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Establishing a baseline for monitoring and evaluating user satisfaction with climate services in Tanzania

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Abstract: This report is an output from the Global Framework for Climate Services Adaptation Program in Africa (GFCS-APA) Tanzania country activities. The aim of the report is to establish a baseline for monitoring "User Satisfaction with Climate Services" at the national, district, and local levels, with a focus on the programme target districts of Longido and Kiteto. A qualitative approach was employed to document 1) existing institutional coordination and steering mechanisms for a dedicated climate services platform at the national level; 2) respondents' awareness of and access to climate information and services at national, district and local levels; 3) respondents' perceptions of the 'usability' of climate information and services, and 4) the role of indigenous knowledge (IK) about weather, climate, and related adaptation options. Following Cash et al., (2003), we analyzed "user satisfaction" in relation to respondents' perceptions of the credibility, salience, and legitimacy of climate information and services. Key findings include: 1) A national steering mechanism for climate services has been adopted, but there is a need to strengthen institutional coordination across all scales; 2) Awareness of and access to climate information and services are highly variable across institutional scales, indicating a need for increased awareness of the concept of climate services as well as efforts to enhance delivery of climate information; 3) Perceptions of the *credibility* of climate information and services are paramount to increasing user satisfaction, and depend upon respondents' experience using climate information in practice. Mismatches between the timing of decision-making and the production and delivery of forecasts, as well as the limited spatial and temporal resolution of climate information and products, undermine the *salience* of climate information. The way in which forecasts are currently packaged and communicated presents additional challenges to understanding and interpreting the information for practical decision-making. At the local level, disparities in capacities to access and benefit from climate information and services and the potential for climate information to take on political implications when attached to specific advice pose challenges to the *legitimacy* of climate information and services development. 4) IK was seen as being particularly important to decision-making at local levels, where it gains its credibility through the long-term observations it is based on, as well as the experience that communities already have working with this knowledge. Incorporating IK within climate services development is necessary to enhance the legitimacy of the processes and the applicability of the knowledge that is generated to local decision-making, but there are a number of challenges to incorporating scientific and indigenous knowledges. The findings highlight that improving user satisfaction with climate services will be a long-term process that requires capacity building among producers, intermediaries, and users at all levels, particularly to promote innovation in delivery, communication, and tailoring of climate services products. Developing knowledge that is salient, credible, and legitimate in particular decision-making contexts will also require long-term collaboration, as well as transparency about the strengths and limitations of scientific information and open dialogue about the various ways in which stakeholders at different scales assess the credibility of climate information. Based on the analysis, the authors put forward twelve recommendations to improve user satisfaction with climate information and services in Tanzania in the future.

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Executive Summary

This report is a contribution toward baseline activities for the Global Framework for Climate Services Adaptation Program in Africa (GFCS-APA) in Tanzania to measure progress toward the programme M&E framework indicator 1.4.2: "User Satisfaction with Climate Services". Data collection, analysis, and synthesis were conducted by the Center for International Climate and Environmental Research – Oslo (CICERO) and the University of Dar es Salaam (UDSM). A qualitative approach incorporating multiple data collection methods (interviews, focus groups, and observation) was employed at three institutional scales: national, district, and local, with a focus on the programme target districts of Longido and Kiteto. User satisfaction with climate services and information is multi-dimensional. Data collection and analysis focused on understanding respondents': 1) institutional coordination and steering mechanisms for a dedicated climate services platform at the national level; 2) awareness of and access to climate information and services at national, district and local levels; 3) perceptions of the 'usability' of climate information and services, and 4) the role of indigenous knowledge (IK) about weather, climate, and related adaptation options to capture various elements of 'user satisfaction'. To identify the specific components of perceptions of 'usability', data were analysed in relation to sub-indicators of users' perceptions of the credibility, salience, and legitimacy of climate information and services, also known as the knowledge system criteria (Cash et al., 2003, Tang and Dessai 2011). An overview of the indicators is provided in Figure 2 (page 5), and Key Recommendations are provided on pages 43-45. Summaries of baseline findings relating to each indicator can be accessed by clicking on the links below:

1) Institutional Coordination and Steering Mechanisms
2) Awareness of and Access to Climate Information and Services
3) User Satisfaction with Climate Information and Services
4) Role of Indigenous Knowledge

Key findings

A national steering mechanism has been adopted, but there is a need to strengthen institutional coordination across all scales. Awareness of and access to climate information and services were reported to be highly variable across institutional scales. A common challenge to climate information access was the perceived lack of sufficient mechanisms to systematically deliver information, both within and across scales. Findings highlight that perceptions of the credibility of climate information and services are paramount to enhancing user satisfaction at all institutional scales. Perceptions of credibility are dynamic and non-linear and are dependent upon experience using climate information *in practice*. Improving the credibility of climate

information and services will be a long-term process. Two challenges to the salience of climate information across scales include mismatches between the timing of decision-making and the production and delivery of forecasts, as well as the limited spatial and temporal resolution of climate information and products. Additionally, the way in which forecasts are currently packaged and communicated presents significant challenges to understanding and interpreting the information for practical decision-making. Efforts to improve the salience of climate information should simultaneously consider impacts on the credibility of information, balance user requests with current scientific capacities, and manage user expectations in a transparent manner early on. The inclusion of multiple perspectives and relevant stakeholders within knowledge production and decision-making at all scales is key to enhancing the legitimacy of climate information. The programme should continue and expand efforts to ensure that key stakeholders are included at all stages of climate services development. Disparities in capacities to access and benefit from climate information and services and the potential for climate information to take on political implications when attached to specific advice (particularly at local scales) pose challenges to legitimacy. The role of indigenous knowledge was seen as important across all scales, although perceptions of credibility were highly variable, and there were challenges to enabling use of IK at district and national levels. IK was perceived to be more salient and legitimate than scientific climate information, particularly at local levels. Findings highlight that the perceived credibility, salience, and legitimacy are often interrelated and cannot be treated or considered separately. It will be important to consider both synergies and trade-offs among perceptions of these criteria within efforts to address user satisfaction. The findings highlight that improving user satisfaction with climate services will be a long-term process that requires capacity building and long-term, iterative collaboration among producers, intermediaries, and users at all levels, particularly to promote innovation in the delivery, communication, and tailoring of climate services products. Importantly, this should include efforts to create transparency around the strengths and limitations of scientific information and to facilitate open dialogue about the various ways in which stakeholders assess the credibility of climate information. Based on this analysis twelve recommendations are presented (see page 43), which may contribute toward developing strategies to improve user satisfaction with climate information and services in Tanzania in the future.

Acronyms

CCAFS	CGIAR Research Program on Change and Food Security
CCCS	Centre for Climate Change Studies
CICERO	Centre for International Climate and Environmental Research – Oslo
CMI	Chr. Michelsen Institute
DC	District Commissioner
DED	District Executive Director
DM	Disaster Management
DRR	Disaster Risk Reduction
FGD	Focus Group Discussion
GFCS	Global Framework for Climate Services
GFCS-APA	Global Framework for Climate Services Adaptation Programme in Africa
IIED	International Institute for Environment and Development
IK	Indigenous Knowledge
LUANAR	Lilongwe University of Agriculture & Natural Resources
M&E	Monitoring and Evaluation
MAFC	Ministry of Agriculture, Food Security, and Cooperatives
MAM	March-April-May Season
MDAs	Ministries, Departments, and Agencies
MLFD	Ministry of Livestock and Fisheries Development
MLHHSD	Ministry of Lands, Housing, and Human Settlements Development
MoW	Ministry of Water
MoHSW	Ministry of Health and Social Welfare
NEMC	National Environment Management Council
NGO	Non-governmental Organization
OND	October-November-December Season
PICSA	Participatory Integrated Climate Services for Agriculture
PMO – DMD	Prime Minister's Office – Disaster Management Department
PMO-RALG	Prime Minister's Office – Regional and Local Governments
RBA	River Basin Authority
TANDREC	Tanzania Disaster Management Committee
TMA	Tanzania Meteorological Agency
UDSM	University of Dar es Salaam
UNFCCC	United Nations Framework Convention on Climate Change
VEO	Village Executive Officer
VPO – DoE	Vice President's Office – Division of Environment
WFP	World Food Program

