USDA Climate Hub Concept in the Americas Workshop

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FINAL REPORT

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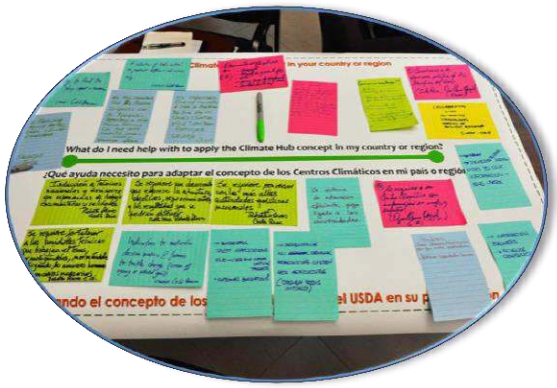

USDA FAS

USDA CARIBBEAN CLIMATE SUB HUB for Tropical Forestry and Agriculture

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

IICA

Caribbean Institute for Meteorology and Hydrology CIMH

CIMMYT International Maize and Wheat Improvement Center

INTERNATIONAL INSTITUTE OF TROPICAL FORESTRY

SAGARPA SECRETARÍA DE AGRICULTURA, GANADERÍA, DESARROLLO RURAL, PESCA Y ALIMENTACIÓN

ESTADOS UNIDOS MEXICANOS

Consejo Empresarial Salvadoreño para el Desarrollo Sostenible CEDES

CATIE Solutions for environment and development Soluciones para el ambiente y desarrollo

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Picture 1: Participants from Mexico, Panama, Guatemala, Honduras, El Salvador, Barbados, Nicaragua, and Costa Rica met for a two-day workshop with USDA representatives from the National Climate Hubs Network and the Foreign Agricultural Service to strengthen collaboration in addressing climate change issues in agriculture and forestry in Latin America.

1. Overview

USDA representatives from the Caribbean, Central America, Southwestern US, Washington DC, and met with government and non-government delegates from seven countries in Central America to discuss the USDA Regional Climate Hub network. The workshop enabled international participants to examine the USDA Regional Climate Hub model at the US Forest Service International Institute of Tropical Forestry in Puerto Rico. The group explored opportunities for institutions to interact with the USDA Hubs and to establish and support similar networks throughout Latin America and the Caribbean.

1.1 Background

The USDA has established seven Regional Climate Hubs and three Sub Hubs for Risk Adaptation and Mitigation to Climate Change in order to deliver information to US farmers, ranchers, and forest landowners that can help them adapt to climate change and weather variability. Regions include the Pacific Northwest, Southwest, Northern Plains, Southern Plains, Midwest, Northeast, and Southeast Hubs and the Caribbean, Northern Forestry, and California Specialty Crop Sub Hubs. These Hubs assist in building capacity to provide public information and guidance on technologies and risk management practices at regional and local levels. For more information see the Regional Hub website at www.climatehubs.oce.usda.gov/. The Caribbean Climate Sub Hub (CCSH), in partnership with the Southwest Regional Climate Hub and the USDA Foreign Agricultural Service (FAS), hosted the Climate Hub Concept in the Americas Workshop at the International Institute Tropical Forestry in San Juan, Puerto Rico.

The workshop came about as a result of an expressed desire on the part of the Ministry of Agriculture of Mexico (SAGARPA) to learn more about the concept of the climate hubs, how they operate, and to explore how SAGARPA might execute such a concept in Mexico. The workshop was expanded to include delegations from Honduras, El Salvador, Costa Rica, Nicaragua, Guatemala, and Panama, as well as representatives from the National Oceanic and Atmospheric Administration (NOAA), the USDA Tropical Agricultural Research Station in Mayagüez, Puerto Rico (TARS), the USDA Natural Resources Conservation Service (NRCS), the US Department of State, The University of Puerto Rico, and the following non-profit cooperators: Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Instituto Interamericano de Cooperación para la Agricultura (IICA), International Maize and Wheat Improvement Center (CIMMYT), and the Consejo Empresarial Salvadoreño para el Desarrollo Sostenible (CEDES).

The Hub network mission is well-aligned with a growing number of organizations that realize the importance of addressing the threat climate change presents to global food security. Already, the effects of shifting precipitation patterns, sea level rise, and increased temperatures are being felt throughout much of the Caribbean and Central America in the form of severe droughts, coastal aquifer salinization, and proliferating pests and diseases that plague crops. In the face of these and other socio-economic challenges, there is a recognized need to improve connections within the agricultural

community to ensure producers have access to the best available science, tools, and markets needed to adapt and thrive.

The development and implementation of the workshop was a coordinated effort led by the Foreign Agricultural Service's (FAS) Office of Capacity Building and Development (OCBD), Caribbean Climate Sub Hub, Southwest Regional Climate Hub and the International Institute of Tropical Forestry (IITF) and included representatives of the FAS Office of Agreements and Scientific Affairs, USDA Climate Hubs national staff, USDA Climate Change Program Office, FAS Posts, and the USDA Forest Service.

1.2 Outcomes

The workshop produced several outcomes that were conducive to furthering the mission and goals of both the Climate Hubs and the international participants. The workshop:

Raised awareness of Climate Hubs

- Strategies
- Networks & Partnerships
- Tools
- Challenges

Identified shared strategies & challenges in

- Network and Communication Management
- Technology Transfer
- Vulnerability Assessment
- Science Translation
- Information Management

Created new connections among

- USDA/Climate Hub personnel & Central American Government Officials
- Central American Countries
- Government Advisors & Decision Support Services

1.3 Raised Awareness of USDA Regional Climate Hubs

Overall, the workshop provided both the USDA FAS and Climate Hubs an excellent opportunity to further their mission and goals by building partnerships within the Latin American Caribbean (LAC) agricultural community in order to improve global and domestic food security. Innumerable efforts are underway throughout the LAC region to build climate-smart agricultural systems, improve agriculturally related government services, and coordinate efforts both internally – by bridging gaps across various agencies and departments – as well as externally – by building strong international partnerships. Rapid increases in the rate at which knowledge is being created, and the need to efficiently translate that knowledge into policies, programs, and actions in the face of climate change are pushing organizations to address problematic institutional structures

