Climate Services for Climate-Smart Development
A Preliminary Guide for Investment

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1. Introduction

Changes in climate from seasons to decades, often affecting extreme event occurrences, continue to impact societies, even as shifts in resource demand, land use, and urbanization have heightened the vulnerability of many populations, particularly in the developing world. In this context, protecting and producing development gains requires the incorporation of climate information into place-based development decisions and policy.

This kind of "climate-smart" development will require a range of climate services. But gaps in information, communication, policy, practice, and institutional capacity compound the difficulties of creating useful climate services in many settings. Climate services are on the whole new, and there is not yet a clear prescription for how such services should be built and how they should function.

The World Meteorological Organization (WMO) has provided important leadership in the area of climate services and is working to develop a Global Framework for Climate Services (GFCS).[1] And at both national and international scales, a number of climate services activities are being developed and implemented.[2] This document takes into account guidance derived from these efforts, plus additional research experience, in order to identify major areas for investment needed to enable climate services that support climate-smart development. The document also identifies questions that must be addressed to ensure that climate services are sustainable, efficient, and adequate to meet societies' needs.

The investments needed to support effective climate services are varied, but fall under two broad categories: (1) place-based programs to enable regional to local climate services, and (2) larger-scale collaborative activities to improve knowledge and capacity in climate services.

2. Supporting Development of Regional to Local Climate Services

While climate variability takes place on many scales, impacts are experienced locally and are a function of local conditions, practices and capacities. To address this,

[1] WMO. Climate Knowledge for Action: A Global Framework for Climate Services – Empowering the Most Vulnerable. Report of the High-Level Taskforce for the Global Framework for Climate Services.
[2] Red Cross Red Crescent Climate Centre. www.climatecentre.org/
German Climate Services Center: www.climate-service-center.de/
UK Met Office Climate Services: www.metoffice.gov.uk/services/climate-services
WMO & WFP collaboration on weather data: http://www.wfp.org/stories/wfp-and-wmo-step-collaboration-weather-data

development-focused climate services must be place based, incorporating information about the climate, environment, and society at the appropriate scale.

2.1 Scoping

New investments in climate services for climate-smart development should be guided by a careful scoping process. The scoping should identify leading climate-sensitive development challenges and priorities in the region, drawing on national priorities and other sources (e.g., NAPs and NAPAs). Focusing on these priority areas, the scoping should identify relevant institutions – including universities, government agencies, service and technical organizations – and examine existing capacities, needs, gaps, and opportunities. Scoping exercises should identify existing partnerships and highlight relevant past or present programs and initiatives upon which new efforts can build. In those instances where such an analysis is not already available and accessible, it should be undertaken as a first step to enable informed decisions about new investments in targeted climate services for a particular setting.

2.2 Roadmap

Once an understanding of ground conditions is in place, an investment roadmap should help prioritize and time activities, identify and manage threats, and establish evaluation criteria. Taking into account needs, capacities, and priorities, such a roadmap will vary depending on national and sectoral circumstances. Each roadmap should, however, address three crucial elements of climate services:

A. ***Information***: Climate services depend fundamentally on quality data and information.
B. ***Collaboration****:* Effective climate services are built on sustained communication and interaction between and among user and provider communities.
C. ***Policy & Practice****:* Climate services must connect data and information to policy and practice in order to see impacts on the ground.

Experience tells us that attention to all three components is necessary for climate services to be effective in terms of development impact. Each element is discussed further below.

A. Information

Climate services depend on information about the climate and its impacts on people and the environment. Information about the past, present and future climate is an essential part of all climate services, but it must be matched with appropriate socioeconomic and sector-specific data. Climate services must also be supported by operational institutions, including meteorological departments and other technical institutions with the mandate and capacity to deliver, support, and disseminate this information. All aspects of this can be facilitated through regional and international collaboration and capacity building. Investments in information to support climate services should focus on the following key elements:

Information about Past Climate is an important building block of every operational climate service activity. Historical information helps establish connections to relevant impacts, allowing decision-makers to understand the nature of climate variability and trends, to validate model-based simulations and forecasts, and to assess the utility of new practices and policies. Historical weather data can be utilized to examine climate trends and to analyze those characteristics of climate that are most relevant to practical applications, including the frequency of extreme events, the timing of monsoon onset, dry spells, heat waves, and others. When developing roadmaps, high priority should be given to assembling the best historical climate records possible. These efforts should include data rescue and development of merged satellite/station data climatologies.[3]