1 Introduction and Background

1.1 Overview of Rationale and Approach

This report constitutes the CICERO and UDSM contribution to the baseline activities for Tanzania under the GFCS-APA as outlined in the programme M&E framework, where CICERO and UDSM are responsible for measuring progress towards indicator 1.4.2: User Satisfaction with Climate Services[1] "users at the national, district and local levels from the different target sectors express satisfaction with the relevance of the climate services provided to them". Following the M&E terminology utilized by Chr. Michelsen Institute (CMI) and Lilongwe University of Agriculture and Natural Resources (LUANAR) within the GFCS-APA Baseline Report in Malawi, it is necessary to recognize that evaluation can focus on outcomes (i.e. medium-term effects of interventions) and impacts (i.e. long-term, durable effects of interventions). Given the short duration of the project, the programme partners have established an M&E approach that focuses on evaluating outcomes, rather than long-term impacts. This has resulted in the development of a shared programme-wide approach to M&E with 16 indicators to monitor progress toward these outcomes, with evaluation of user

[1] Climate information encompasses statistical analysis of historical trends, as well as forecasts and predictions about future weather and climate. Various definitions of climate services exist. The WMO (2015) defines climate services as the provision of climate information in such a way as to assist with decision-making (WMO website, accessed 8 Nov 2015). The European Commission defines climate services broadly as "transforming climate-related data and other information into customised products such as projections, trends, economic analysis, advice on best practices, development and evaluation of solutions, and any other climate-related service liable to benefit that may be of use for the society." (European Commission 2015) According to Hewitt et al. (2012), a successful climate service must be: "based on scientifically credible information and expertise, have appropriate engagement from users and providers, have an effective access mechanism and meet the users' needs." Given the newness of the concept of climate services, as well as the fact that this programme is intended to build the basis for effective development of climate services, much of this baseline assessment will relate to climate information, rather than climate services as such.

satisfaction with climate services at national, district, and local levels contributing to this broader effort.

Since terms such as "user satisfaction" are subjective and multidimensional, a qualitative research approach designed to gather data towards a number of sub-indicators was deemed appropriate. Data collection and analysis thus focused on documenting respondents': 1) Awareness of existing climate information and services; 2) Access to climate information and services; 3) Perceptions of the usability of climate information and services. In addition, a review of the existing institutional architecture for production, delivery, and coordination of climate information and services in Tanzania from the national level down to the local levels is provided to contextualize the assessment of user satisfaction. To identify the aspects of perceptions of the 'usability' of information, we have utilized the framework of the knowledge system criteria of credibility, salience, and legitimacy by Cash et al. (2003) (**Figure 1)**. Credibility refers to the scientific adequacy, trustworthiness, and reliability of knowledge. Salience refers to the relevance of knowledge to practical decision-making. Legitimacy refers to the openness and fairness of knowledge, meaning that it incorporates diverse perspectives and is equally beneficial to all users. These three criteria have been widely used within academic literature focused on practical applications to disaggregate the factors that shape knowledge use within complex environmental and sustainable development issues that span multiple sectors / disciplines and necessitate the integration of multiple sources of knowledge at a variety of scales (e.g., Hegger and Diperink 2014, Schuttenberg and Guth 2015), including within efforts to develop usable climate services (e.g., Cash 2006, Tang and Dessai 2011).

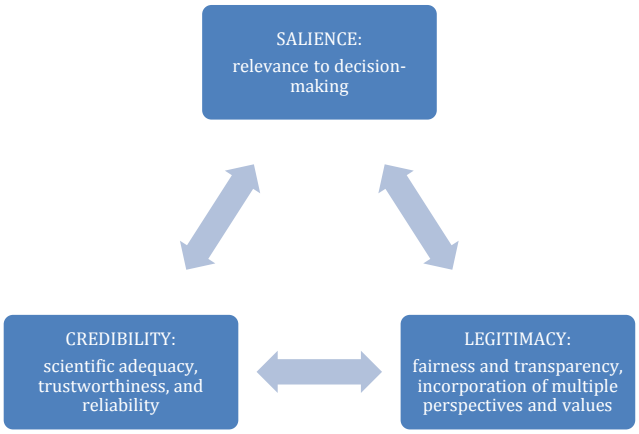

Figure 1: The knowledge system criteria and definitions[2].

[2] The multi-directional arrows between the criteria illustrate that there exist mutual relations, as well as tensions and tradeoffs, between the various criteria.

It has been widely acknowledged that for knowledge to be usable within decision-making, it must meet all three criteria, though there are overlaps and trade-offs among these. For example, increased salience for some stakeholders may serve to decrease the credibility of knowledge for others. It will be essential for the GFCS-APA to further understand the dynamics between the credibility, salience, and legitimacy of climate services and how these shape user satisfaction at multiple scales. Thus, we find the knowledge system criteria to be a useful framework for helping to better understand current satisfaction with climate services, as well as identifying pathways for improving user satisfaction in the future.

1.2 Methods

We (CICERO and local partner UDSM) have used a qualitative approach, which lends itself to deep understanding of the complexities of climate service production and use and user satisfaction with climate services. The report is based on three data collection activities at the national and subnational levels. This includes: 1) surveys, semi-structured key informant interviews, and focus groups at the local level, 2) semi-structured key informant interviews at the district level, and 3) semi-structured key informant interviews and document analysis conducted at the national level.

Local level data were collected by nine Master's students under the Centre for Climate Change Studies (CCCS) at the University of Dar es Salaam (UDSM) between May – August 2014. Local level insights were also drawn from doctoral research conducted by Daly in Longido District between May 2013 – April 2015 examining the production, access, and use of climate knowledge. The UDSM Master's studies focused on a range of topics related to the availability, accessibility, use and communication of climate services, including gender, livelihood, and sector specific considerations (See Appendix 1 for a description of Master thesis topics and research locations). While the themes and locations of the local research varied, a set of common questions regarding climate information and services access was utilized to enable qualitative comparison across studies and sites (see Appendix 2). This enabled identification of common themes and issues across sites that are broadly illustrative of opportunities and challenges to improving user satisfaction with climate services in many locations in Tanzania; however, because of varying sampling methodologies used across the various student studies, results are not always directly comparable or statistically representative within or across District.

District level for Longido and Kiteto were collected between May – August 2014 and March – April 2015. A total of 33 semi-structured interviews were conducted with a range of key informants at the district levels representing various roles and sectors. 19 of these interviews focused on understanding existing institutional structures and climate information flows to and from the district level. The remaining 14 interviews were conducted as follow up to better understand more specific aspects of opportunities and challenges to climate information use at the district level using a protocol (see **Appendix 3**). The second round of district level interviews were transcribed and coded to systematically identify emergent themes related to the awareness, availability, access, credibility, salience, and legitimacy of scientific climate information/services and IK about climate variability and change (**Figure 2**). In addition, the authors' participation in various stakeholder meetings and programme activities has yielded further observations, interactions, conversations, and insights that have helped to contextualize and inform the findings for this baseline study.

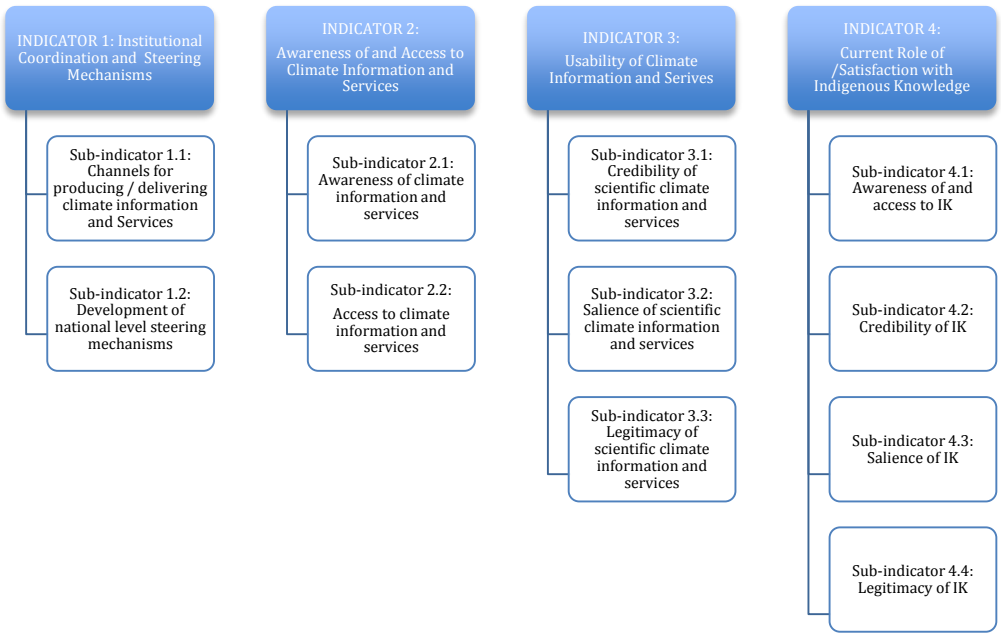

Figure 2: Indicators and Sub Indicators for Assessing User Satisfaction with Climate Services