and, at the same time, confront congruent issues of food sovereignty and social justice. As USDA Climate Change Program Office Leader William Hohenstein pointed out at a recent workshop on GHG mitigation in agriculture, simply reacting to changes 'as they come' is an increasingly insufficient strategy in addressing global climate change. Unless fairly dramatic GHG emission reductions are accomplished globally within the coming decade(s), climate models consistently show the rate of temperature increases and other climate changes quickening throughout the second half of the twenty-first century (IPCC 2014). Changes of the magnitude and pace now being projected demand a new level of effectiveness in planning and implementation in the present. Strategies for accomplishing this new level of higher organizational functioning are the subject of much research, discussion, and experimentation from the realm of policy creation and resource governance (Adger, 2001; Brunner et al., 2013; Clark 1997; 2002; Lasswell 1971; Warner, 2010), to business organization and information management (Van Wijk et al., 2008; Easterby-Smith et al., 2008; Osterloh & Frey, 2000). Much of the conversation in both realms centers around information management and knowledge creation and transfer. These are functional aspects that organizations must manage internally, as well as externally, with the express goal of affecting the attitudes and behaviors of personnel within the organization and the various stakeholders interacting with it. The issue poised to managers now is; how to effectively manage and transfer information in a way that facilitates timely and informed decisions at every organizational level? While this issue is challenging to organizations on the scale of a single business with a fairly focused mission and goal set, it can be profoundly challenging for governmental organizations seeking to promote a range of outcomes over large geographic areas. The ever-increasing pace of knowledge creation and modification can compound these difficulties.

The FAS and the USDA Climate Hubs have taken an important step in confronting these challenges by building international partnerships through workshops, such as this and other FAS efforts, and by improving related communication and coordination across USDA agencies and other governmental departments. A key recommendation for the CCSH and FAS is to devise a strategy and action points for facilitating cooperation between Hub staff and FAS attachés in Latin America. Strategies could be as simple as coordinating a bi-monthly conference call in order to share experiences, information, and challenges. Many regions in the Caribbean and Central America are facing similar climate related challenges to similar crop assemblages. The region also shares similarities in producer demographics, including small-holder, limited resource, and aging population, and there is much to learn from each other's successes and failures. This learning process will likely not take place without a deliberate, sustained, and coordinated effort on the part of all key partners in the region. The CCSH, with the continued support of the FAS and other USDA entities, is uniquely positioned to be a leader in facilitating this process.

1.4 Shared Strategies & Challenges

Many areas throughout the Caribbean and Central America are facing similar climatic challenges to similar crop systems; including drought, coffee rust, and storm damage; and

share similarities in producer demographics. As such, countries and organizations have much to learn from each other's successes and failures. Agriculture and global food security are likely to be significantly impacted by changes in global climate (IPCC, 2014). The effects of climate change are presenting a myriad of new challenges as well as exacerbating challenges that Caribbean farmers have long dealt with, such as water shortages and pest outbreaks (Gould et al., 2015). These challenges are compounded by global population growth and the ever-increasing need for more efficient food production (FAO, 2015a). The US Forest Service and US Department of Agriculture have joined the UN, regional governments, and many international NGO's in the conversation of how to mitigate the greenhouse gas emissions (GHGs) that are accelerating global climate change, while increasing food security worldwide.

Projected climate change effects threaten agricultural production and food security throughout the LAC (IPCC, 2014; Maharaj & Singh-Ackarali, 2014). Intensifying droughts, the proliferation of pests, fungus and diseases, and instability in global markets are already having a profound effect in the region. These impacts align with climate model projections for the region (Hayhoe et al 2014, Henerah et al, 2015; IPCC, 2014). For many LAC countries, the agricultural sector represents a large share of economic activity and the most important source of employment (CIA, 2014). Shifting rainfall patterns have affected many important crops and growing regions with periods of heavy rainfall being followed by persistent droughts. Wetter than average years led to a 2012 outbreak of coffee rust in several Central American countries where coffee cultivation and exportation are key sources of employment and income (WCR et al, 2013). The outbreak and subsequent loss of significant portions of the harvests was followed by a severe drought in 2014/2015 that has had a profoundly negative impact on the fruit, vegetable and livestock sectors (FAO, 2015b).

The impacts these climatic anomalies have on agricultural production also have strong cultural and economic implications and reverberate throughout all aspects of life in the region. When alternative employment opportunities are not available to displaced agricultural workers within the region, fluxes in migration to urban centers and emigration to other countries often result. Increasing migration to cities is likely to exacerbate vulnerabilities related to inequality, poverty, indigence and informal settlements, worsening the situation of millions already exposed to environmental risks (Warn & Adamo, 2014). Several workshop delegations cited emigration as a negative impact that their respective countries are experiencing as a result of climate change (see Workshop Notes). The link between climate change impacts on crop yields and the dislocation of people has been researched and discussed within academic and governmental organizations for several years (Bohra-Mishra, P., 2014; Kaenzig & Piguet, 2014; Simms & Reid, 2006; Tacoli, 2009; Warn & Adamo, 2014). Feng et al. (2010) explicitly explored the link between variations in climate, agricultural yields, and population migration responses between the US and Mexico. They estimated that a 10% reduction in crop yields would lead an additional 2% of the population to emigrate. Depending on the warming and adaptation scenarios used, the study estimated that by approximately the year 2080, climate change could induce 1.4 to 6.7 million adult Mexicans (or 2% to 10% of the current population aged 15–65 y) to emigrate as a result

of declines in agricultural productivity alone (Feng et al., 2010)[1]. The types of out-migration being experienced by some Central American countries are similar to those being experienced by Puerto Rico, which has been losing population for several years.

While immigration and emigration are always part of the shifting cultural landscape of any country, large emigrations due to crisis, or loss of economic opportunity, can have profound and lasting impacts on the political and economic situations within a country, as well as affecting the political stability of a region. Coffee Rust and drought are two factors that have contributed to a recent wave of migration to the US from Central America, and as such are having a region-wide, cross-boundary effect on the social, political, and environmental landscape of the region at-large. The loss of significant portions of the labor force of any country affects what types of activities may be possible in the future, as well as dispersing the families that form the fabric of a society. Situations such as this illustrate how the challenges of climate change transcend traditional disciplinary and geo-political boundaries to affect every aspect of human life.

2. Common themes and shared challenges

Common themes from the workshop were determined from proceedings notes, presentations, exercises, and conversations among workshop participants. This report distills these threads into five main topics, as listed below, and seeks to elucidate why these themes are important in building resilient agricultural communities, as well as, how these topics overlap with conversations from various academic sources. The challenges of climate change are fostering a renewed exploration of how organizations might structure themselves to improve functioning both in the realm of internal coordination and external mission delivery.

