Earth Perspectives
a SpringerOpen Journal

RESEARCH ARTICLE Open Access

Shaping global agendas on climate risk management and climate services: an IRI perspective

James W Hansen*, Stephen Zebiak and Kevin Coffey

Abstract

This paper provides a historical overview of the development and mainstreaming of global agendas on climate risk management and climate services from the vantage point of the International Research Institute for Climate and Society (IRI), and present two examples that illustrate how efforts to mainstream these agendas shaped both the institute and the broader communities that it sought to engage. In the first example, we trace developments that led to the emergence of a global agenda on climate services, including creation of the Climate Services Partnership (CSP). The CSP is an informal, open network of interested climate information users, providers, donors and researchers, serves as a platform for knowledge sharing and collaboration to advance climate service capabilities worldwide. The second example is mainstreaming climate risk management within the international agricultural research-for-development community. The CGIAR research program on Climate Change, Agriculture and Food Security (CCAFS) was structured to include a research theme on "Adaptation through Managing Climate Risk," which put climate risk management on the same footing within the agenda as adaptation to future climate change. We conclude with several lessons drawn from IRI's involvement in the processes that shaped global agendas around climate risk management and climate services.

Keywords: Climate services; Climate risk management; Mainstreaming; Resilience; Agriculture

Background

Over the past 15 years, the focus and strategy of the International Research Institute for Climate and Society (IRI) evolved – from climate prediction and applications, toward a more holistic approach to climate risk management and to climate services – in parallel with the agenda of the broader climate research and applications community that it has sought to engage (Goddard et al. 2014). IRI perspectives on climate risk management and on climate services grew from the institutional experience of working toward its mission "to enhance society's capability to understand, anticipate and manage the impacts of climate in order to improve human welfare and the environment". We highlight here a few key points about the IRI's strategy for research, service and training, which are further detailed and illustrated in the companion papers of this journal issue.

The initial focus of IRI was on advancing seasonal climate prediction and its application. From the beginning, IRI work engaged both research and practical application always in the context of real decision or policy settings. Experience working at the interface between research and practice quickly revealed that practitioner communities rarely found climate information products developed by climate researchers and operational agencies (including IRI) to be understandable or useable. Some form of translation inevitably was needed to cast information into a form that addressed the right questions and informed practical decision-making processes. Innovation in the decision process was often also needed in order to take advantage of new information and knowledge about climate. Additionally, policy or institutional constraints were often found to hinder implementation of new climate-informed practices. The opportunity to overcome these challenges required substantial investment in engagement among researchers, information providers and practitioners that, when effective, enabled the "co-

* Correspondence: jhansen@iri.columbia.edu
International Research Institute for Climate and Society, Columbia University, Palisades, NY, USA

discovery" of approaches and supporting information to effect climate-informed practice and policy. We found that the most effective way to start the collaboration process was to focus on understanding the problems and decisions that new services would address. This learning served both as inspiration and motivation for IRI articulating its work and its objectives in a different way. Through on-the-ground experience, the institutional view on our own work and its potential value shifted from a focus on "applications" of climate forecasts and information, toward enabling better decisions and policies where climate-related risks and opportunities could be effectively assessed and managed. IRI developed and began to promote its concept and approach to climate risk management (CRM). Moreover, IRI reformulated its mission and institutional objectives, and even its name (from "International Research Institute for Climate Prediction" to "International Research Institute for Climate and Society"), in the context of CRM.

As IRI gained experience, it increased its investment in key institutional partnerships and engagement in international processes relating to climate-related challenges. These partnerships provided fertile ground for dialogue, debate and further learning that shaped the interest and perspectives that IRI has brought to the more recent international discourse and activities around climate services.

IRI's participation in the development of global agendas on climate services and climate risk management, which significantly shaped its own agenda, gives the institution a unique historic perspective. This paper provides a historical overview of the development and mainstreaming of global agendas on climate risk management (focused on agriculture and food security) and climate services from the vantage point of the IRI (summarized in Figure 1), and illustrates how IRI's approach to research and partnership influenced both the institute and the broader communities that it sought to engage. Section 2 traces IRI's contribution in the global discourse on climate services and to key events that led to the UN Global Framework for Climate Services, and the launch of a global Climate Services Partnership. Section 3 describes IRI's role in the development and leadership of the CGIAR research program on Climate Change, Agriculture and Food Security, which has contributed to mainstreaming climate risk management within the international agricultural research community. The paper concludes with some lessons learned through participating in agenda mainstreaming processes.

Rallying a global community around climate services

A growing appreciation for the importance of climate variations to societies, the need to better manage the

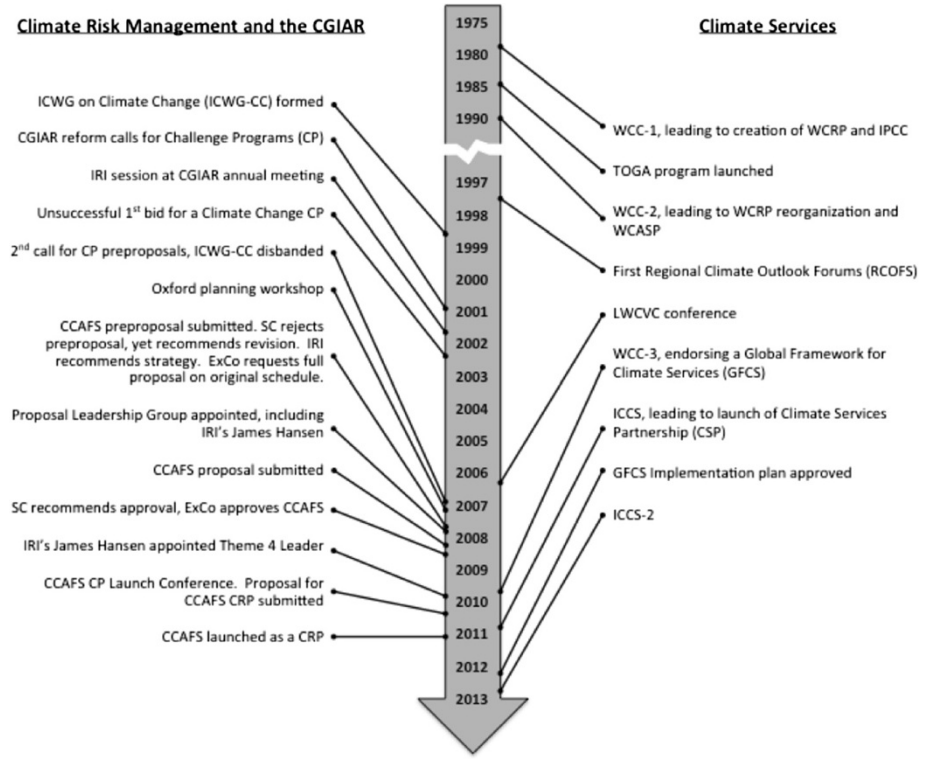

Figure 1 Time line of significant events that shaped the development global agendas for climate risk management for agriculture, and climate services.