National level key informant interviews were conducted with government ministries, departments, and agencies (MDAs) between August – December 2014 (see Appendix 4 for list of MDAs included). Interviews focused on gathering data about the production, application, delivery/transmission/flow, and satisfaction with climate services and the findings are reported on in more detail in Yanda et al. 2015. Policy document analysis was conducted between January – May 2015 and findings are reported in detail in Daly et al. 2015. The latter analysed key national policy documents from cross-sectoral themes (development, environmental management, disaster risk reduction, food security) and sectors (agriculture, health) using document analysis (see Creswell, 1998) using a key word search and detailed review, in order to: 1) assess whether and how climate change dimensions are addressed; 2) identify whether and how the policies respond to the prioritized adaptation themes that are outlined in the National Climate Change Strategy; 3) highlight potential policy gaps and conflicts and; 4) identify entry points for enhancing climate services provision across sectors and policies.

Presentation of data and results addresses all indicators at the national, district, and local levels. However, we have chosen to present the district level data in greater detail in this report, particularly with regard to discussion of the knowledge system criteria, for two reasons. Firstly, up to this point, there has been little coverage of the district level within other programme reporting. Secondly, and most importantly, the district level is particularly important for climate services development, because under Tanzania's decentralized governmental structure, districts are where much of the implementation of plans and policies takes place and where government officials interface most directly with local populations intended to benefit from climate services. While the bulk of the GFCS-APA partner activities have focused on understanding the dimensions of climate services availability, access, and use at local scales (e.g., Climate

Information Needs Assessment, ICT Scoping Study), there has been less documentation of specifically how and why people might choose to use the information they receive (or not). Applying the knowledge system criteria of credibility, salience, and legitimacy helps to fill this gap in knowledge.

1.3 Background on Districts

The majority of residents in both Kiteto and Longido Districts identified livestock keeping and/or farming as their primary livelihood; however, there are significant differences in terms of the mix of livelihood strategies within and between the districts, with implications for vulnerabilities, including the ways in which climate risks are understood and experienced. Kiteto is located in central Tanzania, in the very southern portion of Manyara Region. The district is generally semi-arid to arid, but there is significant climate variability within the district itself. The northern part of the district is part of the arid Maasai Steppe, receiving an average of 350-400 mm of rain per year, with significant rainfall observed from January through March, while the central and southern portions of the district receive an average of 500-650 mm of rain per year with significant rainfall observed from November through May (Malisa 2014). The predominant livelihoods for residents in Kiteto District are: pastoralism (60%), agriculture (22.8%), and agro-pastoralism (17.2%).[3] Longido District is located in far northern Tanzania bordering Kenya. The district is also semi-arid to arid, with an average of 300-600 mm of rainfall per year (Homewood 2009); however, a much larger portion of the district is arid when compared with Kiteto. District officials reported that 95% of people living in Longido identify as pastoralists, 4% as farmers, and 1% are engaged in small business or petty trade. However, it is important to recognize that even those who identify as 'pure' pastoralists often engage in some agricultural activities, though the extent to which they rely on agriculture for their livelihoods varies greatly.[4]

3 KINNAPA(2011), A profile of KINNAPA development programme, Kiteto District, Manyara Region, Tanzania

4 Chevenix Trench et al. (2009) found that about 67% of households in Longido were cultivating, generally alongside livestock keeping, in 2002/03, but that this was highly variable within the district. Primary constraints that shaped variability of engagement in agricultural activities across the district included low returns related to poor agro-climatic potential, high levels of wildlife damage (i.e. elephants), and lack of adequate labor pools (in that order).

2 INDICATOR 1: Institutional Coordination and Steering Mechanisms

Indicator 1: Awareness of and Access to Climate information and Services		
Sub-indicator	**Institutional scale**	
1.1 Channels for Producing and Delivering Climate Information and Services	National	Channels for receiving climate information through formal government pathways were primarily through written letters and email. Channels for receiving climate information through informal pathways were through television and websites.
	District	Primary channels for receiving climate information through formal government pathways were written letters and email. Television was the primary channel for receiving climate information informally.
	Local	Primary channels for receiving climate information were radio, television, extension officers, and village meetings, with radio being the most prevalent.
1.2 Development of National Level Steering and Coordination Mechanisms	National	A steering mechanism was adopted in August 2014, but has not subsequently met to discuss issues related to climate services development; the 'Road Map' for the National Framework for Climate Services is under development.

2.1 SUB-INDICATOR 1.1: Channels for Producing and Delivering Climate Information and Services

At the national level, production of climate and meteorological information in Tanzania is mainly done by TMA; however, there are other national and sub-national institutions that are also involved in the production of climate and meteorological information, including: Ministry of Agriculture, Food Security and Cooperatives (MAFC), Ministry of Lands, Housing and Human Settlements Development (MLHHSD), Ministry of Livestock and Fisheries Development (MLFD), Ministry of Water (MoW), and River Basin Authorities (RBAs). The Vice President's Office – Division of Environment (VPO-DoE), the Prime Minister's Office – Disaster Management Department (PMO-DMD), and the National Environment Management Council (NEMC) are also involved in climate services delivery, through national climate change assessment reports, warnings on long- and short-term climate and extreme events, climate-related brochures, and various advisories to the public.

Dissemination of climate information produced by TMA occurs via two main streams. The first stream involves communicating information through the mass media (mainly radios, television, and newspapers), TMA websites, and mobile phones (for time-sensitive information of up to five days lead time). A variety of climate information products are available on the TMA website, including weather alerts and warnings (e.g., for extreme weather), weather forecasts and outlooks (daily, 10-day, monthly, seasonal), agro-meteorological bulletins, and other forecast products (e.g., model outputs, satellite imagery, severe weather products). Delivery of climate information by mobile phone is provided specifically for time-sensitive information with a lead-time of up to five days. The second stream of distribution is to government institutions through posted letters (weather briefs), e-mail, fax, telephone, and face-to-face delivery. Information sharing between national MDAs is channelled first through the PMO or is shared directly during formal board, committee, or task force meetings. Many respondents reported that there is not an established or continuous means of facilitating information flows between national MDAs, which may result in limited access to information horizontally across national level institutions.

Through the formal government distribution system, climate information produced by TMA is first sent to the PMO and national MDAs and then delivered to district offices. The Prime Minister's Office – Regional Administration and Local Government (PMO-RALG) is responsible for transmitting information to the Regional and District levels. Letters are the primary means of formally delivering climate information (primarily the seasonal climate forecast or extreme weather or disaster warnings) through government channels at the district level. Delivery of information by phone or email occurs, but less frequently, and generally only when there is emergency or highly time-sensitive information. Information from TMA is delivered to the District Executive Director (DED) and District Commissioner (DC) first, who will then distribute the information to the relevant staff members in the various district department offices and the village level.

Among district-level respondents, TMA was cited as the primary organization providing climate information in Tanzania, particularly daily weather forecasts and seasonal climate information, in both districts. Other national and sub-national institutions were reported to provide information, particularly historical rainfall data. For example, the MoW, through the Pangani River Basin Authority (RBA), collects rainfall measurements and other data that are pertinent to Kiteto District. Longido District Council also has three rain gauges that are operated by its Department of Agriculture and Livestock Development. Seasonal climate predictions are available to district level actors through letters, email, and the TMA website. However, the availability of specific advisory services was reported to be very limited. A multi-year climate change adaptation project implemented by the International Institute for Environment and Development (IIED)[5] has helped Longido District to establish a Climate Change Focal Point and to develop direct lines of communication with TMA and this was seen as helping to make seasonal climate information more readily available. Nonetheless, the majority of respondents in Kiteto and Longido did not feel that there is an adequate system in place to distribute information horizontally at the district level (i.e., between various district departments).

Climate information is made available at the local level through both formal and informal institutions, as well as through the mass media. Distribution of information through government systems from the district level to the ward, village, and sub-village level generally occurs through written letters, which are delivered to the Village Executive Officer (VEO) and local agricultural and livestock extensions officers. There are several existing institutional mechanisms that can serve as delivery channels for weather and climate information at village scales, including: ward development committee meetings, village leadership meetings, and village assemblies. Customary leadership structures are also employed as a means to deliver weather and climate information, since these tend to be highly trusted within communities, but may meet less frequently than formal government leadership. Mass media was another channel through which weather and climate information is made available.