2.1 Stakeholder Engagement

The term stakeholder generally refers to any individual or organization that has an interest or concern in something whether it is a business, a project, or a community. Stakeholder engagement refers to the process of identifying and opening the lines of communication with interested stakeholders. In the realm of agriculture, this can be a very challenging endeavor as entire populations may be able to claim vested interests in the food systems that support them. Therefore, it may be important for organizations seeking to enhance the resiliency of agricultural communities to target specific 'end-user' groups for in-depth engagement, while remaining open to general input from the larger

[1] Kaenzig & Piguet, 2014, discuss and question the methodology employed to arrive at these results.

public. Also important is the nature and timing of engagements before and during a project or ongoing effort. In their recent analysis of the relevant literature on effective delivery of climate data to agricultural communities, Mase and Prokopy (2014) found that traditional 'top-down' approaches in which experts produce science to inform the decisions of practitioners have been generally ineffectual. The authors reviewed 47 peer-reviewed articles and found, "More than half of the articles (28) emphasized the challenges of communicating with farmers and/or advisors about weather and climate information, and/or offered recommendations about how to improve communication on these topics. About 40% of the articles (18) relied on participatory research or advocated participatory development of weather or climate tools to increase the likelihood that farmers will actually use the information to inform decisions." (pp: 49) Kristjanson et al., (2009) also noted the importance of effective stakeholder engagement in the planning stages of any project, noting that, "Especially important is that the problem to be solved be defined in a collaborative but ultimately user-driven manner." (pp:2)

Caribbean Climate Sub Hub Leader William Gould spoke to this issue during the workshop by discussing the need to reorder the way research and science priorities are set by first, understanding which user groups are most likely to utilize the resulting information, then actively seeking their input in the early planning phases. This sentiment is in line with a growing consensus that solely producing scientific information is not enough to affect behavioral change and that engaging stakeholders in the planning and problem definition stages of a project can greatly enhance its outcomes (Clark, S., 2002; Kristjanson et al., 2009; Laswell, H., 1971; Mase & Prokopy, 2014; Roderick et al, 2013). Many studies and research initiatives are currently undertaken without a specific end-user group in mind, but rather to fill a need or gap as perceived by the researcher, scientist, or funding group. This type of research are often output-oriented (e.g., publications, methods, tools or technologies), as opposed to outcome-oriented (Kristjanson et al., 2009). If there *is* an identified stakeholder group that the research or project is targeted to help or inform, there is often no pre-identified mechanism or strategy for conveying the end results or new knowledge to the group other than the standard methods of publication and passive dissemination. These methods may be effective for some groups, such as academics and other scientists, but may not be the most efficient way to affect management practices within the small-holder, agro-socio-ecological systems of the LAC (Brunner et al., 2013; Clark, 2002; Kristjanson et al., 2009). Vulnerability assessments present opportunities to evaluate stakeholder groups, prioritize engagements based on need and vulnerabilities, and build communications strategies specific to targeted groups.

Picture 3: William Gould, USDA Caribbean Climate Sub Hub Leader.

In his presentation at the Hubs in the Americas Workshop, Puerto Rican farmer, and CEO of Agro Tropical Inc., Duamed Colon emphasized the need to incorporate producers in creating research in which producers are participants and give them a role in decision making processes. Colon, who has a background in Marine Biology and has worked with the University of Puerto Rico extensively over the years, has been a valuable stakeholder and partner in helping the CCSH devise effective communication strategies to reach the agricultural community of Puerto Rico. Agro Tropical Inc. is an organization dedicated to the research, development, and implementation of sustainable agriculture. Using grants available through the National Resource Conservation Service (NRCS) Conservation Innovation Program and Sustainable Agriculture Research and Education Program (SARE), Agro Tropical is currently exploring the effects of various cover crops in building recalcitrant soil organic matter and soil biota on their plantain farm in Puerto Rico, as well as studying the affects of various growing and mechanized management techniques.

Picture 4: Duamed Colón of Agro Tropical examines a plantain/cover crop system in Puerto Rico.

By engaging in on-farm research that seeks to address specific issues facing plantain farmers in the region, Agro Tropical is developing a knowledge base that is geographical specific, practical, and can be demonstrated to other growers. Colon asserted that these projects can be more effective because producers can witness counterparts in their region using science to bring about their own personally desired results. These sentiments are well-aligned with initial results from surveys, interviews, and research conducted by the CCSH, as well as feedback from other producers and academic literature. On-farm demonstrations have been identified by producers as a highly effective and desirable way to disseminate information for reasons similar to those cited by Colon. Farmer's have expressed themselves as being much more willing to attempt new management techniques and incorporate new ideas and crops if they can see it actually being tried and successful on a farm within their region (Mase & Prokopy, 2014). Likewise, having the buy-in of local farmers and producers can make governmental or non-governmental organizational efforts much more effective and likely to be successfully executed. This buy-in is a function of trust and respect that represent an organizations' 'social capital.' This type of capital is best built by genuine transparency and inclusivity when seeking to address an issue such as climate change impacts to agriculture or food security. Seeking advise and input from potential partners in the advisory and practitioner realms during the planning process can convey respect, build relationships, and improve the likelihood that resulting products and techniques will be understood and widely used (Kristjanson et al., 2009; Mase & Prokopy, 2014).

2.2 Information Management

Information management refers to how an organization receives, stores, organizes, disseminates, and incorporates information into their operations and structure. These processes have long received much attention within the business world (Daft & Lengel, 1986; Earl, 1996). Galbraith (1973) explained variations in organizational structures as a function of how much information an organization needs to reduce task related uncertainty and ensure acceptable performance. Designing such structures within the realm of climate change adaptation can be profoundly challenging, as some measure of uncertainty may be inherent in any climate projections. Aside from the statistical uncertainties present in climate model projections, managers and advisors face uncertainties that arise from incomplete personal knowledge. Climate change information covers a vast range of topics that range from the actual science of how climate change is occurring (atmospheric chemistry, etc.), to specific mitigation and adaptation processes for everything from urban design to agriculture. Many of these fields have sub-fields, with hundreds, if not thousands of new studies being published each year. While this vast amount of information is encouraging and certainly a positive step, it can be overwhelming to those seeking answers to specific questions (uncertainties). Learning-based approaches that emphasize collaborative and iterative approaches to knowledge creation were originally proposed as a way to deal with uncertainties in environmental management (Holling, 1978), and have become pivotal strategies in adaptive, co-management paradigms (Berkes, 2009, Brunner & Steeleman, 2005)

During the workshop, many participants expressed a strong need to create processes and organizations that can distill, filter, and translate the wealth of climate information to better suite the specific needs of a region, crop, or working lands sector. A related challenge is then being able to effectively convey the distilled information to producers in a way that fits their unique needs. Reducing uncertainties related to agriculture and climate change in the face of limited organizational staffing, budgets, and other constraints may require equipping local landowners and managers with the tools and knowledge needed to become their own information managers. To that end, some adaptation efforts, such as the US Forest Service Adaptation Workbook, are now seeking to provide managers with access to tools that can streamline personalized information on how to best adapt management practices on their land.