associated impacts and potential opportunities, and the relevance of this for development objectives led to the growing interest and action around climate services. The Climate Services Partnership (CSP) draws on this growing interest and engagement across a global community. The CSP – an outcome of the first International Conference on Climate Services (Columbia University, New York, October 2011) – is an informal, non-governmental platform for promoting and advancing climate services throughout the world. Made up of researchers, providers, users and funders of climate services, the CSP aims to support climate services capabilities through strengthening knowledge capture and exchange, fostering collaboration and supporting institutional linkages across relevant agencies and programs. This initiative provides a platform for connecting initiatives and actors within the larger climate services agenda that is taking shape today, into a growing community of practice.

The concept and vision for climate services have evolved considerably over recent years, but rest on climate programs and activities over many decades (Zillman 2009). Here we review some aspects of this history, with attention to how and why IRI became increasingly involved.

The roots of climate services

Recent international dialogue and actions around climate services build on a history of climate activities over several decades. Many national meteorological services included climate offices dating as early as the 1950s. For the most part these services focused on the provision, analysis and occasionally interpretation of historical climatological data in the context of particular "applications" such as agriculture and transportation. Climate research advanced significantly in the 1970s, with the development and increased use of global climate models that provided a new means to study climate processes, but also enabled researchers to address questions of climate sensitivity and climate change particularly in response to increasing greenhouse gas concentrations.

Building on this growing body of research, the first World Climate Conference (WCC-1) was convened in 1979. The findings stated, "Having regard to the all-pervading influence of climate on human society and on many fields of human activity and endeavor, the Conference finds that it is now urgently necessary for the nations of the world: (a) To take full advantage of man's present knowledge of climate; (b) To take steps to improve significantly that knowledge; (c) To foresee and prevent potential man-made changes in climate that might be adverse to the well-being of humanity" (Proceedings of the World Climate Conference. Geneva 1979). A principal outcome was the creation of the World Climate Programme (WCP), comprised of four component programs that addressed climate research, data, impacts and applications. Its aim was to promote and coordinate efforts to better observe, model and understand the climate system and its relation to human wellbeing. The WCP subsequently supported the establishment of the Intergovernmental Panel on Climate Change (IPCC), charged with ongoing scientific assessment of climate change, its social and economic impacts and potential response strategies.

The dimensions of climate research, and eventually climate services, expanded significantly in the 1980s, as work on understanding, modeling and predicting aspects of the El Niño/Southern Oscillation (ENSO) phenomenon intensified. Under the auspices of the World Climate Research Program, the Tropical Ocean – Global Atmosphere (TOGA) program was launched in 1985. Work under the TOGA program was highly influential, demonstrating not only a theoretical basis for predictability of climate on seasonal-to-interannual time scales associated with ENSO, but also predictions of this phenomenon validated retrospectively, and in real time (Anderson et al. 1998). By 1995, TOGA left in place an operational observing system consisting of moored buoys, island tide gauges, surface drifters, a volunteer ship observing program and a variety of satellite observations, all to support continuing routine seasonal predictions. The TOGA period represented a new era for the climate community, leading to a much more ambitious climate agenda. Following closely on the TOGA program, the concept of an international institution dedicated to both the improvement of seasonal prediction capability and its practical use toward societal benefit culminated in the founding of IRI (then the International Research Institute for Climate Prediction).

The beginnings of this expanded climate agenda were already in place as the second World Climate Conference (WCC-2) was convened in 1990. WCC-2 resulted in a restructuring of the World Climate Programme, introducing the explicit dimension of climate services by formulating the World Climate Applications and Services Program (WCASP), with a remit for operational climate information, prediction and analysis systems, including user liaison. WCC-2 reformulated the WCP program on climate impacts to include consideration of impacts and responses. Both moves broadened the emphasis from the production to the use of the information.

Under the new WCASP, initiatives were introduced that focused on the delivery of climate forecasts and information to user communities. The Climate Information and Prediction Services (CLIPS) project was aimed at developing capacity for delivering climate information for improved decision-making, focusing primarily on development of training activities and curricula. Regional Climate Outlook Forums were introduced in 1997 (a major El

Niño year with strong climate-related impacts in many regions), and were designed to bring together research, operational and "user" communities around a process to produce a consensus regional climate outlook and consider associated socio-economic impacts and response strategies (Basher et al. 2001). IRI was invited into, and became very active in, both of these initiatives as an institution that had pioneered seasonal climate and impact prediction methodologies, products and tools at the global and regional scale[a] (Barnston and Tippett 2014).

More services and applications activities were envisioned under the World Climate Program, but the process failed to deliver adequate resources and support throughout the decade and a half following WCC-2. The World Climate Research Program was, however, active throughout the period. Under its Climate Variability and Predictability (CLIVAR) program, the Working Group on Seasonal to Interannual Prediction was established in 1999. IRI scientists have served in the role of Chair or member of WGSIP since the beginning, as well as in other CLIVAR roles[b].

Building momentum around climate services

LWCVC conference

After more than a decade hiatus following the second World Climate Conference, the concept emerged for an international interdisciplinary conference on decision processes in climate applications. IRI participated in the early discussions and planning for this conference, voicing strong support for using the opportunity to highlight emerging experience in climate risk management and user engagement processes[c]. Eventually, IRI proposed and was accepted as a co-sponsor of the conference, with WMO and the Finnish Meteorological Service.

