climate variability. Climate change is expected to increase risk from extreme events in much of the developing world (IPCC, 2012). Extreme events erode livelihoods through loss of productive assets, while the uncertainty associated with climate variability is a disincentive to investing in agricultural innovation (Maccini & Yang, 2009). Within farming communities, the impacts are borne disproportionately by the relatively poor (Zimmerman & Carter, 2003). The combined *ex-post* impact of climate shocks on farmers' assets, and *ex-ante* impact of climate risk on farmer decision-making and investment by rural finance markets and supply chains, contribute to poverty traps that lock many farmers in climate-vulnerable livelihoods (Barrett & Santos, 2014), thereby working against the transformation needed to adapt to climate change.

The evidence suggests that climate services, and the use of climate information for farm decision-making, weather-related insurance, agricultural planning and food security management, have considerable potential to enable farmers in environments prone to climate risk to transition towards more climate-smart agricultural systems while protecting their livelihoods from climatic extremes. The evidence also suggests that the way that these interventions are designed and implemented matters.

There appears to be considerable demand for, and use of, climate information by smallholder farmers (Hansen *et al*, 2011). Access to climate information influences farmers' decisions, even when resource constraints limit their options (Mudombi & Nhamo, 2014). Evidence that climate services improve farmer livelihoods is more limited, and comes largely from participatory pilot projects (Rao *et al*, 2015) and model-based valuation (Roudier *et al*, 2014). The design of climate services can influence the benefits available to farmers. Widespread gaps between farmer needs and available climate data, and weaknesses in the translation and communication of climate information (reviewed in Hansen *et al*, 2011), constrain its usefulness for agricultural decision-making. Pilot-scale participatory research has improved the understanding of farmers' needs, and produced innovative processes that improve farmers' understanding and use of climate information (Rao *et al*, 2015). Yet only a few pilot projects have attempted to address the widely recognised mismatch between available information and the needs of farmers and other agricultural decision-makers (Hansen *et al*, 2011).

Programme evaluation (Madajewicz *et al*, 2013) and pilot-scale experimental studies (Cole *et al*, 2013) show that well-designed index-based insurance can improve livelihoods by enhancing adoption of agricultural innovations. Payouts triggered by major climate shocks reduced loss of productive assets and hastened recovery (Bertram-Huemmer & Kraehnert, 2015). Low uptake rates in many initiatives and randomised trials have led to concern that low demand may limit the potential for index-based insurance to benefit smallholder farmers at scale (Cole *et al*, 2013). On the other hand, evidence that farmer demand is influenced by design-related factors, including the degree of basis risk (the fact that farmers may receive a payout even when their crops survive, or they may experience losses when a payout is not triggered) (Elabed & Carter, 2015) and farmers' understanding and trust in the products (Hill & Viceisza, 2012), suggests that improved design and implementation could enhance uptake. Recent rapid scaling of several initiatives suggests that uptake may be determined largely by evolving capacity to overcome these challenges and provide more effective services (Greatrex *et al*, 2015).

Climate-Smart Agriculture: case studies beyond the farm

This section briefly presents three case studies that illustrate how climate services, and the use of climate information for insurance, can become a means to promote the use of CSA practices at scale.

Colombia: from farmers to private sector and government using climate services to inform decision-making processes

In Colombia, the government, private sector and researchers are working together in order to provide farmers with agro-climatic information useful to support their decision-making on what varieties to plant, when to plant seeds, what pests and diseases might appear and how to reduce their impact in the crop, and how to manage water and input resources to make more efficient use of them. In other words, the project is providing information on what CSA practices to implement, given an agro-climatic forecast reaching approximately 18,000 farmers.

The process is promoting the *generation* of climate predictions and understanding how to use them in crop models to produce agro-climatic forecasts. The *translation and transfer* of the climate information is being enabled through Local Technical Agro-Climatic Committees (LTACs), and structured training to technicians. In LTACs, producer associations and the International Centre for Tropical Agriculture (CIAT) are implementing an integrative methodology linking scientific and local knowledge in order to help farmers and technicians to understand climate information and *use* it to decide which CSA options to implement.