Effective knowledge transfer was a common topic during the workshop and is an aspect of information management where much progress remains to be made in general (Kristjanson et al., 2009; Mase & Prokopy, 2014; Roux et al., 2006). While academic and governmental research institutions have proven themselves quite proficient in conducting studies and creating new stores of scientific knowledge, there is a perception among many professionals in the field, including many experts who attended the Climate Hubs in the Americas Workshop, that this research and information is not having the desired effect on attitudes and practices, or that the rate at which it is having an affect is not sufficient to keep pace with the challenges that the information is seeking to address. National Climate Hub Director Randy Johnson spoke to this issue, saying that an impetus for the creation of the Hub network was that, in the face of the increasingly damaging

impacts of climate change, "the science was not making it to the field fast enough." Crafting mechanisms to improve this flow of information and knowledge was a common theme among participants at this workshop and has been documented as a barrier to adaptation in academic literature (Mase & Prokopy, 2014; Folke et al., 2005).

To respond to these types of challenges requires organizational strategies to effectively adapt, plan, and respond. All of these activities require an effective information management chain that encompasses how an organization creates or receives knowledge or information, and how in turn they assimilate that information into their policies, programs and personnel. It has been suggested and discussed mechanisms and philosophies employed in the creation of knowledge are closely tied to the institutional structures that an organization employs in the dissemination of that knowledge (Galbraith, 1973; Nadasdy, 2004). Accepted practices and processes for creating knowledge are directly tied to an organization's information management strategies and the philosophies that underlie them. Opaque, remote processes of knowledge creation that work to privilege scientific knowledge (and those who create it) to the exclusion of experiential, local knowledge (and those who create it), may be subliminally aimed more toward preserving the institutional structures in which they are housed than addressing the challenges they are ostensibly working to overcome (output *vs.* outcome oriented) (Clark 2002; Folke et al., 2005, Nadasdy, 2004). Closely related to the discussions on stakeholder engagement and others during the conference, building effective processes for gathering, organizing, and disseminating information may require conscious effort, formal, institutionalized processes, as well as informal social networks (Folke et al. 2005). These processes represent adaptive organizational practices in the same way that terracing or inter-cropping may represent adaptive cultivation practices for farmers. Many government, non-profit and private organizations are seeking new structures and methods that improve institutional functioning in the face of a rapidly changing world. These organizational strategies are by necessity both 'inter' and 'transdisciplinary' (Clark, 2002) and there is much the conservation and agricultural community can learn from studies and literature aimed toward the business world, and vise versa.

2.3 Science Translation

Science translation refers to the process of assimilating and synthesizing scientific studies and literature into forms that may be more readily accessible to a general public or targeted end-user group. These processes acknowledge that many people may lack the time and/or scientific background to access and understand how something like global climate change may effect their lives.

Developing mechanisms to effectively translate and communicate science to practitioners was repeatedly expressed by workshop participants as a common challenge, as was overcoming the hurdles of bureaucratic inertia, and coordinating isolated efforts among government, non-profit and private organizations. Southwest Regional Hub Deputy Leader Caitriana Steele shared strategies being employed in her region, citing the importance of using culturally sensitive terminology and tactics to avoid alienating stakeholders for whom coordinating collective actions to address global issues may

threaten their values of independence and autonomy. In serving a large geographical region, Ms. Steele cited the difficulty in crafting mechanisms and strategies that are effective across such a diverse stakeholder base. The term climate change means different things to different people depending on their own understanding and perception of the term and what it entails. In interviews conducted by CCSH staff, several Virgin Islands producers expressed the belief that 'climate change' would not affect the islands negatively due to their distance from melting ice caps and the topography of the islands (aka, rising sea levels would not strongly effect them.) Statements like this and others illustrate the potentially esoteric nature of a threat like 'global climate change,' or 'global warming.' By and large, producers interviewed by the CCSH, while they did consistently rate climate change as a serious threat in the near term (< 25 years), did not connected the local issues they were struggling with such as drought, pests, and disease, as potential impacts of the larger global problem of climate change. Within the continental US, the issue of climate change has been politicized to the extent that advisors and researchers have found it beneficial to frame the issue in alternative language, such as "weather uncertainty", as in the case of Ms. Steele and the Southwestern Climate Hub. In 'meeting producers where they are,' the Southwest Climate Hub has been a part of developing an assortment climate adaptation tools such as spatially specific cattle heat stress forecasts. Tools like this one address immediate grower concerns and promote adaptive strategies while sidestepping potentially controversial language.

Through the CCSH's own research and interviewing of both agricultural advisors and practitioners in the US Caribbean, a common sentiment has been that there is no lack of information through which to inform best practices and sound, resilient planning. Many perceive shortfalls coming in the communication, translation, and execution of these plans and practices. The need to improve communication is a common theme in many organizations. 'Lack of communication' or the 'need to improve communication' can become something of a 'catch-all' for organizational shortcomings, or strategies toward the improvement of mission execution. To be successful in achieving actual improvement in the accomplishment of goals, organizations must be mindful not to allow general phrases, such as a 'need to improve communication', stand as action points or strategy. Such statements must be developed into specific strategies for improvement that articulate the specific 'who' and 'how' of communication improvement. The same could be said for collaboration. There is a wide consensus, in the literature, among advisors, practitioners, and among workshop participants, regarding the need for more collaboration across departments and agencies in order to more efficiently achieve mission-oriented results and avoid needless duplication of work. However, merely pointing out the need for this collaboration and coordination is insufficient to facilitate its occurrence. Both communication and collaboration must be structured in ways that value and respect all parties involved in order to be substantive and effectively build consensus (Clark 2002).

Dr. Guilermo Ortiz of the University of Puerto Rico researches dairy farming in the islands and discussed the difficulty in bridging the gap between research and implementation during his workshop presentation. Ortiz has partnered with the CCSH and Tai South Farms in Puerto Rico to produce the first in a series of adaptation videos

intended to be virtual 'on-farm' demonstrations, disseminating climate adaptive practices through the use of media. The first of four, the video is focused on how dairy producers can adapt to increasing drought, the mounting cost of supplemental feed, heat stress in cattle and other challenges. Subsequent videos will be focused forestry, plantains, and fruits and vegetables production in Puerto Rico and the US Virgin Islands. The adaptation video series is one strategy the CCSH is undertaking to connect scientists and researchers with producers and package information in a way that is accessible to a broader audience.