The conference, "Living with Climate Variability and Change: Understanding the Uncertainties and Managing the Risks" (LWCVC) was convened in 2006 to "review the opportunities and constraints in integrating climate risks and uncertainties into decision-making in the core socio-economic sectors" (WMO (World Meteorological Organization) 2009a). It emphasized bringing user community perspectives together with climate scientist perspectives, drawing participation from multiple sector groups (agriculture, water, public health, energy, disasters) as well as experts in decision-making. This, together with the focus on decision processes and decision contexts distinguished LWCVC clearly from previous climate conferences. IRI was able to contribute to LWCVC in several ways. Beyond IRI serving as a co-sponsor and co-organizer, IRI scientists were invited presenters or co-chairs of many of the thematic sessions.

LWCVC provided an opportunity for presentation, discussion and debate among a diverse but invested and interested community of researchers and practitioners. From this process a number of significant conclusions emerged. The findings highlighted, for the first time, key requirements for establishing climate services that enable effective climate risk management practices. The workshop recommended that climate services should be: (a) driven by the needs and requirements expressed by relevant decision sectors, (b) developed within real-world decision contexts, (c) enabled through facilitating institutions and policies, (d) based on environmental, sectorial and socioeconomic data, (e) based on tailored climate information, (f) supported by local capacity, (g) included in planning strategies that incorporate incentives, and (h) supported by sector-specific services from National Meteorological and Hydrological Services and related institutions (WMO (World Meteorological Organization) 2009a). These ideas have permeated all subsequent discourse on climate services.

World climate conference-3 and the global framework for climate services

The World Climate Conference-3 (WCC-3), convened by the World Meteorological Organization in 2009, was the landmark event on the pathway toward current international initiatives in climate services. The vision statement, "WCC-3 will establish an international framework to guide the development of climate services linking science-based climate predictions and information with climate risk management and adaptation to climate variability and change throughout the world," framed climate services in the context of decision-making. This was a significant conceptual step – perhaps leap – toward the prevailing view of services that encompass decision makers as well as researchers and information providers.

An International Organizing Committee (IOC) was given the task of developing the conference scientific and policy agendas, conducting outreach to key partner organizations and sponsors, and developing appropriate communications.

Through discussion, debate and stakeholder consultation, the IOC's subcommittee for the High Level Segment defined the vision and action agenda that became the conceptual underpinnings for the Global Framework for Climate Services (GFCS). The Concept Note that was delivered to WCC-3 participants presented a rationale, objectives and a proposed programmatic structure for the GFCS that clearly built upon existing infrastructure and activities of the World Climate Programme, but also transcended them through inclusion of a mechanism to actively engage the climate services practitioner communities – the User Interface Platform[d]. IRI was invited to serve on the IOC, and through this mechanism contributed to the planning of WCC-3 and the visioning for GFCS. IRI interventions sought to broaden the User

Interface Platform concept to include fostering institutional partnerships, cross-disciplinary research, innovation, decision-support tools, knowledge capture, evaluation, establishment of good practices, education and capacity building. This advice was based on IRI's own experience and that of other organizations already working in the "boundary space" of climate services development.

WCC-3 drew more than 2500 participants, including numerous heads of state, UN agencies and international organizations (with significant IRI involvement[e]). A wide-ranging Expert Segment addressed research findings on sector-based needs and applications, climate science and information, climate risk management and climate adaptation, and various societal perspectives on climate services. The key outcome of the conference was the WCC-3 Declaration, which endorsed the GFCS as proposed through the IOC, and set in motion a process creating a High Level Task Force[f] to undertake consultations and make recommendations for next steps in implementation (WMO 2009).

Thus, the international climate agenda was transformed and energized around a new vision for climate services that is still in play today. Progress continues to further define and implement the GFCS, and to establish appropriate governance and mobilize resources to support it. While much of the current implementation activity rests within intergovernmental processes, there are continuing opportunities for nongovernmental partners such as IRI to contribute[g].

Climate services partnership

Even as international momentum around climate services has been building, a range of climate services programs and institutions have been introduced at national and regional levels in response to growing awareness and demand across sectors (including agriculture, food security, water, health, energy and disaster management). Sector-based organizations and development institutions have invested in building climate information and services capacities into their programs. At the same time, research organizations have been working on developing new knowledge to support new and better climate services. Because these various initiatives have, for the most part, been pursued independently, the experience and knowledge gained has largely resided within each program.

This is the backdrop from which the idea of the CSP emerged. The initial, informal discussions among a few organizations were built on the concept of creating a space for exchange of information and experiences among active climate services stakeholder groups across sectors and regions. An international conference – the first International Conference on Climate Services (ICCS) – was proposed as the means to start this process. IRI worked with an expanded organizing committee to develop ideas for the conference and its outcomes. The intent was for the conference to be action-oriented, engaging organizations that were active and in climate services in some manner, with genuine interest in sharing their experience and learning from others. From early in the planning process, the notion of some sort of continuing process was held as a means to foster continued exchange and collaboration expected to emerge from ICCS.

The Conference; held at Columbia University, New York, October 2011; brought together more than 100 participants, representing meteorological or climate service centers, UN agencies, humanitarian organizations, development institutions, national agencies, non-governmental organizations and universities. The Conference produced lively debate and discussion, and achieved consensus on the proposition that first motivated the conference: that establishing a means to effectively share knowledge and build collaboration would enable the community to accelerate learning, develop new capacities and establish good practices that would benefit all.

In the ICCS Conference Statement, the participants agreed to establish the Climate Services Partnership as a platform to pursue precisely this agenda. By consensus, the Climate Services Partnership was proposed as an informal and open process in order to support broad participation, and to enable the CSP to be nimble and responsive to members' interests and ideas. A Coordinating Group was established to provide review and recommendations on activities, consider membership, resourcing questions and event planning. In support of the initiative, IRI offered to form a Secretariat[h] to coordinate communications, develop knowledge resources and organize collaborative projects of the Partnership.

The initial CSP activities have included: (a) establishing a mechanism for sharing knowledge and lessons learned, and developing a set of case studies contributed by the Partnership members; (b) initiating collaborative working group activities to expand knowledge in priority areas, including economic valuation of climate services and good practices in climate services development; and (c) identifying mechanisms to support the Global Framework for Climate Services and other relevant international processes. A variety of information resources on climate services activities, programs, institutional arrangements, outputs and experiences have been developed through CSP activities.[i] Ongoing collaborative work on the economic value of climate services includes assessment of the relevant literature and the development of new resources on valuation methodologies appropriate for climate services. CSP maintains active contact with the GFCS Project Office, and has facilitated a process to provide feedback and recommendations on proposed aspects of GFCS implementation.