[5] Funded by UK AID-DFID, IIED has been supporting the district governments of Longido, Monduli and Ngorongoro Districts through the project "Promoting Adaptation and Climate Resilient Growth through Devolved District Climate Finance" to mainstream climate change adaptation into their planning systems and build readiness to access climate finance in support of community driven adaptation. The approach has been to strengthen the existing institutional environment to enable climate resilient development planning, including building stronger relationships between district officials and TMA staff.

2.2 SUB-INDICATOR 1.2: Development of National Level Steering and Coordination Mechanisms

The Tanzania Disaster Relief Executive Committee (TANDREC) met in August 2014 to discuss the development of climate services at the national level. Two key recommendations were adopted during this meeting: 1) that the existing DRR platform should serve as the national forum for sustained dialogue between national stakeholders, including producers and users of climate services, and 2) that TANDREC would expand its mandate to serve as the Steering Committee for the climate services development in Tanzania. Since adopting these recommendations, there is no evidence that the committee has met again (as of December 2015) to follow up on issues specific to climate services development and coordination.[6] TMA is currently leading the development of a draft 'Road Map' for the development of a National Climate Services Framework, with inputs from the Project Delivery Team (PDT). It is expected that this will be presented to TANDREC sometime during the first half of 2016.

[6] Major events, such as the national election (which took place at the end of October 2015) and a nation-wide cholera outbreak (ongoing since August 2015), have been cited as challenges to convening TANDREC to further address climate services development.

3 INDICATOR 2: Awareness of and Access to Climate Information and Services

Indicator 2: Awareness of and Access to Climate information and Services		
Sub-indicator	**Institutional scale**	
2.1 Awareness	National	• All respondents are aware of climate information and some expressed awareness of the concept of climate services.
	District	• All respondents are aware of climate information, but few expressed awareness of the concept of climate services.
	Local	• Most respondents are aware of climate information, but none expressed awareness of the concept of climate services.
2.2 Access	National	• Climate information was available to all respondents. All respondents reported TMA as the primary source of climate information. Other news outlets, international climate prediction centres, and academic institutions were also listed as sources of climate information.
	District	• Climate information was available to all respondents. • All respondents were able to access climate information, but not always consistently. • All respondents reported TMA as the primary source of climate information. Other governmental institutions (e.g. MoW, NEMC) were also cited as sources of climate information, along with NGOs and academic institutions.
	Local	• Availability of climate information was highly variable both within and across sites. • Access to climate information was highly variable both within and across sites. Access to climate information was generally less than half of respondents across sites, with women reporting lower levels of access than men. • Respondents reported TMA as the primary source of climate information, although NGOs were also important sources of information about long-term climate change.

Table 2: Summarized Findings for Indicator 2

3.1 SUB-INDICATOR 2.1: Awareness of Climate Information and Services

At the national level, TMA was recognized as the primary producer of climate information in Tanzania. All respondents at the national level reported being aware of climate information produced by TMA. Few respondents at the national level were familiar with the concept of climate services. Furthermore, the concept of climate services is not currently reflected in any national policy or planning documents in the sectors of food security and agriculture, disaster management and risk reduction, and health (Daly et al. 2015). Lack of awareness and mainstreaming of the climate services is attributed to the fact that it is a relatively new concept.

All district-level respondents in Kiteto and Longido indicated that they are aware of scientific climate information produced by TMA, but only a few were aware of the concept of climate services. In both Kiteto and Longido Districts, respondents were aware of the following types of scientific climate information: statistical climate data and trends, short-term weather forecasts, seasonal climate forecasts, historical trends, and (generalized) projections about long-term climate change. None of the respondents indicated awareness of tailored climate information products or advisories, with the exception of three respondents who knew about agro-meteorological bulletins produced by TMA. Several of the respondents noted the importance of external trainings facilitated by NGOs (sometimes in partnership with TMA) in enhancing awareness of climate information, as well as facilitating trainings to enhance awareness of climate change.

At the local level, Master's student research indicates that, in general, the majority of local populations are aware of the climate information produced by TMA, but that this is highly variable from site to site and among various populations. In one study conducted in Kiteto, 88% of respondents working in the beekeeping sector indicated that they are aware of weather forecasts being produced by TMA. (Malisa 2014)[7] However, a second study conducted in Kiteto with small- and large-scale farmers indicated that only 36% respondents were aware of climate information provided by TMA. (Shamim 2015)[8] While these studies may not be representative

[7] Figures represent findings based on surveys to beekeepers in Kiteto District, coming from three villages purposively selected for exhibiting high levels of honey production. In the three villages, n=20 beekeepers were purposively selected for a total sample size was n=60 respondents. Findings are, therefore, not statistically representative of the general population at the district scale.

[8] Figures represent findings based on surveys administered to both large- and small-scale farmers in Kiteto District. Large-scale farmers were purposively selected at the district level. Small-scale farmers were randomly selected from several purposively selected villages. A total sample size of n=50 respondents were included in the survey. Findings are, therefore, not statistically representative of the general population at the district scale.

at the district scale, they do indicate that there is a need for further study to determine why there is such variation in levels of awareness among villages both *between* and *within* various districts, as well as across different user groups. Local respondents did not express awareness of the concept of climate services. However, it is worthwhile to note that the ways in which the term "climate services" was translated from English to Swahili or vernacular languages and/or the ways in which particular questions were phrased may have contributed to the findings that there is lack of awareness of the concept of climate services.

	Awareness of Climate Information at Local Scales			
Location (District)	**% Aware of Info**	**Sample (n=)**	**Population**	**Study Author**
Kiteto	88%	60	Beekeepers	Malisa
Kiteto	93%	100	Farmers	Ngowi
Kiteto	36%	40	Farmers	Shamim
Kilosa	35%	100	Farmers	Maro
Mbarali	90%	84	General	Ndunguru

Figure 3: Awareness of Climate Information at Local

3.2 SUB-INDICATOR 2.2: Access to Climate Information and Services

The research indicates that there are often breakdowns in this chain of delivery of climate information and services, both vertically and horizontally, which can result in delays or complete failures of the information reaching the intended recipients at the district and local levels. There is currently no protocol or any other formal system or mandates for distributing climate information to all district staff, which constrains access to information. Lack of reliable internet within the district headquarters was also considered a significant barrier to accessing weather and climate information. In Kiteto District, some officials reported sometimes needing to travel to Dodoma in order to access reliable internet. Similar issues are experienced in Longido District. Most district level respondents in Kiteto and Longido felt that while climate information was often generally available, it was not always accessible in a consistent, timely, or uniform way. The availability of seasonal predictions is much lower than that of daily weather forecasts among district level respondents. Seasonal forecasts are perceived to be generally available at the beginning of the season, but most respondents noted that after the initial delivery of the forecasts, there is little availability of updates to the forecast during the season.

While many respondents at the local level indicated that they were aware of the information that is available from TMA, others were not. This was seen as a fundamental barrier to accessing climate information. Additionally, while a variety of climate information products are technically available at local levels, the ability to access these on a consistent basis was variable. Daily weather forecasts, communicated through mass media (radio and to a lesser extent and at the district level, television) are perceived to be the most widely available and accessible at both the district and local levels (Mwajombe 2014, Ngowi 2014, Zacharia 2014). Seasonal climate information was the second most widely accessed type of climate information at the local level (Maro 2014, Mwajombe, 2014). In several sites, access to weekly and monthly climate information and advisories was significantly lower than other types of climate information

(Malisa 2014, Ngowi 2014). Less than half of respondents in Kilosa and Mbarali Districts reported receiving early warnings about extreme events (Maro 2014, Mwajombe 2014). These findings are partially supported by findings from the CCAFS baseline study, which, on the one hand, found that forecasts of an extreme event and information about the onset of the rainy season were most frequently accessed by households (Coulibaly et al., pg 29, Figure 15), and on the other, suggests that daily weather forecasts are the most frequently accessed (ibid., pg 30; Figure 17). Discrepancies between the two sets of baseline findings may also illustrate that there is variation within and across districts, as the Master's student findings draw on research conducted both within and beyond the target districts, and with specific types of users in some cases, including water managers in Upper Ruaha Catchment (Mwajombe, 2014), agriculturalists in Kiteto District (Ngowi, 2014), and agriculturalists in Magu District (Zacharia, 2014).