2.3 Bridging Organizations

"Bridging organizations provide a forum for the interaction of these different kinds of knowledge, and the coordination of other tasks that enable co-operation: accessing resources, bringing together different actors, building trust, resolving conflict, and networking. Social learning is one of these tasks, essential both for the co-operation of partners and an outcome of the co-operation of partners. It occurs most efficiently through joint problem solving and reflection within learning networks" (Berkes, 2009, pp: 1692).

The USDA Regional climate hubs are a part of a growing network of bridging organizations centered around the delivery of climate change information. Within the US, these organizations include the Landscape Conservation Cooperatives, the Department of Interior's Climate Science Centers, NOAA's Regional Integrated Science and Assessments (RISA) and the US Forest Service's Climate Change Resource Center, among others. Internationally, organizations such as the Caribbean Institute for Meteorology and Hydrology (CIMH) and the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) are among many organizations seeking to provide information and education across national boundaries. These organizations and their missions' represent a recognition and response to the need to more effectively manage information flow from creation to application.

The role of bridging organizations in information management and delivery becomes more critical in mediating expertise when information becomes so prolific that no single decision-maker, expert, or even office can wade through the mountains of studies and papers being produced around a specific topic. This is quickly becoming the case in regards to resilient agricultural practices. Workshop participants echoed this by expressing a need to effectively distill information into tools that aid in stakeholder decision-making regarding specific issues such as pest control, drought preparation, water management, etc. To build such tools requires researching what relevant science is available on the desired topic, then synthesizing that science into actionable steps for those on the ground. This may require bridging organizations to designate specific personnel dedicated to the tasks of collecting and synthesizing available science on topics most relevant to their stakeholders. This science may also need to be vetted and possibly altered to reflect local conditions specific to the stakeholders it is intended to benefit. These tasks are time consuming and seem to often fall outside the purview of local level agricultural advisors thus presenting bridging organizations an opportunity for meaningful intervention. Figure 1 presents other potential roles for bridging organizations.

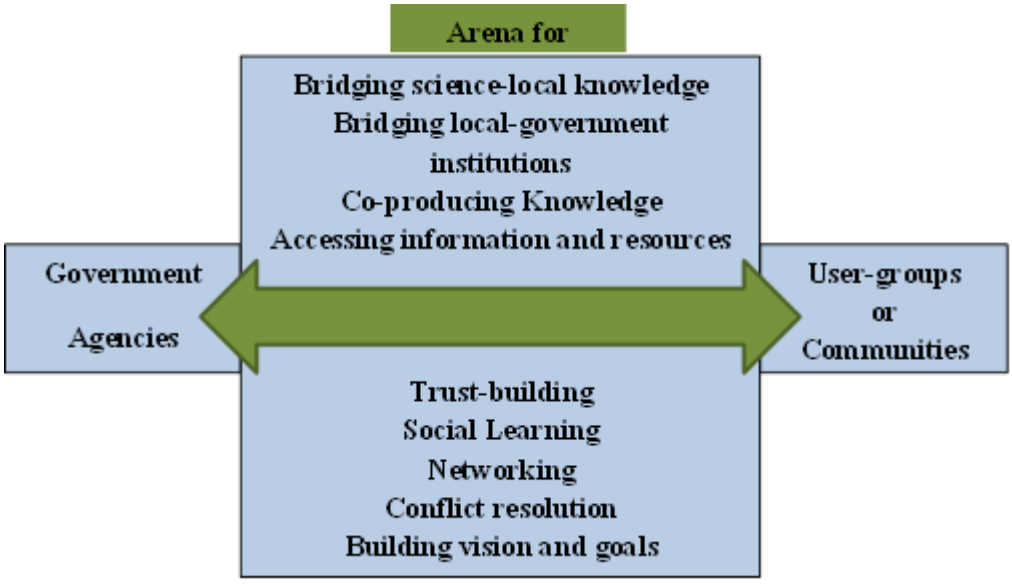

Figure 1: Potential roles of bridging organizations. Fulfilling all these tasks may require cooperation among various bridging organizations playing different roles. Taken from: Berkes, 2009.

Collins and Evans (2002) developed a model of expertise that is helpful in conceptualizing the role of bridging organizations. In their model, science represents a realm of knowledge and expertise that is abstract or generalizable while experience represents a realm that is specific and locally based. Both realms represent valuable forms of *contributory expertise.* These forms are distinguished from *interactional expertise,* defined as: "Having enough expertise to allow for interesting interactions between contributory experts of both abstract/generalizable and local/practical knowledge domains, which allows for interactions to occur to the extent that all participants leave the process cognitively changed" (Carolan, 2006 pp: 423). In the context of agriculture, forestry and climate change, this would involve bringing together scientists, planners and policy makers from governmental and non-profit organizations with local farmers and forest landowners and facilitating the sharing of ideas and experience in a productive and respectful way.

Communication strategies that convey value and respect must exist on the personal level between the individuals that are interacting, however, that alone may not be enough to produce the large scale cooperation needed to stem the tide of working lands decline in many parts of the Caribbean. Many workshop participants expressed optimism that the Climate Hubs and similarly fashioned organizations could effectively serve in the role of facilitator/ liaison to help overcome communication challenges by bridging the gap between science, policy, and practice. These types of 'bridging organizations' have the potential to lower the costs of collaboration and conflict resolution, and play a crucial role in crafting enabling legislation and governmental policies that support self-organization while framing creativity for adaptive co-management efforts (Berkes, 2009; Folke et al., 2005). Self-organized social networks are important structures within adaptive governance that may be more equipped to process and respond to the rapid rate of scientific knowledge creation and climate change than formal networks and

institutions (Brunner et al., 2013; Folke et al., 2005; Mase & Prokopy, 2014). These networks can often be the by-product of more formal arrangements, workshops, meetings, and other forms of collaboration, as individuals come into contact with counter parts working on similar issues within different organizations.

Bridging organization can also serve to alleviate the disconnect often expressed between centralized management organizations and local-level advisors and producers by facilitating two-way feedback as policies and programs are tested and modified within the context of local systems (Berkes, 2009). These feedbacks are then ideally incorporated into adaptive policies and programs that are a direct result of local and scientific knowledge being considered and interpreted side by side. Local stakeholders are able to see how their input and opinions are valued and reflected in organizational and agency efforts thus fostering an atmosphere of collaboration rather than one of dominance or indifference. Regional bridging organizations may be receptive, respectful and appreciative of local knowledge, but without the flexibility and support to act on this knowledge, collaborative efforts may soon lose steam as practitioners come to learn that their local well-meaning advisors are powerless to address their individual situation and concerns.