Following the recommendation of a continuing series of ICCS conferences, CSP convened the second International Conference on Climate Services (ICCS2) in September 2012, together with local host (and CSP member), Climate Services Center, Germany. ICCS2 brought together a larger and more diverse attendance than did its predecessor (including 200 participants from 40 countries, and greater representation of the private sector and user communities). It provided opportunity for review, discussion and deliberation on initial CSP activities; and proposed additional CSP activities including: knowledge capture on climate services user perspective, institutional and business models; establishing good practices and minimum standards in science, user engagement and evaluation of climate services; capacity development; engaging NGO programs and resources; linking financial services with climate services; and principles for public-private partnerships in climate services.

CSP plans to continue to convene an annual international conference in the future, as well as support other relevant thematic or regional meetings. There has also been encouragement for developing additional, low-cost means for discussion, debate and information sharing. Toward this end, CSP has established a web-based facility – the CSP Knowledge Exchange - providing an alternative, accessible means for presenting and discussing programs, concept papers, and opinions relating to climate services.

The CSP represents a novel, grassroots initiative to advance the climate services enterprise from research, to practice, to impact. Although CSP has established new resources, gained financial support, and engaged considerable participation, there remains great deal more that this initiative could accomplish. Its informal, nongovernmental structure makes it easy to engage academia, civil society, private sector partners and governmental organizations. Based on the interest and participation of its members, and resources they can attract, CSP has the potential to create a truly rich repository of climate services knowledge and information, a clearinghouse for continually-evolving good practices, and a dynamic collaboration space for new ideas and innovations. If it is successful, it will not only serve as a preferred resource for its individual members, but will also contribute to advancing the scientific underpinnings, implementation, assessment and improvement of climate services globally. With due attention to how such work could most effectively link to, and support, formal climate services development, especially the Global Framework for Climate Services, these CSP contributions can assume even greater significance and impact.

The CSP offers IRI a means to build upon and amplify its own work, engage new partnerships, and contribute to building global capacity in climate services and climate risk management in new ways. IRI sees its own mission and objectives reflected in CSP. It is squarely in the interest of IRI to support and contribute to CSP as a primary mechanism for contributing to its international climate services agenda.

Shaping a global agenda around CRM for agriculture

A CRM approach to adapting agriculture to a changing climate

Within agriculture, a framework and methodology for analyzing risk and its implications for decision-making in the agriculture sector were largely in place by the late 1970s (Anderson et al. 1977). Yet climate risk management (CRM) gained identity as a concept that crosses sectors only in the last decade, with IRI prominent among the institutions that framed and promoted the concept. A few common features characterize the IRI approach to CRM (Goddard et al. 2014; Hansen et al. 2007; Hellmuth et al. 2007; Baethgen 2010). It recognizes climatic uncertainty as a fundamental challenge; and seeks to quantify and, where possible, reduce the uncertainty that decision-makers face. Managing climate risk often involves a portfolio of interventions including, for example, climate-informed technologies that reduce vulnerability to climate variability, and climate-informed policy and market-based interventions that transfer risk from vulnerable populations. Climate information – including historical observations, monitoring of current conditions and prediction at the range of relevant lead times – plays a prominent role in IRI's work on CRM. IRI's approach to CRM focuses on the full range of variability, seeking to protect against the impacts of adverse extremes, while also capitalizing on opportunities in years or seasons when climatic conditions are favorable.

Bridging adaptation and development

Long (30-100 year) climate change scenarios and impact studies that dominated the first three IPCC assessments may have been useful to frame political discourse toward mitigation policies, but are not relevant to the planning horizons of vulnerable farmers, or of governments of poorer countries grappling with immediate climate-sensitive development challenges. Few climate-sensitive agricultural decisions have planning horizons longer than about two decades, and most are much more immediate. Early policy under the UNFCCC compounded this dilemma by defining adaptation narrowly in terms of the anthropogenic change component of climate, and restricting the main adaptation funds to the verifiable additional adaptation costs imposed by anthropogenic climate change, while the cost of development that would target the sources of climate vulnerability had to be borne elsewhere (Pielke 2005; Khan and Roberts 2013; Ayers and Huq 2009). This

"additionality" policy, which was meant to ensure that industrialized countries provide adaptation funds beyond existing development assistance commitments, was seen as an obstacle to poor countries securing funds for promising adaptation options that also addressed immediate climate-related development challenges. For adaptation interventions with longer planning horizons, the considerable uncertainty inherent in projections of local changes in climate (particularly precipitation) complicates decision-making, and the challenge of justifying requests for adaptation funds. By focusing on immediate actions that target vulnerability and build resilience to the impacts of climate across time scales, CRM is increasingly recognized as a crucial bridge between immediate development challenges and longer-term adaptation.

Adaptation through a resilience lens

Applying a CRM approach to adapting agriculture to a changing climate raises several challenging issues. Consider the case of a stressed smallholder farming system in a risk-prone environment. The same factors – a weak asset base, and dependency on a narrow range of weather-dependent sources of livelihood– tend to make the household vulnerable to both future climate change and current climate shocks. The strong likelihood that climate change will increase the frequency or intensify of damaging extremes, such as droughts, floods or heat waves, increases the urgency of transformation toward a livelihood strategy that is less weather-dependent, more stable and more prosperous. Yet in these settings, extreme events are prone to reverse the gains from agricultural development investments by eroding farmers' productive assets. Evidence suggests that poverty traps often lock poorer farmers, in high-risk environments, into highly vulnerable livelihood strategies. The poverty traps literature highlights the existence of threshold levels of assets that act as tipping points between chronic poverty and the potential for asset accumulation (Barrett and Carter 2006). Climate variability and resulting risk appears to contribute to poverty traps in several distinct ways, including acting as a barrier to accessing available production technologies and market opportunities (Hansen et al. 2011).