Information about Current Climate plays a key role in many operational climate services, across sectors and spatial scales. Climate observation systems must involve geographically comprehensive coverage, frequent and reliable observations sustained over decades, well-maintained instruments, and the use of globally standardized observing practices. While these networks are well developed in some areas, in other areas they are lacking. In these areas, roadmaps should focus on developing observations systems, prioritizing the "Essential Climate Variables" designated by the Climate Observing System.[4]

Information about Future Climate, in the form of climate forecasts or long-term projections, is vital to most climate services. Such products are generally derived from global climate models. It is, however, impractical and unnecessary to establish new global-scale modeling and prediction facilities in developing counties. Rather, developing country initiatives should secure access to available model outputs through regional or international centers. To support this, capacity building and the establishment and support of sustained efforts in developing local forecast products, including validation and skill information, is essential. In some cases, access to remote computational facilities may be needed to avoid transferring large quantities of data over the Internet.

New Climate Variables are increasingly called for in the context of specific applications. Examples include the frequency and duration of dry spells, dust density, or the probability of extreme events (i.e., "weather within climate"). Forecasting such climate variables has been shown to greatly enhance the ability of societies to manage climate-related risks; forecasting of such variables also generates information that is crucial, for example, in insurance programs and disaster risk management.[5] In each

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[3] Brunet M, Jones P (2011) Data rescue initiatives: bringing historical climate data into the 21st century. Climate Research 47:29-40; Ethiopia National Meteorological Service Map Room (2012): http://213.55.84.78:8082/maproom/.NMA/; NRC (2001) "A Climate Services Vision." *National Research Council (U.S.). Board on Atmospheric Sciences and Climate*, National Academies Press. Page et al. 2004. "Data Rescue in the Southeast Asia and South Pacific Region: Challenges and Opportunities." *BAMS* October 2004;

[4] GCOS Essential Climate Variables: http://www.wmo.int/pages/prog/gcos/index.php?name=EssentialClimateVariables

[5] Balzer, N. and U. Hess. (2010) Climate change and weather risk management: evidence from index-based insurance schemes in China and Ethiopia. World Food Programme; Hellmuth M.E., Mason S.J., Vaughan C., van Aalst M.K. and Choularton R. (eds) 2011. A Better Climate for Disaster Risk Management. International Research Institute for Climate and Society (IRI), Columbia University, New York, USA; IRI Technical Report 07-03 (2007) Working Paper - Poverty Traps and Climate Risk: Limitations and Opportunities of Index-Based Risk Financing, Barrett, C.B.; B.J. Barnett; M.R. Carter; S. Chantarat; J.W.

setting, prioritization of efforts in new information products should be based on demands emerging from the engagement and collaboration with relevant user communities.

Sector and Socioeconomic Information is crucial to understanding climate-related impacts, and to developing and assessing climate risk management practices and policies. In some cases, this information already exists and is being incorporated into climate services. More often, some information exists, but has not yet been incorporated into climate services. In such cases, a priority investment is engaging the relevant community of practice to identify, organize, and analyze relevant sector and socioeconomic data in conjunction with relevant climate information.

B. Collaboration

Climate services use climate and other kinds of information to improve decision-making in climate-sensitive areas. This requires an understanding of operational reality, capacity constraints, threats, priorities, and vulnerabilities in relevant areas. So while high-quality data and information products are critical elements of climate services, a greater challenge is the integration of climate information into the decision-making realities in the different sectors of interest. Reliable science-based climate information is unlikely to be usable or useful without a strong engagement between communities of expertise in several areas from research to operations.