2.4 Partner Coordination

Partner coordination refers to the processes and expertise needed to identify, recruit, and then facilitate meaningful interactions among partner organizations in order to achieve mutually beneficial outcomes.

During her workshop presentation, Caribbean Landscape Conservation Cooperative (CLCC) Partnership and Outreach Coordinator Kasey Jacobs discussed the Landscape Conservation Cooperative (LCC) model in light of more general efforts to coordinate conservation efforts at the landscape level. For Jacobs and many others, traditionally landscape management approaches have lacked integration across geographical, organizational, and jurisdictional boundaries. To address this, the CLCC is moving toward "deliberate multi-partner strategic action and science." Jacobs asserts that traditional paradigms in science and research development have been asking the wrong questions. In using climate change as an example, Jacobs said that the scientific conservation community has been asking, "What do you need to deal with climate change?" when they should be asking, "What challenges are you facing?" This approach allows for research agendas to be guided by end user groups and gives them ownership in conservation efforts. Historically, research investments have been heavily weighted toward the production of science rather than its communication or delivery, the CLCC is seeking to address this gap through its multi-agency conservation action teams that are organized around specific resources and challenges. She stressed the importance of investing in communication on the front end of projects and constantly reflecting on what methods have been effective and adjusting tactics accordingly. By bringing together strategic groups of stakeholders and potential partners through workshops, meeting, and collaborative projects, the CCSH is seeking to accomplish multiple objectives along various organizational lines. On one level, formal collaborative arrangements are sealed

through agreements, MOUs and follow-up meetings. Perhaps just as important as these formal networks, formed within existing bureaucratic structures, are the informal social networks formed among individual stakeholders. Arenas for information sharing are deliberately created during workshops through long breaks between sessions and by designing exercises that help each participant have an opportunity to share what activities they or their organization are engaged in- others are then encourage to reach out with common missions, goals, barriers, etc. In this way, informal social networks and agreements are made which facilitate continued collaboration across organizational structures without the need to first formalize agreements between institutions that can slow the flow of information. Both formal and informal networks are necessary to facilitate timely adaptive management and should be encouraged by Climate Hubs as they work to build cross-boundary networks (Folke et al., 2005).

Picture 5: Participants identify potential partner institutions in their country or region.

3. Moving Forward

Growing variability in climatic conditions demands greater adaptive capacity and flexibility within the organizational structures that are designed to respond to threats and challenges within a given sector. Past conditions may no longer serve as reliable analogues for the future. Business as usual within the agricultural sector may not prove sufficient to meet environmental challenges that are stretching the capacity and abilities of the advisory, relief, and farming communities. The UN estimates that the global population may reach 8.9 billion by 2050. The FAO estimates that world food production will need to rise by ~70%, and food production in the developing world will need to *double* to keep pace with the increase. Iterative processes are needed to respond to the dynamic needs that are emerging alongside new paradigms of climate variability. It can no longer be assumed that programs and policies can be implemented that will remain effective for decades to come. Local leaders need the authority, flexibility, capacity, and impetus to interface with and respond to producers in their service regions in meaningful ways. If we, as the agricultural advisory and policy community, are going to promote greater flexibility and adaptation from stakeholders, then there is also a need to have the political will and fortitude to instill and institutionalize similar process within organizations that will facilitate listening and responding to the needs of stakeholders in a way that fits local time-tables and priorities rather than those set by remote, predetermined departmental priorities. Improving communication networks and connections between agency advisors and their stakeholder groups of farmers and producers via the Regional Climate Hubs or other similar organizations represents an

important step towards institutionalizing such iterative processes, but only to the extent that these new networks work to develop the social capital and interactional expertise needed to facilitate meaningful interactions within the working lands community (Aeberhard & Rist, 2008; Kristjanson et al., 2009; Mase & Prokopy, 2014; Roux et al., 2006). Meaningful interactions are those that leave all contributors cognitively changed (Carolan, 2006) and lead to a more contextual understanding and informed decision-making (Clark, 2002). Tactics for facilitating these types of interactions represent adaptive actions on the part of organizations that govern the working lands community, and as such must be based on region specific social-ecological needs (IPCC, 2014). Bridging organizations will be effective only to the extent that they are supported within their respective organizations and/or countries, and only to the extent that feedback coming from stakeholders via hub style networks is internalized and responded to in a reasonably timely fashion. This is not to say that agricultural system adaptation should become a completely bottom-up driven scenario, certainly there is a leadership role to be played within the scientific and advisory community in providing a scientifically sound vision of a resilient future as well as contributing to the knowledge, techniques, and tools needed to achieve it. But this process must include a greater role for stakeholders within the process of planning and the setting of agency agendas and priorities.

An overarching objective of the Climate Hubs is to establish two-way communication between the land management stakeholders and the science and technology providers so that feedback from stakeholders directly influences the programs and priorities of the agricultural scientific community. In this way, the Hubs can serve as bridging organizations in providing interactional expertise within the working lands community. Hubs translate the vast amount of science available into forms that are both understandable and actionable to targeted stakeholders, but also mediate how the agency uses this information to interact with its stakeholders. Developing specific strategies and actions to accomplish these objectives with limited resources is an ongoing challenge.

The US Caribbean and the CCSH are in a rather unique position. The amount of land under agricultural production within the islands has reached historic lows. While it may be difficult to see a positive side to this trend, it provides the islands with the opportunity to build a climate resilient, social and environmentally just food system from the ground up. Certainly we are not implying that the islands are starting with a 'blank slate,' such a viewpoint would gloss over all the pre-existing social-ecological conditions that contribute to the vulnerability of working lands within the islands, the long history of agricultural and forestry research, and the recent efforts by local producers and federal, commonwealth, and territorial agricultural departments (Adger, 2006; Gould et al., 2015). Rather we would like to call attention to the opportunities that building adaptive, resilient agricultural systems hold for revisiting and addressing existing social-ecological vulnerabilities by building new democratic frameworks and processes in the realm of knowledge creation and management.

3.2 Next Steps

At the conclusion of the workshop, participants were asked to confer with their respective delegation colleagues and decide on three definitive 'next steps' to follow-up on the various outcomes of the workshop (see exercise results in the Appendix attached). Many expressed an intention to communicate the proceedings with their departments and ministries at home as well to explore options for creating similar Hub style networks in their own countries. Throughout the workshop it was stressed that what is important is not the creation of new Climate Hubs that mirror those in the US, but rather devising and implementing new ways to improve science delivery to agricultural stakeholders. The Mexican and Central American delegations outlined steps to move ahead with implementing the 'Hub' concept and expressed a desire to continue working with the USDA Hubs in a mutual exchange of information and collaboration to assist in this effort.