Daily weather forecasts from TMA provide information about rainfall totals and distribution (for the previous 24 hours), predicted rainfall (by zones) for the next 24 hours, wind conditions in various locations, the time of sunrise and sunset, and temperatures across the African continent. However, despite the availability of daily forecasts, respondents at both the district and local levels noted that regular access to the information was constrained by the infrequency and timing of the forecast delivery on nightly news and/or radio programs. On television, the weather forecasts are only shown once during the nightly news program, generally after 8:00 PM, which was considered inconvenient (i.e. too late) or impossible (i.e. they cannot access a television at that time of day) to watch by some respondents. This was exacerbated at local levels by the fact that there is variation among households with regard to ownership of televisions, radios, and mobile phones. There are additional dynamics at the household level that further differentiate and constrain access to climate services, including control of and access to household financial resources and other assets (see Section 3.3: Legitimacy of Climate Information and Services for detailed discussion).

Long-term climate projections and other information about climate change were seen as the least accessible at the district level. The VPO-DoE and NEMC were cited as the primary sources of information about long-term changes in climate through governmental channels, though this was perceived as difficult to access. Trainings organized and facilitated by NGOs were cited most frequently as the source for receiving information about long-term climate change at the district level. For example, in Kiteto District, the NGO NAADUTARO facilitated climate change trainings, together with representatives from NEMC, for various district stakeholders. In Longido, respondents reported receiving information about climate change through trainings by TMA as part of the climate change adaptation project run by IIED. Outside of these specialized training opportunities, it was reported to require significant effort to locate and obtain information about climate change. For this reason, many district level respondents did not feel that they are able to effectively to access this information, even though they were aware of its availability.

4 INDICATOR 3: Satisfaction with Climate Information and Services

4.1 SUB-INDICATOR 3.1: Credibility of Scientific Climate Information and Services

Indicator 3: Satisfaction with Climate Information and Services		
Sub-indicator 3.1 Credibility		
	National	• TMA's position as the only national agency authorized to provide climate information enhances its credibility. • General trust in scientific methods by most national respondents enhances credibility of climate information and services. • Limited observation networks and technical capacities due to financial constraints were seen as a challenge to credibility. • Lack of legal or institutional mandates to facilitate sustained interaction to enhance trust and relationships between producers / users were seen as a challenge to credibility.
	District	• Credibility is the most fundamental determinant of perceptions of usability; however, perceptions of credibility are dynamic and non-linear. • Mixed levels of trust in scientific methods imply that the use of 'science and technology' increases credibility for some users, but may decrease it for others. • Unrealistic expectations of the certainty attached to scientific information pose challenges to perceptions of credibility of climate information and services. • The complexity of translation (e.g., from English to other languages, from technical terminologies to more simplified language) can pose challenges to credibility. • Mismatches between the spatial scales at which forecasts are produced and the scales at which users are able to validate them and lack of capacity to validate forecasts at more localized scales pose challenges to credibility. • The indicators used within scientific predictions were not well understood and were not seen as robust, posing challenges to credibility. • Respondents cited the need for empirical evidence to 'demonstrate' the value / benefit of climate information *in practice* in order to build long-term perceptions of credibility.
	Local	• In most cases, climate information has not reached the threshold where it is perceived to be at least as credible as other information /

		knowledge already used at local levels; current thresholds for credibility are generally in relation to the perceived credibility of IK. • The need for empirical evidence of the value / benefit of climate information *in practice* was the most important challenge to credibility. • Low levels of trust in scientific methods are a current challenge to credibility of climate information and services. • Lack of integration of climate information delivery within customary decision-making and localized information vetting processes is a challenge to credibility. • Perceptions about the certainty of information 'coming from the government' may result in treatment of climate information as deterministic, rather than probabilistic, which is a challenge to credibility. • Unrealistic expectations of the certainty attached to scientific information pose challenges to perceptions of credibility of climate information and services.

Perceptions of credibility are dynamic and non-linear

There are complex dynamics at play in shaping levels of trust that are attributed to the forecast, which are not linear and unfold over a long time horizons. Further, perceptions of the credibility of a forecast take time to build and can be easily damaged. Respondents were quick to cite examples of when the scientific forecasts had been 'wrong', indicating that inaccurate forecasts can have significant and long-lasting impacts on credibility. For example, many respondents reported that in 2014 TMA had provided information that the short rains would start in September in their zone and also that higher than average rainfall was expected. Longido Respondent # 2 explained: "For example, last year, in September, they sent out information saying that there will be a lot of rain during the Vuli season [OND season]…but it happened differently than that! We received a written letter with this information, but then it turned out to be the opposite." There does appear to be some tolerance for 'incorrect' forecasts, as long as they are balanced out by 'correct' forecasts over time. Respondents further noted that the credibility of the forecasts is constantly evaluated and reassessed based on the empirical evidence (i.e., local *ex post* evaluation).

General trust in scientific climate information varies across institutional scales

At the national level, TMA is perceived to be the authoritative producer of climate information and services. This is a major source of the perceived credibility of climate information produced by TMA, since it is the designated by the government as the only agency authorized to provide climate information. A primary challenge to the credibility of climate information at the national level is technical limitations, which are due to the inadequate number of operational weather stations and a lack of enhanced surface and upper air observations to inform comprehensive meteorological observations. (Yanda et al. 2015) These concerns indicate that scientific approaches to producing climate information are deemed credible generally, but that limitations to TMA's current capacities to undertake these technical activities at sufficient levels remain a challenge to perceptions of credibility in practice. Furthermore, communication between TMA and relevant institutions and decision-making bodies at the national, district, and local levels is constrained by bureaucratic processes and the lack of mandate and resources to create and sustain the necessary institutional mechanisms or platforms to facilitate interaction between

producers and users of climate services. This limits iterative interactions and further constrains the development of long-term relationships needed to enhance the credibility of information.[9] Furthermore, the division of responsibilities between TMA, the VPO-DoE, and PMO-DMD limit regular interaction between these three key institutions on issues spanning short- and long-term climate concerns (Yanda et al. 2015).

At the district level, credibility of climate information was deemed the highest priority among nearly all district level respondents. One respondent in Kiteto reflected: "For weather information, the most important thing is that anything that is arriving to people should be correct." In contrast to perceptions at the national level, current perceptions of the credibility of scientific climate information available at the district level in Tanzania are highly variable. Information coming from TMA was considered to be the only authoritative climate information available and was perceived as being credible in part due to the use of modern technologies and because it was perceived to be strongly backed by evidence. Many respondents in Kiteto and Longido Districts indicated that when given a choice, they would tend to trust the scientific information more than other sources of information, but not in all cases; however, stating a relative preference for scientific information did not guarantee that it was considered fully trustworthy. Even the most positive views about the credibility of scientific climate information were accompanied by significant mistrust. Further, while the use of 'science and technology' can be a source of credibility for some, it can also be a source of scepticism and mistrust for others. The majority of the respondents noted that there is currently little trust in the accuracy or precision of the forecasts that they currently receive.

According to data collected by Master's students at UDSM, levels of trust in scientific information were generally low at the local level, although there were differences both within and across districts. In all locations that assessed current levels of climate information access and use, the percentage of the population that actually uses scientific climate information for their decisions is much lower than the percentage of the population that accesses this information. This is corroborated by findings from the CCAFS baseline survey (Coulibaly et al., 2015, pg. 26, Figure 13). For example, among beekeepers in Kiteto District, 93% of respondents access scientific climate information, yet only 22% felt that it was reliable. (Malisa 2014) In Mvomero District, only 6% of respondents found scientific climate information to be reliable and 11% found it to be somewhat reliable.[10] (Kiama 2014) Similar to respondents at the district

[9] The lack of sustainable and institutionalized mechanisms for facilitating user-producer interfaces poses challenges to the salience and legitimacy of climate information as well.

[10] Figures represent findings based on surveys of agro-pastoralists in Mvomero District, coming from two purposively selected villages. In the two villages, n=50 agro-pastoralists were purposively selected for respondents over the age of 18, for a total sample size was n=100 respondents. Findings are, therefore, not statistically representative of the general population at the district scale.

level, the lack of trust in scientific information was due, in large part, to the fact that outcomes were not perceived to match with what had been predicted (Lori 2014).