The agricultural literature on risk emphasizes the risk perceptions and preferences of decision-makers, and how they interact with probability distributions of variables such as production and income in response to stochastic drivers (Anderson et al. 1977; Hardaker et al. 2004). While this framework is useful, it is not sufficient for dealing with the implications of risk for the climate change adaptation challenge, and particularly how the dynamic interactions between risk, decisions, and household wealth or assets, evolve over time. The possibility that these dynamic interactions are affected by critical thresholds or "tipping points" presents a particular challenge. For these reasons, climate risk management in the context of adaptation to progressive climate change is increasingly expressed in terms of resilience, which offers a conceptual and analytical framework for dealing with the evolution of nonlinear systems characterized by critical thresholds, subjected to stochastic variability and uncertain trends.

Resilience from an ecological perspective was originally defined as "the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist" (Holling 1973). When applied to human systems, the concept of resilience had to be extended to include both decision processes that allow deliberate and anticipatory reconfigurations of the system (i.e., adaptation), and the very real possibility that the "original state" is undesirable (Engle 2011; Bahadura et al. 2013).

A more recent framing of resilience from a development perspective provides a theoretical link between near-term risk and climate change impacts for smallholder farmers (Barrett and Constas 2013). In the context of poverty traps, the authors discuss resilience in term of a livelihood trajectory that is subject to stochastic risk (e.g., from climate variability) that inhibits asset building for smallholder farmers. For rainfed farming systems vulnerable to seasonal variability, climate shocks can cause repetitive cycles of asset loss that threaten progress out of poverty traps, leaving households in a chronic state of food insecurity. In this case, a resilient rural household does not necessarily return to its initial state following a shock. Rather, a resilient household is one that is moving toward a more positive state, accumulating enough assets to escape chronic poverty, while protected from setback by shocks. This interpretation moves beyond resilience as the ability of a system to retain its current form regardless of climate variability (Berman et al. 2012). Instead, resilience to climate shocks can allow farmers to build wealth, which facilitates a transformation towards livelihoods that do not require asset depleting coping strategies.

Thinking about the adaptation challenge through a resilience lens has several practical implications for efforts to support smallholder agriculture. It provides a framework for thinking about what combination of development and safety net interventions should be considered in a particular context, to move communities onto a positive livelihood trajectory that will be well-adapted to future climatic conditions, while protecting them from falling back in the face of climate shocks. If a farming system is characterized by a poverty trap, adaptation efforts must either increase farmers' assets above the poverty trap threshold, or change the conditions that led to the poverty trap. Understanding how climate-related risk undermines agricultural development and contributes to

poverty traps may suggest promising new interventions to improve the success of development efforts. In the presence of poverty traps, different forms of safety nets may be needed to protect the poor and vulnerable from destitution or abandonment, and to protect the non-poor from falling into chronic poverty.

A partnership between the IRI and the international agricultural research community provided an opportunity to develop and apply the IRI's evolving thinking about CRM in the context of a new applied research program on Climate Change, Agriculture and Food Security (CCAFS).

The CCAFS story

CCAFS – a program of the CGIAR in partnership with the global change research community – is the world's largest research effort to address the challenges that a changing climate imposes on agriculture and food security across the developing world. The CGIAR[j] is a network of 15 International Agricultural Research Centers (IARCS), and the funding and governance bodies that support them. CGIAR research played a major role (Evenson and Gollin 2003) in the Green Revolution, which led to near tripling of global food production between 1961 and 2000 when global population doubled[k], and dramatically reduced poverty and hunger particularly in Asia and Latin America. The aggregate return on investment in CGIAR research, in terms of development impact, has been high throughout its history (Raitzer and Kelley 2008; Renkow and Byerlee 2010). The CGIAR evolved significantly since it was established with three IARCS in 1971. As the number of IARCS increased, its mission broadened from increasing global food availability to include first rural poverty reduction and then natural resource sustainability.

Since 2000, IRI has viewed the CGIAR as the most strategic partner for advancing climate risk management for agriculture. The opportunity to partner with the CGIAR in the development of CCAFS was a breakthrough for the IRI's efforts to advance CRM for agriculture.

The challenge program phase

A set of reforms initiated in 2001 within the CGIAR (CGIAR 2000) set the stage for CCAFS. These included the introduction of Challenge Programs as a new model for collaborative research that sought to strengthen synergies and collective action among the IARCs; and to expand the CGIAR's research agenda, partnerships and funding beyond the core work of the IARCs. Challenge Programs were designed as "time-bound, independently governed programs of high-impact research that target CGIAR goals on complex issues of overwhelming global or regional significance that require partnerships among a wide range of institutions to deliver their products". The Challenge Program goal of moving beyond the traditional mandates of IARCS, on emerging issues of global concern, was quite relevant in the case of climate change. While climate is not explicit in the mandate of any of the IARCs, attention to climate pervades much of the CGIAR's research because agriculture is so weather-dependent. The CGIAR had already formed an Inter-Center Working Group on Climate Change (ICWGCC) in 1998, as a mechanism to address the growing issues of climate change adaptation and mitigation. An initial call for proposals led to the creation of four Challenge Programs; but a proposed Climate Change Challenge Program, led by the ICWGCC, was not approved.

CCAFS came out of a second call for Challenge Program pre-proposals in 2006. The CGIAR Alliance, representing directors of the IARCs, agreed to dissolve the ICWGCC and pursue a Challenge Program, in partnership with the global change research community represented at the time by the Earth Systems Science Partnership (ESSP). The process started with a small meeting (Oxford, UK, Feb 2007) of representatives from the CGIAR and global change research community that proposed a strategy and preliminary thematic structure. The pre-proposal that came out of the process was not accepted. Yet the CGIAR Executive Council considered the topic sufficiently important to request a full proposal, on a tight original time frame. IRI responded quickly to the resulting challenge with a set of recommendations for moving the process forward, which were well received and eventually adopted. As a result, IRI was invited to participate in a 9-person Leadership Group, representing the CGIAR and the global change research community, tasked with developing the CCAFS proposal.