Up to now, the National Rice Producer Association of Colombia (FEDEARROZ) is including recommendations associated with agro-climatic forecasts within its support package to farmers, called the *Massive Technology Adoption Programme (AMTEC)*, in order to promote among its producers more efficient use of water in dry seasons, appropriate use of fertilisers and agro-chemicals which reduce damage to the environment, as well as variety selection and pest and disease control preparation. In addition, this approach, integrated with big data and climate-site specific management (Delerce *et al*, 2016), has helped rice producers to avoid economic losses, which were estimated at US$ 3.6 million in 2015, preventing producers from planting seeds when climate conditions were expected to be adverse for their crop. Bean and cereal producers, through the National Cereal Producer Association of Colombia (FENALCE), are also using agro-climatic forecasts, especially for variety selection and pest and disease management, according to anticipated future climate conditions and more efficient use of agro-chemicals, thus reducing farmers' expenditure. Given the importance and usefulness of this initiative, the government of Colombia has included the LTACs in the national strategy to reduce agro-climatic risks, with the goal of establishing LTACs in at least 15 regions of the country.

Ethiopia, Senegal, Malawi, Zambia: R4 Rural Resilience Programme

The *R4 Rural Resilience Initiative (R4)* is a strategic partnership between the United Nations World Food Programme and Oxfam America that aims to improve the income, food security and resilience of vulnerable rural households which face increasing risks due to climate change. The initiative currently operates in Ethiopia, Senegal, Malawi and Zambia, and as of 2016 it reached about 40,000 farmers.

By combining community participation in contract design with scientific support for insurance index design, strong institutional partnerships, and using national safety net programmes to allow qualified farmers to purchase insurance through labour, *R4* successfully targets poor smallholder farmers who were previously considered to be uninsurable. Its work on *risk transfer* through insurance is combined with community *risk reduction* projects, *risk reserves* through facilitating small-scale savings to buffer against idiosyncratic risks, and *prudent risk taking* through improving access to microcredit.

Like other agricultural insurance initiatives, the goals of *R4* align with the productivity and resilience pillars of CSA, presenting innovative features with interesting implications for CSA. First, it seeks to build the resilience of smallholder farmers that are particularly poor and vulnerable to the impacts of a variable and changing climate, bringing innovations such as insurance-for-work in order to overcome barriers to their participation. Second, *R4* seeks to connect insurance to improved access to credit and inputs to foster adoption of more productive practices. Third, using insurance-for-work to support community projects, such as conservation farming, raises the prospect of insurance to support reduction or capture of GHGs.

Evaluation of *R4* in Ethiopia showed that the insurance and related interventions increased farmers' access to credit, fostered investment in production inputs, and built their access base; and that the benefits were greater for women farmers, than for men (Madajewicz *et al*, 2013).

Uruguay: Development and Adaptation to Climate Change in the Agricultural Sector (DACC)

The *DACC* project, established in 2012 with a World Bank loan to the Ministry of Agriculture of Uruguay, aims to assist the farming community to implement sustainable strategies to manage the natural resource base for increased agricultural productivity while improving adaptation to climate variability and change. A key component was the establishment of a *National Agricultural Information System* (*SNIA*, from its Spanish acronym) that integrates existing and newly produced information, products, and tools to improve climate risk management and to assist decision-making and the elaboration of policy.

The *SNIA* pursues two main goals. The first is to facilitate access to relevant information and products, and to assist public and private agricultural stakeholders to access, screen, prioritise, and understand relevant information and products. This goal follows the concept of a 'one-stop service', where users can go to one place (*eg* the *SNIA* web site) for a large portion of their information needs. The second goal is to integrate data and knowledge (*eg* climate, vegetation, land uses, prices, plans, markets, *etc*) that are now available in separate publications, bulletins and websites, and make it available from one location. Because decision-makers, including policy-makers, approach problems holistically (Meinke *et al*, 2009), clearly communicated, integrated and multidimensional information is usually more effective for assisting decision-making, planning and elaboration of policy, than separate publications.