Many respondents did not have a good understanding of how scientific indicators used in forecasts are measured and observed, which contributed to their lack of trust in scientific climate information. Another perceived barrier to credibility is that the parameters or indices (e.g., ocean temperatures, wind speeds and directions) through which the forecasts are generated are perceived to: 1) fluctuate more than the indices used within indigenous forecasting methods, 2) be difficult to monitor, and 3) not be robust. District level officials felt that the indicators used within scientific seasonal forecasts shift at sub-seasonal scales, rendering the forecast inaccurate.

The lack of spatial specificity was noted as the primary barrier to the credibility of climate information at all time scales. Responses from FGD in Kimokouwa and Ilera villages (in Longido and Kiteto Districts respectively) suggest that the daily, monthly, and seasonal weather forecasts that reach farmers and pastoralists through radio and television are too general. Stakeholders further claimed that this information is not tailored to suit the needs of diverse end-users in particular sectors or a given area (Maro 2014). Respondents expressed a desire for higher resolution forecasts that could provide information at more localized scales.

Probability, expectations of certainty, and perceptions of credibility

Respondents indicated that it is not necessary for climate information to be accurate 100% of the time to gain credibility. Most respondents clearly stated that they recognized that the weather and climate forecasts coming from TMA were probabilistic in nature. Kiteto Respondent #2 reflected that "in a certain month they will say there will be a drought and then it will happen. At other times they have said there will heavy rains and then it will cause floods. And it happens. But sometimes it's right and sometimes it's wrong… because it is just a forecast." Several respondents felt that TMA will need to work extensively with communities to demonstrate that scientific predictions can provide the same benefits as IK. This is to say that without designated strategies that can help to build the long-term credibility of scientific climate information, people will continue to rely on IK. Kiteto Respondent #5 concludes:

"[Indigenous knowledge] is the alternative to TMA and the like. It is indigenous knowledge that is keeping people around. And they trust it. Unless you convince people that what you are predicting is better, and they learn through experience that your predictions do work, they will revert to their knowledge."

It was reported by some respondents that there is a tendency for people take information coming from the government quite literally or treat it with more certainty. As such, heightened expectations are created because the information is coming from the government that do not correspond with the inherent uncertainty that is attached to weather and climate forecasts. Similarly, it was reported that there are sometimes expectations at the village level that scientific information should provide more exact or more certain information, since it is based on modern technologies. As at the district level, challenges to credibility also arise when seeking out translations into vernacular languages (e.g. Maasai) for local use, as there is not always one agreed translation for the word 'forecast'. This has implications for expectations of the certainty of climate information and resulting perceptions of credibility. However, even when respondents do recognize that the information coming from the government is not guaranteed,

it is still necessary to reach a threshold where the climate information is perceived to be right most of the time, or at least where it is perceived to be accurate more often than the information and knowledge that is already available to them (e.g., indigenous knowledge). As at that district level, this is likely to be a process that will occur over longer time horizons.

Issues of validation challenge credibility

Mismatches between the spatial scales at which forecasts are produced and the scales at which users are able to validate them poses challenges to the credibility of climate information. Respondents recognize that part of the reason that they perceive TMA's information to be 'wrong' is because it is not produced for local scales. For example, if a seasonal precipitation forecast applies to a zone[11], it may rain in one part of the zone, but it may not have rained in most of the other areas. Thus, the forecast was 'correct' from the perspective of the scientists, but seen as 'wrong' from the perspective of people on the ground. According to one respondent: "Really, the zonal information it reduces your certainty a bit. It reduces your certainty because you can say that in the zone it will rain, but maybe it will be just in Moshi. And if it rains there, it will be raining in the same zone. But here in our region, we lacked rainfall." (Respondent #1, Longido) This illustrates mismatches in processes of and standards for evaluating credibility among scientists and average citizens.

In both Longido and Kiteto, issues of low credibility also are related to the fact that it is difficult for average citizens to confirm or 'ground-truth' the scientific climate information they receive. There was a desire for tools (e.g., rain and temperature gauges) that could be used to evaluate forecasts and predictions. For example, Longido Respondent #2 stated:

"If it would be possible, it would be good to have these instruments to measure rainfall, to make these available for the farmers' and pastoralists' areas, so that they would know what above, below, and average is…how many millimetres. Because having these machines to measure rainfall in their areas is very important for farmers and livestock keepers. When the experts explain the forecasts to them, they should be able to compare the information coming from TMA with the measurements they have made. They will know how many millimetres of rain have fallen. They can compare the [forecast] information with their own measurements."

District level respondents noted that the communities they work with have also specifically stated the need for empirical evidence to enhance perceptions of credibility of scientific climate information. In general, it was noted that it is not a simple process to convince people to adopt new practices. Several respondents used the example of new crop varieties or livestock breeds as an example. "This process [of using modern cattle breeds] needs time and convincing. There

[11] TMA currently produces official seasonal climate forecasts nation-wide at the zonal scale. Zones are comprised of three administrative regions, with each region being made up of three districts. At the time of writing, Longido and Kiteto District fall within the same forecast zone, although experimental district-level forecasts were developed for the 2015 OND season in several select districts.

is a need to learn from others." Farmer field schools were perceived to be successful in Longido toward enhancing uptake of new crops, such as sorghum. Similarly, trusting new climate information was often seen as being based on the capacity to be able to personally observe its outcomes, rather than relying on the advice of 'experts'. There was a desire to be able to have demonstration projects that will not pose risks to individuals' livelihoods to prove that the use of climate information can be beneficial in practice.

Translation challenges and implications for credibility

There were several issues identified with relation to translations of weather and climate information and how this influences perceptions of the credibility. Some of these issues are related to historical and cultural usages of words as they are used in common conversation and the ways in which this can shape the meaning and interpretation of climate information, with important implications for credibility. Many respondents emphasized the problematic nature of the word for 'forecast' when it is translated from English into Swahili (Swahili: utabiri). According to several respondents, the word implies inherent uncertainty, but also has historical and cultural connotations of being associated with activities such as sooth-saying or fortune telling. Some respondents noted that this might contribute to lower levels of credibility, since this may be perceived to be "just telling stories". Another challenge is that TMA often uses the word "mwelekeo" (English: tendency or trend) rather than "utabiri" for the printed seasonal forecasts that are distributed. A tendency or trend may be perceived as something that has already happened / been observed, rather than something that is expected to happen in the future, and, therefore, may connote a greater level of certainty. This may have implications for differences in how users interpret the information or may lead to confusion about what level of certainty should be expected from the information, which can have important implications for credibility. At the very least, it may be important to further study how average citizens interpret these different terminologies to inform efforts to improve the packaging and communication of climate services in the future.

Delivery channels and credibility

The means of delivering climate information to the village level was seen as an important determinant of whether or not local residents would trust the information. For example, one respondent noted that his office frequently collaborates with traditional leaders in the area (Swahili: viongozi wa mila, Maasai: laigwenani) to help deliver important information, since this will be more trusted by the villagers. In Longido, most communities will discuss decisions about where, when, and how to move their livestock (e.g., to decide when to open and close reserve grazing areas in the village) during village assemblies and this is a prerequisite to responding to the information. Farmers are reported to discuss and debate about the scientific forecasts to determine whether they think that it is correct and whether and how they will use this. Both of these are localized processes of vetting information and building credibility for scientific climate information at local scales. Linking climate services delivery with more localized processes for evaluating and establishing the credibility of information will be important.

4.2 SUB-INDICATOR 3.2: Salience of Climate Information and Services

Indicator 3: Satisfaction with Climate Information and Services		
Sub-indicator 3.2: Salience		
	National	• Many current users of, and potential applications for climate information and services have been identified. • Delayed delivery of climate information is a major challenge to the salience of climate information. • Delivery and use of climate information along with other types of information enhances the salience of climate information.
	District	• Many current users of, and potential applications for climate information and services that have been identified • Delayed delivery, as well as the timing of the release of climate information in relation to key livelihood decisions, is a challenge to the salience. • Differences in the timing of decisions for different livelihoods result in varying perceptions of salience within and across districts. • Current lack of updates to the seasonal forecast and other sub-seasonal climate information products climate pose challenges to salience. • Mismatches in the user demand for and regular availability of existing climate information products is a challenge to salience. • Spatial and temporal distributions of precipitation throughout the season were highly relevant to decision-making; the current presentation of forecasts in terms of seasonal totals is a challenge to salience. • The production of forecasts according to administrative boundaries (e.g., regional or district border) may pose a challenge to salience, especially in districts with large climatological gradients. • The generalized nature of available climate information is difficult for district officials to interpret in order to tailor and provide specific advice for use at local levels, posing challenges to salience.
	Local	• The generalized nature of available climate information is difficult for village extension agents to interpret in order to tailor and provide specific advice for use at local levels, posing challenges to salience. • Lack of capacities to effectively tailor information for specific uses at local scales is a challenge to salience.