To date, many working examples of effective climate services have developed mechanisms to foster collaboration between the climate community and other relevant sectors.[6] It is clear from these experiences that prolonged and repeated interactions toward mutually agreed-upon objectives, mutually agreed-upon metrics for evaluation, and shared governance produce the most useful results. Single consultations, surveys, and workshops often provide a good starting point, but are not sufficient to generate either the products or the changes in policy and practice needed to foster climate services and contribute to climate-smart development. Investment and support for sustained interactions and collaborations must thus be a priority in the development of climate services. Such interactions can be facilitated through targeted action geared toward nurturing collaborative space and the development of new communities and mechanisms of practice. Specific mechanisms include the following:

Partnership Development. In many cases, a limited understanding of climate information on the part of users is matched by an incomplete appreciation of the decision process on the part of climate information providers, with the result that actual demand for climate information is often low and/or poorly informed. To remedy this, partnerships need to be established between climate information providers and users in order to identify needs of climate services. Partnerships should address the following questions:

- How does climate variability and change relate to the users' interests?

Hansen; A.G. Mude ; D.E. Osgood; J.R. Skees; C.G. Turvey; M.N. Ward.

[6] For example, the Climate and Health Working Group in Ethiopia, the National Agricultural Research Institutes of the Southern Cone, the US Federal Climate Change and Water Working Group the Famine Early Warning System Network, and many others.

- What specific aspects of the climate are most important for the users' concerns and decisions?
- How could climate information be incorporated into actual decision making to improve outcomes?
- Do resource and policy constraints restrict what responses are possible? How can these constraints be addressed?
- Is the provision of the desired climate service scientifically and logistically feasible?

The following mechanisms can be used to nurture collaboration and dialogue toward improved development outcomes:

Climate Focal Points

Organizations like the IFRC, World Bank, WFP and USAID have developed small centers with mandates in climate. These centers provide a focal point for interaction with the scientific and technical community: They clarify, identify and aggregate demand for climate information and services across the parent organization, and they facilitate the implementation of climate-related projects. At regional, national and local scales, a similar concentration of effort and expertise can provide an efficient mechanism for the evolution of climate services.

Staff Exchange

Exchanges are a low-cost high-impact mechanism to enable innovation, cross-pollination, and the establishment of multi-disciplinary networks. As an element of a broader strategy for climate services development, targeted exchanges are also an effective tool for knowledge transfer and as a means to facilitate south-south collaboration. There are several effective modalities for staff exchanges. For example, national-scale operational units and line ministries have supported staff secondments and collaborative work units; international research institutions host visiting scientists, policy makers and practitioners; and regional centers of expertise organizations enable extended visits for national-level practitioners and staff from similar centers in other regions.

Regional- and National-Scale Communities of Practice

Regional-scale communities of practice, including "working groups," put climate scientists together with sector specialists to tackle difficult problems. Successful working groups have some common elements, including a dedicated staff with the necessary expertise to respond to both users and providers; a mechanism to identify strengths, weaknesses, opportunities and threats to the partnership; and process for addressing issues. Communities of practice help providers to understand user needs and they help users understand what climate information is available.

An example of a community of practice is found in Ethiopia, where the IRI has worked with the Ministry of Health and the National Meteorological Agency of Ethiopia to make significant progress in developing a climate-informed early

warning and response system for climate-sensitive diseases such as malaria. In this case, the multi-sectoral Climate and Health Working Group spearheads the use of climate information for health interventions. Leadership from the Ethiopian Ministry of Health has ensured that the solution to the public health problem is demand driven, an essential factor in maintaining momentum given the multitude of competing priorities.

Other examples of communities of practice are the sector-based outlook forums, the Malaria Outlook Forum in southern Africa, and the Food Security Outlook Forum of the Greater Horn of Africa. These forums bring national, regional, and international experts together around a common challenge area. They develop and share approaches to managing operational risks, articulate climate information needs, and engage climate information providers in understanding what information exists and how it can be tailored to operational needs.

Investments in such mechanisms should be a priority moving forward. Major facilities such as those supported by NASA SERVIR can serve as focal institutions for one or more communities of practice.

Training and Education

In all of the aforementioned collaborative models, climate experts should work within existing practitioner-training programs, where they exist. When climate is integrated into such training, rather than treated as a new and separate concern, it becomes more relevant and useful to the practitioner. While support for integrated climate/sector training materials and methods has been limited to date, this kind of investment offers an important pathway for the uptake of climate information and, ultimately, for the development of climate services in support of climate-smart development.