As a result of initial workshops with relevant stakeholders from the Ministry of Agriculture, several activities and products were defined for populating the *SNIA* website, including: early warning systems based on improved agro-climatic monitoring and climate forecasts; monitoring and control of effluents from agricultural systems (dairy, crops, feedlots); characterisation of climate-related risks as input for index-based insurance policies; and sustainable land use plans for crop production. The *SNIA* early warning system takes into consideration climate anomalies, vegetation status, soil water content, and a drought severity index, and overlays these with real-time stocking rates to monitor and identify regions that are most vulnerable to drought. For example, in May 2015, the Ministry of Agriculture declared an official emergency in some provinces of Uruguay based on those layers of information, triggering the implementation of special credit lines to assist farmers to buy feed and to solve problems of access to drinking water for their cattle.

This is a good example of the effectiveness of considering *'translated'* climate information (*ie* soil water balances, vegetation status, drought indices), and integrating it with other information (*eg* stocking rates) to inform decisions such as the declaration of emergencies. This type of *translated and integrated* information is also critical for informing decisions at the farm level, such as, selling or buying livestock, and ensuring adequate levels of feed.

Conclusions and lessons learned

The cases presented in the previous section constitute a good set of examples of how climate services and insurance can promote the adoption of Climate-Smart Agriculture practices and technologies.

The Colombian case study exemplifies how the positive experience of the Local Technical Agro-climatic Committees, which engaged in the four pillars of climate services (*production, translation, transfer and use*), convinced the Government of Colombia of the value of promoting such an initiative countrywide. The case constitutes an example of how climate services can contribute to the adoption of CSA, once that information is put into the hands of relevant stakeholders.

The *R4 initiative* in four countries in Africa is an excellent example of how insurance can enable an environment in which farmers can engage in CSA practices. In particular, this type of initiative can foster participation of farmers in activities that can enhance resilience, it can improve access to inputs to increase the adoption of more productive practices with consequences on incomes and food security challenges, and it can support community projects aimed at reducing or capturing GHG emissions.

Finally, the case of Uruguay exemplifies how the establishment of a *National Agricultural Information System* that includes a strong component on climate information can promote the implementation of policies that aim at working towards CSA practices. The latter includes insurance policies and accessible loans to invest in solutions to cope with water limitations.

This set of examples also demonstrates the importance of focusing not only on the *production* of climate information and knowledge, but also investing in understanding *the translation, transfer and use* of this information. Given that there is a common imbalance between strong and robust research in generating the knowledge, and much smaller efforts (less consistent, less robust, more based on anecdotal approaches) in the other three pillars, good and robust research on the knowledge 'networks' through which information flows, and affects the 'use of knowledge', should be a priority in the research agenda. One example in this direction is the work done by the International Research Institute for Climate and Society (IRI), where index-based insurance has been promoting the involvement of users to define adequate insurance policy. Understanding these knowledge networks is critical for promoting CSA at scale.

Acknowledgements

This work was implemented as part of the International Centre for Tropical Agriculture (CIAT) and the CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS). This work is carried out with support from CGIAR Fund Donors and through bilateral funding agreements. For details please visit https://ccafs.cgiar.org/donors. The views expressed in this document cannot be taken to reflect the official opinions of these organisations.

References

Barrett CB, Santos P, 2014. The impact of changing rainfall variability on resource-dependent wealth dynamics. *Ecological Economics*, **105**, 48-54.

Bertram-Huemmer V, Kraehnert K, 2015. *Does index insurance help households recover from disaster?* German Institute for Economic Research (DIW) Discussion Paper 1515.

Climate Services Partnership, 2017. *What are Climate Services?* [http://www.climate-services.org/]. Accessed 8 February 2017.

Cole SA, Gin e X, Vickery JI, 2013. *How does risk management influence production decisions? Evidence from a field experiment.* World Bank Policy Research Working Paper 6546, Washington DC, USA: World Bank.