Current and potential users of and applications for climate information within decision-making

At the national level and in the public sector, the main users of climate information include: MAFC; MLFD; MoHSW; Ministry of Lands, Housing and Human Settlements Development; Ministry of Transport; MoW and RBAs; Ministry of Works; PMO-DMD; Surface and Marine

Transport Regulatory Authority; Tanzania Airports Authority; Tanzania Civil Aviation Authority; Tanzania Marine Parks Authority; Tanzania Ports Authority; Tanzania People's Defence Forces; Tanzania National Roads Development; and academic and research institutions. A summary of main current users of and potential applications for climate and meteorological information by select MDAs at the national level is presented below (**Table 1)**.

No.	Institution	Potential applications of climate/meteorological information for public-sector decision making at national level
1	Ministry of Agriculture, Food Security and Cooperatives (MAFC)	• Monitor and predict crop production trends at national, district, and local levels • Monitor and predict crop prices and markets • Monitor and predict crop pest and disease outbreak patterns • Provide advisory services to farmers, specifically with regard to: 1) crop types and varieties and 2) timing of fertilizer application • Implement short-term measures to deal with extreme weather conditions (drought or heavy precipitation events) e.g. soil erosion control • Plan national food stocks and addressing predicted deficits • Conduct risk and vulnerability mapping • Encourage adoption of irrigated farming
2	Ministry of Health and Social Welfare (MoHSW)	• Develop emergency response and preparedness plans • Implement malnutrition control during droughts • Conduct vulnerability and risk mapping for public health exposure to climate variability and change • Define and locate vulnerable populations during climate-related emergencies
3	Prime Minister's Office Disaster Risk Reduction and Management (PMO-DMD)	• Develop disaster risk management plans • Coordinate emergency preparedness and response activities • Organize and deliver emergency food, shelter, medical and other aid to the victims of extreme weather events
4	Ministry of Livestock and Fisheries Development (MLFD)	• Establish livestock early warnings on a seasonal basis • Predict livestock migration • Determine the likelihood of livestock disease outbreaks • Advise on timing of destocking • Predict areas expected to have adequate pasture via remote sensing

Table 1: Summary of the main public users of and potential applications for climate/meteorological information at the national level (adapted from Yanda et al. 2015)

Users of climate and meteorological information that is produced by TMA at the sub-national level include the district departments, including: Agriculture, Livestock, Beekeeping, Water, Planning and Finance, Natural Resources and Environment, Land, and Public Health. (Yanda et al. 2015) RBAs are also important users of climate information at sub-national levels, though

they do not align exactly with the district administrative boundaries, often spanning several districts. **Table 2**, below, describes potential applications of climate and meteorological information to short- and long-term sectoral and departmental planning and decision-making at the district level.

No.	Sector/ Department	Potential applications of climate/meteorological information for public-sector decision making at the District Level	
		For Short-term planning	**For Long-term planning**
1	Agriculture	i. Provide advisories to farmers in relation to agricultural activities such as: a) farm preparation b) type of crops / varieties c) timing of fertilizer and pesticide application d) timing of planting and harvesting e) food budgeting/storage	i. Conduct research to develop new crop and seed varieties and other adaptation strategies
2	Water	i. Identify sites and design parameters for dam construction ii. Inform water resource allocations and utilization iii. Recommend water harvesting and storage practices	i. Conduct geological surveys to identify suitable locations for drilling wells ii. Plan for long-term water resources management iii. Create scenarios to develop water diversion and storage systems
3	Land, Natural Resources and Environment	i. Advise on the timing for conservation activities (e.g. tree planting, erosion control)	i. Conduct land-use planning
4	Planning and Finance	i. Budget for climate-related disaster response ii. Make annual projections of agricultural production iii. Project district revenues and budgets based on expected performance of livestock and farming activities	i. Prepare long-term district strategic plans (five years or more)
5	Livestock	i. Predict pasture availability ii. Provides advisory services to pastoralists on: a) timing for destocking b) timing of animal migration c) responses to livestock epidemics and disease outbreaks d) allocating pasture land for grazing	i. Developing district council climate adaptation activities using long-term climate scenarios
6	Public Health	i. Plan for sanitation control ii. Prepare disaster medical assistance	i. Predict patterns of climate-sensitive diseases

	ii. Prepare response to epidemic outbreaks

Table 2. Summary of the main public users of and potential applications for climate information produced by TMA in Longido and Kiteto Districts (adapted from Yanda et al. 2015)

Longido Respondent #1 provided a concrete example of how the 2015 MAM season forecast was used:

"We gave people advice based on the information. For example, in West Kilimanjaro, we dared people to plant during the 'dusty' period, to plant in the dry soil, during the second week of March. People put their crops in in the dust. But then after some time, the crops grew. Normally, people wouldn't do this. They would stop planting. Usually, people would wait for the rain to start until they would plant. But this year, we advised them to plant, and they planted. And the crops grew well. If it is beans, we are sure that they will be able to harvest. They may even be able to harvest corn if they planted the type that matures in a short period."

Across all data collection sites at the local level, Master's student research studies found that climate information from TMA was used in several sectors, particularly for decisions related to agriculture, food security, livestock keeping and beekeeping. Farmers were reported to use forecast information for deciding when to begin farm preparation, plant crops (Yanda et al. 2015), plant fast maturing crops (Zachariah 2014), select seeds, change farming locations (i.e. from lowland to upland), and store food for use during drought (Mwajombe 2014). Malisa (2014) reported that beekeepers in Kiteto who received forecasts from TMA used it for changing beekeeping practices, such as shifting their hive location, hanging style, or type, or changing their harvesting schedule or swarming time. Other more general household actions that were identified in response to seasonal climate forecasts included early completion of annual maintenance of shelters (e.g. re-thatching roofs, fortifying walls), securing household assets, putting food in storage, and conserving/storing water. In addition, some livestock keepers noted the potential for using climate information to inform livestock migration or destocking during drought. Yet findings from the CCAFS baseline study suggest that pastoralists are not currently using climate information and/or weather forecasts to inform their livestock decision-making (Coulibaly et al., 2015, pg. 27, Figure 14,).

Timing of climate information delivery affects salience

The timing of forecasts relative to professional and livelihood decision-making is a key determinant of salience across institutional scales. Despite the many potential applications of climate information identified by national MDAs, national level respondents explained that there are a number of challenges associated with the existing information communication system due to bureaucratic processes, which can delay the receipt of information in a timely manner. Such delays decrease the salience of climate information for practical decision-making. The timing of the production and release of forecasts relative to the timing of livelihood decisions is a key element of salience of climate services. This is different than delays experienced solely due to institutional and bureaucratic procedures; rather, it is an issue related to the physical and scientific constraints that dictate when forecast production is likely to be most accurate. This can result in mismatches between when it is scientifically *possible* to produce

credible information, which results in follow on effects on the salience to users – illustrating trade-offs between credibility and salience.

For example, the development of the national seasonal forecast is dependent upon the timing of the regional seasonal forecast, which occurs during the Greater Horn of Africa Climate Outlook Forum. For example, August and September are generally key months for determining whether, when, and where to migrate with livestock for residents in Longido District. However, the seasonal forecast in Tanzania is generally not produced until late August or early September, meaning that many pastoralists may have already made some of their key decisions before it is possible to receive the seasonal forecast. Similarly, Longido Respondent #1 gave another example for agricultural decision-making based on the 2015 MAM forecast: "Really, it [the time between receiving the forecast and the time period of the forecast] was too short to prepare yourself. Many fields were already planted at that point and the crops had already dried up. And then at that point, it can be difficult to plant crops a second time." During the 2015 MAM season, the forecast was not produced until the very end of February, meaning that it was not delivered to the districts until early March, when the forecast period has already started. Indeed, many district level respondents noted that the seasonal forecasts often arrive too late to use the information to inform seasonal decision-making. Additionally, it was noted that in cases where the 10-day outlooks and agro-meteorological bulletins are received, this is often several days into the forecast period (even when received by email directly from TMA), limiting the possibility of using them for decision-making at sub-seasonal scales.