*Data-Sharing Platforms***.** Climate services require the transfer of complicated information to decision-makers in a useful and usable way. Data-sharing platforms, many of which are online, allow the transfer of this kind of information in an efficient and effective manner. It is important to note, however, that different communities of expertise use different data platforms and protocols. While this is a significant hurdle to collaboration and innovation, platforms that facilitate interdisciplinary collaborations in data sharing and use can help overcome this barrier.

It is also important to take into account the work that has already been done. Freely accessible platforms such as Google Earth and Google Maps; agency-supported platforms such as NASA's SERVIR, USAID's FEWS NET, and the World Bank's Climate Change Portal; sector platforms such as WHO's Health Mapper; and tools used by the Red Cross, FAO, and others need to be considered in this process. It will be confusing, counterproductive and inefficient to develop new platforms and decision support systems that do not build on systems that already exist and are being successfully used.

C. Practice and Policy

To have an impact on development outcomes, climate services must connect to practice and policy. Collaboration between climate information providers and practitioners can increase awareness, identify needs, and even foster innovations to address those needs. This sets the stage for new practices and policy, but is insufficient without operational delivery mechanisms targeted to specific decisions, and information flows to support new policy. These often take the form of specialized tools and information products, but may also include, for example, advisory services. In all cases, the essential function is to support the ongoing implementation of new practice and policy.

Important investment areas relevant to practice and policy include the following:

Decision Support Systems present climate information in a way that is useful to decision-makers and that can help trigger the appropriate actions. These can incorporate a wide variety of approaches, including simulation tools, map-based products, early warning alerts, and threshold-based decision systems. The following approaches have been used successfully to support decision-making in climate-sensitive areas and should be expanded:

Help Desk Facilities

Sector- and organization-specific climate-related "help desks" assist development practitioners in accessing timely authoritative advice. Typically, help desks are tasked with responding to any climate-related question raised by practitioners within a relatively short period of time (say, one business day). This allows development practitioners to confront climate issues without having to first develop a high degree of expertise in the area. In addition to providing technical support, help desks can be a mechanism of two-way communication, documenting effective practices and informing future areas of research and investment.

Integrated Decision Support Systems (IDSS)

IDSS products integrate sector, climate, socio-economic, and environmental information into a single platform, usually to simulate impacts and outcomes associated with different decision options. For example, agricultural IDSS's may permit the investigation of changing cropping practices on production or economic output under different climate scenarios; water management IDSS's may explore the impact of specific river basin operations decisions on water supply, hydropower, and agricultural production under different climate scenarios. IDSS's are designed and developed in collaboration with the community that is intended to use them in order to answer a climate-related question of concern to that community.

Early Warning Systems

Under the Hyogo Framework for Action,[7] there have been significant efforts to predict and prevent disasters and to decrease the time it takes to respond to humanitarian crises. Climate affords us a range of tools, from seasonal forecasts to weather observations, which can be used to guide decision-making and trigger actions. Effective early warning systems are designed in a collaborative manner that informs specific decisions in the community of practice; these systems take into account the operational reality and decision-making context of the humanitarian actors.

Threshold- and Index-Based Decision Systems

Index insurance has been piloted at increasing scales. In the agricultural sector, it has enabled small farmers to cover their risk of bad weather and access production loans.[8] At larger scales, index insurance systems have been applied to sovereign disaster risk. Index and threshold systems are also applicable to other development and humanitarian problems – for example, identifying the threshold of rain that is likely to trigger a flood could also help us establish the thresholds that should lead to specific disaster prevention actions.

Policy Engagement. Much of the work involving new climate services for practice will involve quite technical work between professional climate and sectoral communities, for example in collaborative working groups. A different modality of exchange is needed in most cases to engage policy makers effectively. Policy dialogues have been successful in this regard. Policy dialogues bring together the relevant policy, practitioner, and climate services community, in a setting and format that is comfortable for policy makers. Through such means, the policy community can be made better aware of climate issues and the opportunities to harness new knowledge and information for better development outcomes; they can be engaged to recognize barriers to progress, and possible policy solutions; they can be made aware of technical innovations and possibilities for incorporating them into new policy; and they can be engaged to facilitate investments to scale up or build upon successful initiatives.