Other steps included:

- Identifying key regional collaborators for information dissemination
- Working to coordinate efforts among sectors involved in conservation, environmental management, agriculture, and forestry
- Integrating climate-smart agriculture into national climate change planning
- Identifying and building partnerships with key support services

Overall, the workshop supported the mission and goals of USDA FAS and the Regional Climate Hubs by furthering partnerships to improve global and domestic food security. There is a great deal of effort underway throughout Latin American Caribbean region to build climate smart agricultural systems, improve government services for agriculture and forestry, and coordinate efforts internally – by bridging gaps across various agencies and departments - as well as externally – by building international and public-private partnerships. The Foreign Agricultural Service and Regional Climate Hubs have taken an important step in leading the facilitation of these efforts by building international partnerships through workshops such as this and other FAS efforts, as well as by striving to improve communication and coordination across USDA and other federal agencies.

Many regions throughout the Caribbean and Central America are facing shared climate challenges and have similarities in producer demographics and crop systems. There is much to be learned from successes, failures, and case studies within the region. This learning process will more-likely take place with a deliberate, sustained, and coordinated effort on the part of all key partners in the region. Foreign Agricultural Service and the CCSH are committed to devising a strategy and action points for facilitating cooperation between the Caribbean Hub and FAS attachés in Latin America.

4. Participants

Climate Hubs in the Americas participants in front of the International Institute of Tropical Forestry. **By number:** 1. Caitriana Steele, 2. Isabel Parés, 3. Jerry Bauer, 4. William Gould, 5. Mark Manis, 6. Rhiannon Elms, 7. Roberto Flores Vedejo, 8. Leticia Albarran Mena, 9. Otto Gonzalez, 10. Jill Luxenberg, 11. Laura Scandurra, 12. Grizelle González, 13. Candice Bruce, 14. José R. Pérez-Jiménez, 15. Víctor López Saavedra, 16. Adriana Otero, 17. Althea Austin-Smith. 18. David Wolf, 19. Pablo Imbach, 20. Olivia Gilmore, 21. Randy Johnson, 22. Nery Perez, 23. David Williams, 24. Lashonda McLeod, 25. Ricardo Peña, 26. Ruperto Chaparro, 27. Alejandro Solis, 28. Ariel Lugo, 29. Didio Antonio Batista Moreno, 30. Duamed Colón, 31. Jesus Genaro Arroyo Garcia, 32. Guillermo Ortiz, 33. Roney A. Samaniego, 34. Ramon Rivas, 35. Josh Fain, 36. Guillermo Edo. González Perera, 37. Luis Ortega Reyes, 38. Claudia Barahona, 39. Alvaro Martinez, 40. Juan Marco Alvarez, 41. Tim Porch. **Not pictured:** Edwin Almodovar, Marixa Maldonado, Maya Quiñones, Gary Potts, Kathleen McGinley, Magaly Figueroa, Kasey Jacobs, Ivelisse Perez Rodriguez, Odalys Martínez, and Cédric J. Van Meerbeeck.

Country/Organization	Participant	Email	# in photo
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CATIE/RCCP	Alejandro Solis	Alejandro_Solis@dai.com	27
CIMMYT	Víctor López Saavedra	v.lopez@cgiar.org	15
Climate Advisor, Office of Global food Security, Department of State Washington	Olivia Gilmore	GilmoreOC@state.gov	20
Costa Rica/ Dirección de Asuntos Internacionales (DAI)/MAG	Guillermo Edo. González Perera	ggonzalez@mag.go.cr	36
Costa Rica/ SEPSA/MAG Risk Management	Roberto Flores Vedejo	rflores@mag.go.cr	7
El Salvador/CEDES (Consejo Empresarial Salvadoreño para el Desarrollo Sostenible)	Juan Marco Alvarez	jmagreen@yahoo.com	40
Guatemala/MAGA Director for Information Systems	Nery Perez	neryleonel@gmail.com	22
Honduras/SAG	Claudia Barahona	claudia_barahona@infoagro.hn	38
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Mexico/SAGARPA	Jesus Genaro Arroyo Garcia	Jesus.arroyo@sagarpa.gob.mx	31
Mexico/SAGARPA	Luis Ortega Reyes	luis.ortega@sagarpa.gob.mx	37
Mexico/SAGARPA Operative Personal, Chief of Office	Leticia Albarran Mena	Leticia.albauran@sagarpa.gob.mx	8
Nicaragua/MAG	Ramon Rivas	jrivasvi@gmail.com	34
Nicaragua/MARENA	Alvaro Martinez	alonfs1867@yahoo.es	39
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NOAA - NWS Forecast Office, San Juan, Hydrometeorologist	Althea Austin-Smith	Althea.austin-smith@noaa.gov	17
Panama/ MIAMBIENTE Technical Coordinator for Satellite Monitoring, Climate Change Unit	Roney A. Samaniego	rsamaniego@miambiente.gob.pa	33
Panama/Ministry of Agricultural Development, Drought Emergency Plan Manager	Didio Antonio Batista Moreno	dibatista@mida.gob.pa	29
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UPRM - Research	Guillermo Ortiz	Guillermo.ortiz@upr.edu	32
Universidad del Turabo, Director, Interdisciplinary Research Institute	José R. Pérez-Jiménez	utjperezjm@gmail.com	14