Delerce S, Dorado H, Grillon A, Rebolledo MC, Prager SD, Patiño VH, Varón GG, Jiménez, 2016. Assessing weather-yield relationships in rice at local scale using data mining approaches. *PLoS ONE* [http://dx.doi.org/10.1371/journal.pone.0161620].

Elabed G, Carter MR, 2015. Compound-risk aversion, ambiguity and the willingness to pay for microinsurance. *Journal of Economic Behavior & Organization,* **118**, 150-166.

FAO, 2013. *Climate-smart agriculture sourcebook. Executive summary*. Rome, Italy: FAO. [http://www.fao.org/climatechange/37491-0c425f2caa2f5e6f3b9162d39c8507fa3.pdf].

GFCS (Global Framework for Climate Services), 2017. *World Climate Conference-3 (WCC-3)*. [http://www.wmo.int/gfcs/wwc_3]. Accessed 8 February 2017.

Greatrex H, Hansen JW, Garvin S, Diro R, Blakeley S, Le Guen M, Rao KN, Osgood DE, 2015. *Scaling up index insurance for smallholder farmers: recent evidence and insights*. Report No 14. CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark.

Hansen JW, Mason S, Sun L, Tall A, 2011. Review of seasonal climate forecasting for agriculture in sub-Saharan Africa. *Experimental Agriculture,* **47**, 205-240.

Hill RV, Viceisza A, 2012. A field experiment on the impact of weather shocks and insurance on risky investment. *Experimental Economics*, **15**(2), 341-371.

IPCC, 2012. *Managing the risks of extreme events and disasters to advance climate change adaptation. A special report of Working Groups I and II of the Intergovernmental Panel on Climate Change*. Eds Field CB, Barros V, Stocker TF, Qin Dahe and eight others. Cambridge: Cambridge University Press.

Maccini Y, Yang D, 2009. Under the weather: health, schooling, and economic consequences of early-life rainfall. *American Economic Review,* **99**(3), 1006-26.

Madajewicz M, Tsegay AH, Norton M, 2013. *Managing risks to agricultural livelihoods: impact evaluation of the HARITA [Horn of Africa Risk Transfer for Adaptation project] program in Tigray, Ethiopia, 2009-2012*. [https://www.oxfamamerica.org/static/media/files/Oxfam America_Impact_Evaluation_of_HARITA_2009-2012_English.pdf]. Accessed 8 February 2017.

Meinke H, Howden SM, Struik PC, Nelson R, Rodriguez D, Chapman SC, 2009. Adaptation science for agriculture and natural resource management - urgency and theoretical basis. *Current Opinions in Environmental Sustainability* [http://dx.doi.org/10.1016/j.cosust.2009.07.007].

Mudombi S, Nhamo G, 2014. Access to weather forecasting and early warning information by communal farmers in Seke and Murewa districts, Zimbabwe. *Journal of Human Ecology*, **48**(3), 357-366.

Rao KPC, Hansen J, Njiru E, Githungo WN, Oyoo A, 2015. *Impacts of seasonal climate communication strategies on farm management and livelihoods in Wote, Kenya*. CCAFS Working Paper no 137. Copenhagen, Denmark: CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS).

Roudier P, Muller B, d'Aquino P, Roncoli C, Soumaré MA, Batté L, Sultan B, 2014. The role of climate forecasts in smallholder agriculture: lessons from participatory research in two communities in Senegal. *Climate Risk Management*, **2**, 42-55.

Vaughan C, Dessai S, 2014. Climate services for society: origins, institutional arrangements, and design elements for an evaluation framework. *WIREs Climate Change*, **5**, 587-603.

WMO, 2014. *Implementation plan of the Global Framework for Climate Services*. 70 pp, Geneva, Switzerland: World Meteorological Office.

Zimmerman FJ, Carter MR, 2003. Asset smoothing, consumption smoothing and the reproduction of inequality under risk and subsistence constraints. *Journal of Development Economics,* **71**, 233-260.