2.3 Sustainability

Climate services must in the end be based on dependable operational capacity. This requires that all aspects of the service – including those related to information, communication and coordination, and policy and practice – be sustainable and adequately sustained.

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[7] Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters. World Conference on Disaster Reduction 18-22 January 2005, Kobe, Hyogo, Japan; www.unisdr.org/wcdr

[8] Bryla, E. and J. Syroka. 2007 “Developing Index-Based Insurance for Agriculture in Developing Countries.” UN Sustainable Development Innovation Briefs. #2, March 2007.

Because many existing climate service initiatives have been established as pilot programs, there has not been enough attention paid to sustainability. Moving forward, as investments are made in different aspects of climate services questions of who will pay, and how they will pay, must be given specific consideration. This will require a more rigorous economic analysis of the costs and benefits of climate services and the creation of mechanism to support information, interactions, and policy and practice. Sustainability considerations should influence the design of governance mechanisms, the prioritization of activities, and the scope of the service.

3. Larger-Scale Collaborations

Investments in regional to local climate services initiatives are essential to support climate-smart development. These investments should be supported by a set of broader-scale collaborations designed to tap global knowledge and expertise. Such larger-scale collaborations will allow us to better capitalize on investment in information, collaboration, and policy and practice. Large-scale collaborations will afford the transfer of information, technology, and skills from developed to developed countries, and from different regions within the developing world. Larger-scale collaborations are also essential for achieving economies of scale and transferring lessons learned.

3.1 Knowledge Capture and Exchange

Given the severity of climate impacts in developing countries and the limited resources available to develop services to help address them, it is important that efforts be coordinated. A knowledge exchange process – wherein the community can learn from each other the strategies that merit replication and how to actualize them, as well as the strategies that don't bear repeating – is a major opportunity area. This would also help avoid waste and the unnecessary duplication of initiatives. Climate services knowledge management has been highlighted as a key element of the Global Framework for Climate Services, and toward this end the newly established Climate Services Partnership (CSP)[9] is prepared to advance a knowledge capture and exchange prototype. By learning from disparate initiatives from a range of organizations around the world, the CSP hopes to document in a consistent and rigorous manner good practices in climate service development.

With some investment, the CSP process will allow the global community to take advantage of economies of scale regarding knowledge management, including the creation and maintenance of quality data and information and the development of systematic mechanisms of knowledge exchange. At the same time, the process will build global capacity in the uptake of climate knowledge and information and contribute to the production of improved policy regarding the management of climate-related risk. In providing a mechanism to multiply the effect of good practice, the CSP can speed the development and delivery of climate services around the world in direct support of the Global Framework for Climate Services.

[9] http://iccs.iri.columbia.edu/statement-report.php

3.2 Research Coordination

The World Climate Research Program is a primary international mechanism for coordinating climate research[10]. Its main objectives are to determine the extent to which climate can be predicted and the extent of human influence on the climate system. Priority should be placed on coordinating climate research for climate services, ensuring that users needs are met and that the research community is effectively tackling the most important questions. This can be enabled through information exchange such as the knowledge platform of the CSP. Additional attention should be devoted to the process of communicating research needs to those organizations and institutions that conduct and sponsor research programs.

Climate services development could be further enabled through the establishment of a (formal or informal) network of research-based organizations with programs specifically targeted to climate services development, and responsive to emerging climate services needs. With appropriate coordination and sharing of resources, such a consortium could provide greatly advanced capacities to develop and exchange new knowledge in developing country context.

3.3 Training and Capacity Building

Technical and practical training will typically be required in any regional-to-local climate services initiative in developing countries. Given the magnitude of the investment involved in offering this kind of training, it makes good sense to find ways to coordinate and combine efforts to achieve economies of scale, wherever possible. Some organizations already have quite well developed training programs in particular areas. For example, through its CLIPS program the WMO undertakes training programs in climate data, analysis, and prediction.[11], and this activity will be further developed under the GFCS. Training programs in some sectors such as health and agriculture are also supported through relevant international organizations, and programs such as START.[12]

Building on these activities, a more coordinated and comprehensive suite of core training curricula could be developed for widely applicable climate information and products, and sector-based tools, information, and decision-making. With the needed investments, such efforts could be undertaken through the CSP, and again could feed into the GFCS as well as sector based programs.