Objectives of the proposed program (CCAFS 2009) targeted: (a) critical knowledge gaps about how to enhancing food security, livelihood and environmental goals; (b) adaptation options; and (c) supporting decision-making – in response to a changing climate. A research agenda to achieve these objectives was structured within six Themes (Table 1). The Leadership Group concluded that two separate adaptation themes were justified – focused on managing current climate risk, and on adapting to progressive change – to ensure sufficient leadership to cover the range of research challenges, options for intervention, and required partnerships. Analysis and stakeholder consultation led to selection of three focus regions: Eastern and West Africa, and South Asia. Other features of the proposed program included a partnership between the CGIAR and ESSP (representing the global change research community at-large), a focus on food systems in addition to agricultural production, and governance that maintained independence from the IARCs.

A competitive process led to IRI hosting the leadership of Theme 4: Adaptation pathways based on managing

Table 1 Research theme in the CRP and challenge program phases of CCAFS

CGIAR research program phase		Challenge program phase	
1	Adaptation to progressive climate change	5	Adaptation pathways under progressive climate change
2	Adaptation through managing climate risk	4	Adaptation pathways based on managing current climate risk
3	Pro-poor climate change mitigation	6	Poverty alleviation through climate change mitigation
4	Integration for decision making	1	Diagnosing vulnerability and analyzing opportunities
		2	Unlocking the potential of macro-level policies
		3	Enhancing engagement and communication for decision-making

climate risk". Work began late 2009, and CCAFS was formally launched at a conference in Nairobi in May 2010.

The CRP phase

During the period between submission of the Challenge Program proposal and the official launch of the program, the CGIAR began a major restructuring (Secretariat, CGIAR 2009). The most significant change was the creation of CGIAR Research Programs (CRPs) that would become the mechanism for organizing, reporting and funding research. The CRPs would replace all Challenge Programs. The CCAFS leadership was tasked with formulating a CRP to deal with climate change. Climate change was one of two fast-tracked CRP proposals that led the reform, and set many of the rules and norms that the remaining CRPs would follow.

The resulting CRP (CCAFS 2011; Vermeulen et al. 2011) built heavily on the CCAFS Challenge Program. The six Themes of the Challenge Program were consolidated into four (Table 1). The new CRP incorporated the new climate risk management agenda and other major areas of research, intervention and partnerships from the CCAFS Challenge Program; but also incorporated ongoing climate adaptation and mitigation work within the IARCs. Since all CGIAR research was to be mapped onto CRPs – most of which hadn't been yet been defined – some initial ambiguity about the boundaries had to be resolved. For example, while much of the CGIAR's work on developing genetics and production technology for stressed environments contributes toward climate adaptation, there was a consensus that this would generally fit better within other CRPs; CCAFS would emphasize targeting and evaluating of portfolios of production technology in the context of climate variability and change. Other significant changes to CCAFS included aspects of governance, source of funding (from individual donors to primarily CGIAR funding), and a significant increase in total funding to cover the large amount of ongoing research among the IARCS that was integrated into the program. The responsibility of Theme Leaders expanded to include reporting on relevant work across the IARCs, and ensuring that the work aligned with the CCAFS agenda and produced outcomes.[1] Although CCAFS was dissolved as a Challenge Program, the branding and leadership of CCAFS continued through the transition to CRP with only minor adjustments. This allowed strategic partnerships and activities initiated in the Challenge Program phase to continue.

Mainstreaming an expanded climate risk management agenda

The transition of CCAFS from a Challenge Program to a CRP contributed significantly to mainstreaming climate risk management within the CGIAR. This is because the purpose of a Challenge Program was to expand the agenda and partnerships of the CGIAR, while CRPs were mainstreamed as the new mechanism organizing and resourcing research across the CGIAR. As a Challenge Program, CCAFS was explicitly designed to complement rather than replicate the core work of the CGIAR's IARCs by targeting: (a) emerging adaptation interventions that were not yet mainstreamed due to newness or knowledge gaps; (b) interventions requiring expanded upstream and downstream partnerships beyond the CGIAR's traditional partners; (c) analytical approaches to support targeting and evaluation of adaptation options developed by CGIAR centers; and (d) integrated, cross-scale adaptation approaches that would depend on the coordination, integration and economy of scale that a Challenge Program could provide (CCAFS 2009). The new CCAFS agenda, which incorporated elements of IRI's approach to CRM, became the starting point for an ambitious agenda that was mainstreamed across the IARCS. Within this new agenda, synergies between IRI's climate expertise and CRM experience, and CGIAR's broad base of agricultural expertise and action on the ground across the developing world, opened opportunities for new areas of research, such as climate information and advisory services for smallholder farmers, bringing improved crop production forecasting into food security early warning, and an expanding range of climate-informed food security safety nets.

Expanding on one example, several CGIAR centers had researched the use of seasonal forecasts for farmers prior to CCAFS, but IRI played a key role in bringing these experiences together and adding new technical and applied knowledge. IRI experience enabled the work

to incorporate forecasts that were downscaled and tailored to the needs of smallholder farmers, going beyond the information that was routinely available in target countries. Pilot projects with smallholder communities in Kenya and Senegal provided insights about how to design and communicate climate information for farmers. A conference in late 2012, that brought together practitioners from Africa and Asia, catalyzed efforts to develop and mobilize resources for regional efforts to scale up climate services for farmers (Tall et al. 2013). More recent efforts have invested in the capacity of several African meteorological institutions to provide climate information at a scale that is relevant to smallholder farmers. This line of research has connected the CGIAR with the major climate services initiatives described in the case study in Section 2, with CCAFS playing a prominent role in the Climate Services Partnership, and in the first national implementation project, targeting Tanzania and Malawi, in the Global Framework for Climate Services.

Conclusions

The extent to which IRI sought to bridge disciplines, communities and agendas – internally and externally – was groundbreaking within the climate research community. IRI's efforts to connect climate science and decision-making led to significant changes in its own agenda, mission, and even the name of the institution. In time, the same commitment to integrative partnerships and co-learning opened doors to bring some of our internal lessons into global dialogs and shape global agendas. IRI's evolving agenda had particular influence on global agendas in the areas of climate risk management and, more recently, climate services.

The IRI's experience in participating in the development and mainstreaming of new global agendas suggests a few lessons for other institutions working internationally at the interface between science and society:

First, engaging in global dialogs and partnering with larger communities can multiply impact relative to what is possible through the direct efforts of an institution's own staff. Some of the greatest advances toward its mission have resulted when the IRI played a relatively minor role in service to a larger community. Through CCAFS, for example, leveraging the considerable human capacity and reach of the CGIAR has enabled IRI to advance its work on CRM in an area where its own resources are very limited.