Country/Organization	Participant	Email	# in photo
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USDA/FAS/Guatemala Agricultural Attaché	Lashonda McLeod	Lashonda.McLeod@fas.usda.gov	24
USDA/FAS/Mexico Agricultural Specialist	Adriana Otero	Adriana.Otero@fas.usda.gov	16
USDA/FAS/Mexico Senior Agricultural Attaché	David Wolf	David.Wolf@fas.usda.gov	18
USDA/FAS/OASA Senior Policy Advisor	Mark Manis	Mark.manis@fas.udsa.gov	5
USDA/FAS/OCBD Division Director, Development Resources Disaster Assistance	Laura Scandurra	Laura.scandurra@fas.usda.gov	11
USDA/FAS/OCBD International Agricultural Program Specialist	Rhiannon Elms	Rhiannon.elms@fas.usda.gov	6
USDA/FAS/OCBD International Agricultural Program Specialist	Jill Luxenberg	Jill.luxenberg@fas.usda.gov	10
USDA/FAS/OCBD Special Projects Officer	Otto Gonzalez	Otto.gonzalez@fas.usda.gov	9
USDA/FS, Climate Hubs Leader	Randy Johnson	randyjohnson@fs.fed.us	21
USDA/FS/IITF (SCA Intern)	Ivelisse Perez Rodriguez	Ivelisseperez@fs.fed.us	
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USDA/FS/IITF Caribbean Sub Hub Leader	William Gould	wgould@fs.fed.us	4
USDA/FS/IITF Caribbean Sub Hub Strategic Analyst	Josh Fain	josh.fain@yale.edu	35
USDA/FS/IITF Director	Ariel Lugo	alugo@fs.fed.us	28
USDA/FS/IITF Director International Cooperation Program	Jerry Bauer	gbauer@fs.fed.us	3
USDA/FS/IITF Natural Resources Specialist	Magaly Figueroa	mafigueroa@fs.fed.us	*
USDA/FS/IITF Project leader	Grizelle González	ggonzalez@fs.fed.us	12
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USDA/NRCS, Caribbean Lead Conservationist	Edwin Almodovar	edwin.almodovar@pr.usda.gov	*

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Appendix

Workshop exercise results by country:

Mexico/SAGARPA

2. What are potential partner institutions in your country or region?

- Servicio Meteorológico Nacional
- Secretarias y Ministerios
- Universidades y Centros de Investigación (UNAM, INIFAP)
- Brigadas de extensionistas *(extension workers)*
- Asocioaciones y organizaciones de productores *(producers organizations)*
- National Center of Genetic Resources
- CIMMYT
- Agriculture and Fisheries Information System
- SW Climate Hub

3. What do I need help with to apply the climate hub concept in my country or region?

- Se requiere definir las regiones y un coordinador general *(It is necessary to define the regions and a general coordinator)*
- Se tiene que compartir esta nueva practica para combatir el cambio climático con las diferentes dependencias *(Share this new practice to combat climate change with the different agencies)*
- Concienciar a toda la población de que hay cambios climáticos y que todos deben participar *(Sensitize the population that there is climate change and that everyone must participate)*
- Comunicación y colaboración entre las áreas de apoyo, hace falta presupuesto y respaldo de los titulados (*Communication and collaboration between the areas of support, budget and support of the "titulados")*

1. What types of information or tools are available in your country?

- Plataforma de información meteorológica *(Weather Information Platform)*
- Talleres y foros de extensionistas capacitación y mitigación al cambio climático *(Extension workshops, training of climate change mitigation)*
- Alertas tempranas y pronósticos *(Early warnings and forecasts)*

Guatemala

2. What are potential partner institutions in your country or region?

- Las Cooperativa
- Medios de comunicacion para la diffusion
- Gobierno
- Camaras Agricolors
- Cooperacion Externo
- Academia
- Productores Asociades
- Clima

3. What do I need help with to apply the climate hub concept in my country or region?

- Platformas informaticas diseno resquardo difusion
- Formacion para facilitar integracion

Panama

2. What are potential partner institutions in your country or region?

- MIDA
- ETESA
- Academia
- FAO
- Smithsonia
- SINAPROC
- CATHALAC
- Ministerio de Ambiente y Agricultura
- Instituto de Investigacion Agropenria(?)
- Asociacion de Productores
- Universidad de Panama
- Empresa de Transmision Electrica
- NGO's

3. What do I need help with to apply the climate hub concept in my country or region?

- Fondas
- Diseno a estrategia utilizando en otro paises
- Integracion international
- Fondas de cooperacion
- Coordinar con los beneficiarios

Costa Rica

2. What are potential partner institutions in your country or region?

- CATIE
- SMN's
- Empresa Privada
- Universidades
- IICA
- Local NGO's
- Drinking Water Agencies
- CRRN
- CCAFS(?)
- CEPAL
- Extension Services
- Energy Companies
- Irrigation Agencies

3. What do I need help with to apply the climate hub concept in my country or region?

- To convince politicians of the benefits of a Hub.
- Se requiren un Centro Climatico con informacion en ingles y espanol.
- Induccion a technicos Nacionales y decisores con experiencies de trabajo documentades y validades.

- Se require un documento que exprese la estructura, objectivos, requierimentes y los resultados que se podrian obtener
- Se requiere converser con las mas altas autoridades politicas nacionales.
- Se requiere stronger connections between technicians communities.
- Definicion de stakeholders
- Sostenibilidad
- Capacitacion
- Diseno adaptado al usario

Honduras

2. What are potential partner institutions in your country or region?

- IICA
- USDA/ USAID
- FAO
- CEPAC
- Servico Meteorologico Nacional (CSMN)
- COPEC
- NGO's
- Fundacion Hondureno de Investigacion Agricola
- Universidades y escuelas Agricolas
- Ministeria de Agricultura

3. What do I need help with to apply the climate hub concept in my country or region?

- Crear alianza estrategicas entre instituciones
- Fortalecer capacidades tecnicas
- Capacitacion
- Assistencia tecnico
- Transferencia de tecnologia
- Equipo

El Salvador

2. What are potential partner institutions in your country or region?

- Observatorio Ambiental del MARN- Ministerio del Medio Ambiente y recursos naturales
- Fundacion PROCAFE
- Ministerio de Agricultura y Ganaderia/ MAG
- CAMAGRO
- Asociacion Azucarera de El Salvador
- Mesa Nacional de Cambio Climatico

Nicaragua

2. What are potential partner institutions in your country or region?

- INAFOR
- Sistema Nacional de technologia agroqueoria
- MARENA
- MAG
- CD-SINAPREDEMAC

- Defencia Civil

3. What do I need help with to apply the climate hub concept in my country or region?

- Denotal los principales agregado de la existencia da un centro climatico- para nuestro pais.
- Fortalecer las capacidad de mi pais en maderia de cambio climatico a fin de ser un facilitada apportono de sin procesos.
- Cooperacion para la capacitacion del personal que morijara el centro climatico (enlace Nic).
- Capacitacion se fermte a la importancia y operatividad de los centos.
- Establecer relador iquandito con nuestro pais solicitar enlace

CMMYT

3. What do I need help with to apply the climate hub concept in my country or region?

- Indicators to motivate decision makers and farmers to tackle climate change (sense of urgency or potential gain.)
- Successful pilot applications
- End user – information products, “outcomes evaluations”
- Developing a seasonal forecasting system for agriculture (drought focus initially)
- Develop tailored link mechanisms to link information to end users
- Information brokers
- Science communicators
- Authority to lead (?) effort: policy support and resources
- A collection of tools suited to timely contact end users