Training institutes are an effective complement to region-based training. Institutes are generally organized around a theme, and bring professionals and practitioners together from different settings. One successful model is the IRI's Summer Institute on Climate Information for Public Health.[13]. Another modality worthy of additional investment is online training courses. Both in-person and online courses could draw on a shared basic curriculum.

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[10] www.wcrp-climate.org/
[11] http://www.wmo.int/pages/prog/wcp/wcasp/clips/clips_focalpoints.html
[12] http://start.org
[13] More on the Summer Institute is available here:
http://portal.iri.columbia.edu/portal/server.pt?open=512&objID=1094&mode=2

Extended-term fellowships offer the opportunity for more in-depth study and learning, and can foster both greater capacity and program development in settings where it is most needed. Currently there are many universities that host such fellowships on an individual basis, supported through various sources. It would be valuable to build on existing efforts by supporting a new Climate Services Fellows program. This would provide new training opportunities, and could draw on a network of institutions prepared to serve as hosts to Climate Services Fellows.

3.4 Establishing Good Practices in Climate Services

At present there is considerable experience in many of the technical, practical, and institutional aspects of climate services. For the most part, however, this knowledge has not been consolidated in the form of standards and guidance for climate service providers, communities of practice, and policy makers. Collaborative efforts to compare approaches and results, and to provide guidance and information for the broader community would be of great value, and should be fostered. The guidance would be immediately useful to organizations already engaged in climate services, and could be an invaluable resource for new initiatives. All aspects of the production, translation, transfer, and effective uptake of climate information (i.e., decision systems) are ripe for pooling collective knowledge and distillation of good practices guidance.

Considerable resources regarding issues of data collection and analysis, seasonal climate forecasts, validation, and performance metrics are already available through the WMO.[14] These can and should be extended to include, for example, synthesis of multiple forecast inputs. Guidance on the use of longer-term outlooks of 1-30 years (i.e., near-term climate change) and with respect to longer-term climate change scenarios is lacking. Such guidelines should be developed, even as the underlying science is evolving, as there is considerable misuse of such information occurring at present.

Beyond this, more practitioner-oriented, authoritative guidance on the proper use of available climate information to inform decision- and policy-making – e.g., a Climate Services Guidebook – is urgently needed. Such guidance would outline the key steps and decision points, identify available data and information products, and discuss relevant analysis methodologies and tools, together with their strengths and limitations, all in the context of informing decision and policy. It could be implemented as a book, or online tool, or both. A coordinated project toward this end, engaging leading research and climate service organizations, should be considered a high priority investment area.

There is also a need to identify and promote institutional policies and practices that facilitate the development of climate services. This includes policies that facilitate access to data, and that allow users and provider communities to work effectively together.

[14] WMO Strategy for Service Delivery, 2009.WMO Guide to Climatological Practices. Third Edition: http://www.wmo.int/pages/prog/wcp/ccl/guide/guide_climat_practices.html;

4. Conclusion

Climate services have an important role to play in protecting and producing development gains. Climate-smart development, an essential tool in raising the living standards of the more than 1 billion people living in poverty today, require climate services to facilitate the incorporation of climate information into place-based development initiatives. However, climate services are minimal or absent entirely in most developing countries today. Investments are needed to change this, and such investments can now be recognized as part of a development agenda.

Recommended investments in climate services fall into two broad categories: (1) Supporting the development of regional to local climate services, and (2) Larger-scale collaborative activities to improve knowledge and capacity in climate services. Both kinds of investments are necessary because while climate impacts are all experienced locally, regional and international cooperation is necessary to transfer lessons learned and achieve economies of scale.

Addressing these two issues, this document explores priority investments in climate services, highlighting the need for scoping current conditions and roadmapping future work at the local to regional scale. As part of this activity, investors should focus on three main areas in conjunction: information, collaboration, and policy and practice; and all of these should be undertaken with sustainability in mind. Moving to the inter-regional and international scale, priority considerations include: knowledge capture, research coordination, training and capacity building, and the establishment of good practices in climate services – particularly a Climate Services Guidebook. Investing in these activities can and will make a difference in the capacities of highly vulnerable societies to better protect themselves, and indeed to develop in the face of an ever changing climate.