Second, long-term, persistent investment in relationships with strategic partners is necessary to set the stage to influence on global agendas. In both examples presented in this paper, IRI invested in strategic relationships over several years (Vaughan et al., 2014), generally long before clear avenues for significant impact were apparent. This required effort to identify where interests overlapped, and effort to add value to the work of partners. Those relationships proved to be at least as important as intellectual leadership on the issues that the IRI sought to influence.

Third, breakthroughs are likely to come through serendipity, and require awareness and responsiveness to opportunity. More often than not, IRI has been able to participate effectively when it recognized unanticipated opportunities and had the flexibility to respond quickly, but only when key relationships had already been built over time. In the case of CCAFS, a timely and strategic suggestion by IRI staff opened the door for a longer-term role in program design and implementation. The impact that the CGIAR reform process and transition of CCAFS to a CRP had on mainstreaming an expanded climate risk management agenda across the CGIAR is another example of a breakthrough through serendipity.

Fourth, the greatest advances in these global agendas were associated with new connections between communities that previously had little interaction. By expanding the CGIAR's interactions with the climate community and with the food security information and response community, CCAFS opened the door to the CGIAR to new avenues for impact. The CSP now enables sustained interaction between several major development organizations and funders, and the climate research community, leading to new opportunities and better-informed investments in climate services for development. The research agenda that CCAFS defined for the CGIAR could only be implemented through new partnerships with the climate research, climate services, and food security information response communities – partnerships that the IRI sought to enable.

One example that illustrates several of these lessons is a partnership with the Red Cross, jointly framed around "Early Warning, Early Action" (Coughlan de Perez and Mason 2014). Through several years of working together, we not only developed a refined sense of what kinds of information and services could usefully address operational needs of the disaster management community; but also came to mutual understanding of the need, and some common approaches to stakeholder engagement in climate services. This enabled both institutions to advocate for these ideas, with a common voice and greater impact, in the global dialogue and planning processes that shaped the Global Framework for Climate Services.

Finally, participating effectively in the development of global agendas requires openness to change within an institution's own agenda and culture. Before the IRI could engage effectively in international discourse, its

own staff had to learn how to work effectively across disciplines, and step out of their comfort zones. As IRI interacted with an expanding and evolving community of partners, its own institutional thinking about how science interacts with other segments of society evolved significantly – away from a top-down "expert" – "user" model, and toward co-production of knowledge and co-ownership of communication processes.

Endnotes

[a]The probabilistic forecast product format that IRI first introduced became the standard format for most of the consensus outlooks of the RCOFs.

[b]For example, L. Goddard is currently co-Chair of the CLIVAR Scientific Steering Group.

[c]This was made possible through a formal relationship between IRI and WMO, established the preceding year. Building on informal relations over several years, the WMO and IRI signed a Memorandum of Understanding in 2004 expressing intention "*to collaborate in the delivery of effective climate services, including research in providing climate information and products, development and evaluation of appropriate decision tools, impacts analysis, communication, institutional and policy analysis, demonstration projects involving stakeholders and end-users, and related capacity-building and education activities*".

[d]The Framework Structure included 4 components: Observations and Monitoring; Research, Modeling and Prediction; Climate Services Information System; and the User Interface Program (WMO (World Meteorological Organization) 2009a).

[e]Associated with WCC-3, the book "Climate Sense" was published (WMO (World Meteorological Organization) 2009b). In this volume 3 papers were published with IRI lead authorship.

[f]Draft Terms of Reference and suggested membership for the Task Force were prepared in advance by the IOC.

[g]IRI scientist S. Mason served on the drafting group for the Task Force report and GFCS Implementation Plan. IRI also contributed case studies, consulted with partner organizations and provided review and recommendations on the GFCS implementation.

[h]Initially with resources provided by IRI and the Earth Institute at Columbia University. Subsequently additional support has been provided through USAID, the German Climate Services Center, the CGIAR CCAFS program, among others. With endorsement of the Partnership, IRI continues to host the Secretariat.

[i]An interactive database of information about climate services activities was created, based on surveys distributed through the membership. CSP, in partnership with GFCS, developed a set of case studies, authored by members, that provides more information on outputs and lessons learned. Two climate services programs have also been assessed in greater depth, in terms of cost and benefit, gaps and opportunities. These information resources can be found on the CSP website http://www.climate-services.org.

[j]Prior to its recent restructuring, "CGIAR" was an acronym for Consultative Group for International Agricultural Research.

[j]Based on FAOSTAT data (http://faostat3.fao.org/faostat-gateway/go/to/home/E).

[k]The CGIAR defines an "outcome" as a change in behavior (e.g., change in policy, investment, programs or practice) of a stakeholder that results from a research output, and that that is expected to contribute toward impacting some measure of societal wellbeing or environmental quality.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

JH developed material on climate risk management for agriculture, framed concluding lessons, and incorporated input from other authors. SZ developed material on the climate services agenda. KC contributed to climate risk management in the context of the adaptation and resilience literature.

Authors' information

JH is an IRI Research Scientist, and CCAFS Theme 2 Leader for Adaptation through Managing Climate Risk. SZ is an IRI Senior Research Scientist, and Head of the Climate Services Partnership. KC is an IRI Senior Staff Associate, and CCAFS Science Officer for Theme 2: Adaptation through Managing Climate Risk.

Acknowledgements

The authors thank the editor Dr. Gerten, guest editor Lisa Goddard, Mea Halperin and two anonymous reviewers for their constructive feedback and suggestions. The initiatives and partnerships described in this paper were made possible by NOAA's long-term investment in IRI. This publication and the work it describes were supported in part by grant/cooperative agreement NA10OAR4310210 from the U.S. National Oceanic and Atmospheric Administration (NOAA); by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), a strategic partnership of CGIAR and Future Earth; by the European Union (EU) with technical support from the International Fund for Agricultural Development (IFAD); and by the U.S. Agency for International Development (USAID). The views expressed in this publication cannot be taken to reflect the official opinions of NOAA, CGIAR or Future Earth, or USAID.

Responsible editor: Lisa Goddard

Received: 1 October 2013 Accepted: 21 April 2014
Published: 17 June 2014

References

Anderson JR, Dillon JL, Hardaker JB (1977) Agricultural decision analysis. Iowa State University Press, Ames, IA

Anderson DLT, Sarachik ES, Webster PJ, Rothstein LM (1998) The TOGA Decade. J Geophys Res 103, C7:14167–14510

Ayers JM, Huq S (2009) Supporting Adaptation to Climate Change: What Role for Official Development Assistance? Dev Policy Rev 27:675–692

Baethgen W (2010) Climate risk management for adaptation to climate variability and change. Crop Sci 50:S70–S76

Bahadura AV, Ibrahimb M, Tannera T (2013) Characterising resilience: unpacking the concept for tackling climate change and development. Clim Dev 5(1):55–65

Barnston T, Tippett M (2014) Climate Information, Outlooks, and Understanding - Where Do We Stand? Earth Perspect 1:20
Barrett CB, Carter MR (2006) The economics of poverty traps and persistent poverty: An asset-based approach. J Dev Stud 42(2):178–199
Barrett CB, Constas M (2013) Toward A Theory of Resilience for International Development Applications. Working Paper. http://dyson.cornell.edu/faculty_sites/cbb2/Papers/Barrett-Constas-Oct-2013.pdf
Basher R, Clark C, Dilley M, Harrison M (ed) (2001) Coping with Climate: A Way Forward. Summary and Proposals for Action. International Research Institute for Climate Prediction, Palisades, New York
Berman R, Quinn C, Paavola J (2012) The role of institutions in the transformation of coping capacity to sustainable adaptive capacity. Environ Dev 2:86–100
CCAFS (2009) Climate Change, Agriculture and Food Security. A CGIAR Challenge Program. CCAFS Report No. 1. The Alliance of the CGIAR Centres and ESSP, Rome and Paris
CCAFS (2011) CCAFS Program Plan. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark [http://hdl.handle.net/10568/10227]
CGIAR (2000) *Charting the CGIAR's future reshaping the CGIAR's organization. Summary of proceedings and decisions. CGIAR 2000 International Centers Week ICW2000. Washington, DC, 23-27 Oct 2000* [http://www.worldbank.org/html/cgiar/publications/icw00/icw00sop.pdf]
Coughlan de Perez E, Mason SJ (2014) Climate Information for Humanitarian Agencies: Some Basic Principles. Earth Perspect 1:11
Engle NL (2011) Adaptive capacity and its assessment. Glob Environ Chang 21 (2):647–656
Evenson RE, Gollin D (2003) Crop Variety Improvement and Its Effects on Productivity. CABI Publishing, Wallingford, UK
Goddard L, Bhojwani H, Robertson AW, Baethgen WE (2014) The International Research Institute for Climate & Society: Why, What and How. Earth Perspect 1:10
Hansen JW, Baethgen W, Osgood D, Ceccato P, Ngugi RK (2007) Innovations in climate risk management: protecting and building rural livelihoods in a variable and changing climate. J Semi-Arid Trop Agric Res 4(1): [http://www.icrisat.org/Journal/SpecialProject/sp13.pdf]
Hansen JW, Zebiak S, Baethgen W, Ines AVM, Osgood D (2011) Climate Risk, Information and Market Participation for African Farmers. In: Proceedings of an international conference, Nairobi, Kenya, 13-15 May 2009. AGRA and ILRI, Nairobi, pp 157–175
Hardaker JB, Huirne RBM, Anderson JR, Lien G (2004) Coping with Risk in Agriculture, 2nd edition. Wallingford, CAB International
Hellmuth ME, Moorhead A, Thomson MC, Williams J (ed) (2007) Climate Risk Management in Africa: Learning from Practice. Climate and Society No. 1. International Research Institute for Climate and Society, Palisades, New York
Holling CS (1973) Resilience and stability of ecological systems. Ann Rev Ecol Systemat 4:1–23
Khan MR, Roberts JT (2013) Adaptation and international climate policy. WIREs Clim Change 4:171–189
Pielke RA, Jr (2005) Misdefining "climate change": consequences for science and action. Environ Sci Policy 8:548–561
Proceedings of the World Climate Conference. Geneva (1979) WMO-No. 537, Geneva
Raitzer DA, Kelley TG (2008) Benefit–cost meta-analysis of investment in the international agricultural research centers of the CGIAR. Agr Syst 96:108–123
Renkow M, Byerlee D (2010) The impacts of CGIAR research: A review of recent evidence. Food Policy 35:391–402
Secretariat, CGIAR (2009) Voices for Change: the New CGIAR. CGIAR Fund Office, Washington DC [http://hdl.handle.net/10947/5035]
Tall A, Jay A, Hansen JW (2013) Scaling Up Climate Services for Farmers in Africa and South Asia Workshop Report. CCAFS Working Paper no. 40. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen [http://hdl.handle.net/10568/27833]
Vaughan LF, Furlow J, Higgins W, Nierenberg C, Pulwarty R (2014) US Investments in International Climate Research and Applications: Reflections on Contributions to Interdisciplinary Climate Science and Services, Development, and Adaptation. Earth Perspect 1:23
Vermeulen S, Zougmore R, Wollenberg E, Thornton P, Nelson G, Kristjanson P, Kinyangi J, Jarvis A, Hansen J, Challinor A, Campbell B, Aggarwal P (2011) Climate change, agriculture and food security: A global partnership to link research and action for low-income agricultural producers and consumers. Curr Opin Environ Sustain 4(1):128–133
WMO (2009) World Climate Conference-3: Towards a Global Framework for Climate Services. WMO Bull 58(3):162–164
WMO (World Meteorological Organization) (2009a) Report of the WMO Conference on Living with Climate Variability and Change: Understanding the Uncertainties and Managing the Risks. WMO/TD – No. 1512, Geneva, Switzerland
WMO (World Meteorological Organization) (2009b) Climate Sense. Tudor Rose, Leicester, UK
Zillman JW (2009) A history of climate activities. World Meteorological Organization (WMO) Bulletin 58(3):141

doi:10.1186/2194-6434-1-13
Cite this article as: Hansen *et al.*: **Shaping global agendas on climate risk management and climate services: an IRI perspective.** *Earth Perspectives* 2014 **1**:13.