In order to make the forecasts more relevant for on-going decision-making, many respondents across institutional scales indicated the desire to receive multiple updates over the course of the season. Receiving updates every 2-3 weeks was desirable. The salience (as well as the credibility) of the forecast was perceived to decrease over the course of the season. Therefore, receiving updates to the seasonal forecast and other shorter-term forecasts (e.g. 10-day outlooks) was seen as a way of increasing the salience of the information. Kiteto Respondent #7 reflected:

"They shouldn't just send [the forecast] just once. People are worried that they will send only it once. If they produce another forecast, after they have sent the original, they should send this information too. It would also be good to receive updates from time to time so that we can pass this information on to the farmers. Even twice a month would be enough."

Spatial and temporal mismatches between supply of and demand for climate information

Seasonal climate forecasts were deemed much more useful at the local level than the daily weather forecasts, which were more relevant to the decisions that people make with regard to the management of livestock and farms. According to Kiteto Respondent #2:

"The longer term information is much more useful for decisions. The daily [forecast] only tells you that you should remember to carry an umbrella. It's not really helpful. I mean if you went all that way to provide the daily prediction, that's fine. But I think that most people would want to know what the season is going to look like. That is, they want to know about the longer period of time that will affect their livestock, that will affect their farm. That is more important than the daily one. If you can do both, fine."

One perceived advantage of scientific climate information in terms of salience is that it is able to provide more specific details about the amount of rainfall expected during the season; however, this was found to be more salient for agricultural decisions than it is for pastoral

decision-making (Daly 2014). However, respondents emphasized that the temporal distribution of rainfall throughout the season is just as (or more) important as seasonal or annual rainfall totals. For example, one respondent in Kiteto noted that despite expectations that the short rains would start in November or December, it rained only once in early December and then the rain stopped again. In some areas there was no rain at all for two full months, meaning that the crops that people planted did not mature. Longido Respondent #2 recounted that the during the 2015 MAM season, they had so far experienced several events with very heavy rainfall, which might result in 'average' rainfall during the season, but would not ensure that crops could mature. Similarly, these heavy rainfall events often cause destruction of infrastructure, and can result in human and livestock deaths.

Another challenge to the salience of information was that while forecasts are generally produced and delivered in terms of administrative boundaries (e.g., regional and district borders), it was perceived that weather and climate conditions do not correspond neatly within these boundaries. For example, several respondents in Kiteto faced challenges in determining which forecast was actually the most relevant to them, since they felt that they were 'between' forecasts. This is illustrated in the following response: "Sometimes you might hear a forecast about Manyara, but we will also hear a forecast for the Central Zone. But in context, we are also close to what happens in Dodoma, so we…we don't know where we are. Sometimes the prediction from Dodoma affects us. Sometimes it's from Tanga and the like. So it is difficult to say specifically which area they mention will be relevant to us more than the others." (Respondent #5, Kiteto)

Putting forecasts in context and the need for complementary information

Findings from interviews with stakeholders at all scales shows that there is the need for complementary data or information to enable the effective use of climate information for adaptive decision-making within particular contexts and across time scales. Indeed, the provision of this contextual (non-climatic) information is a key aspect of what differentiates a 'climate service' from pure 'climate information'. However, the research so far does not suggest that contextual information is being communicated in a systematic way to end-users. This leads to a situation where individual decision-makers access complementary information in an ad hoc way. Notably, many of the users at the national level stated that they often use the climate information that they receive from TMA in conjunction with other types of information, including: crop prices and markets data, livestock prices and market data, remote sensing data, vulnerability assessments and risk maps, and livestock migration routes and patterns. For example, a primary challenge to the use of climate information in the health sector was that available data about historical climate trends needed to be analysed alongside health-related data in order to make it salient for decision-making at the national (and district) levels. At district and local levels, many respondents noted that the prices of crops or livestock are key to informing decisions alongside seasonal climate information. Yet agro-met advisories do not currently include information on crop prices or marketing aspects that are key for farmers' decision-making. With regard to long-term adaptation, other information in addition to climate information will be essential to developing robust adaptation decision-making. For example, district level respondents working on water resource issues noted that there is a need for mapping of groundwater resources that would allow appropriate planning and development of water resources in conjunction with the historical climate data they currently access. Such complementary information will be important to avoid maladaptation in the long-term, such as

increasing reliance on non-renewable groundwater resources. Local respondents also echoed the desire expressed at the national and district levels to receive information that is complementary to climate information.

There are often challenges to interpreting predictions, which are perceived to be quite vague, and formulating these into specific advice for local level users (Mwajombe 2014, Ngowi 2014, Yanda et al. 2015). In both Kiteto and Longido, many district officers stated that the seasonal and monthly forecasts that are provided by TMA are presented in overly general language that agricultural extension officers cannot interpret for localized use; yet, these officers are expected to translate the forecast into applicable information for their farmers. This perspective was also expressed by NGOs working in Kiteto and Longido, which often interact with local communities. The daily and dekadal forecasts and monthly outlooks issued by TMA also use indeterminate phrases to describe the spatial distribution and location of expected rainfall, such as "here and there" or "in various places" (Swahili: hapa na pale, maeneo mbali mbali), which is difficult for district extension and other district officers to tailor for specific decision-making contexts at local levels. (Yanda et al. 2015) Yet, the national level seasonal forecast advises uses to consult with their local extension services officers for further advice. This creates a mismatch in terms of what users are advised to do in the national forecast products (e.g. seek advice at more localized scales) and the level of specificity that extension officers are able to provide based on the forecast information that is available to them.

The challenges to interpreting predictions for localized use at the district level may help to explain local level findings, which indicate that the salience of scientific climate information at local levels is very low. In part, this is due to the fact that seasonal forecasts that are generated by TMA are difficult for local residents to interpret for use at local scales (Malisa 2014, Yanda et al. 2015). As a result, participants in FGD in Kimokouwa and Ilera villages (Longido and Kiteto Districts respectively) pointed out that the seasonal forecasts that are generated by TMA are not widely used. For example, it is difficult for average users of climate information to understand and interpret the seasonal climate forecasts, since they do not know the meaning of "average", "above average", and "below average" rain conditions (as measured by TMA) and also what these categories would imply for specific localized actions. It was indicated that interpretation of forecasts was difficult without having an in depth understanding of the climatology of the region as defined scientifically by TMA.

4.3 SUB-INDICATOR 3.3: Legitimacy of Climate Information and Services

Indicator 3: Satisfaction with Climate Information and Services		
Sub-indicator 3.3: Legitimacy		
	National	• The problem of excluding key actors in the early stages of climate services development was realized and addressed, which is likely to enhance legitimacy. • Lack of linkages between TANDREC and other institutions and stakeholders may pose a challenge to legitimacy of climate services development. • Mismatches between climate adaptation planning and implementation and existing national policy priorities and capacities pose challenges to legitimacy.
	District	• Mismatches between national recommendations and capacities at district and local levels to provide localized advice based on currently available climate information pose challenges to legitimacy. • Differentiated capacities to interpret and use climate information across socio-economic strata pose challenges to legitimacy. • Perceptions that climate information is produced for urban populations, rather than rural populations, pose challenges to legitimacy. • Opportunities for users to engage with experts and to contribute their own knowledge within knowledge production activities enhance legitimacy. • Mismatches between available climate information and local capacities to adapt to climate variability and change based on that information pose challenges to legitimacy.
	Local	• Differentiated capacities to access, interpret, and use climate information across socio-economic strata at the village level pose challenges to legitimacy. • Perceptions that climate information is produced for urban populations, rather than rural populations, pose challenges to legitimacy. • Lack of communication networks (e.g. mobile phone) pose challenges to legitimacy. • Differentiated control of ICTs and division of labour at the household level (with women having less control of ICTs and heavier work loads in the evening) results in gendered differentiation in access to climate information, which poses challenges to legitimacy. • The potential for elite capture of training opportunities related to climate services and lack of incentives to share information with all community members following trainings poses challenges to legitimacy. • Perceptions that the advice attached to climate information is 'biased' or 'political' pose challenges to legitimacy.

Legitimacy of processes for climate services development

The legitimacy of climate information and services are directly related to the legitimacy of the processes and knowledge that are involved in producing them. Legitimate processes for climate services development should involve relevant stakeholders and must be perceived as open, transparent and fair. There have been some early challenges to the legitimacy of the process of climate services development through the GFCS-APA at the national level due to the exclusion of key actors in early stages. Some of these issues were recognized early on in the programme

implementation and have been addressed. For example, while the VPO-DoE is the key actor overseeing climate change policy in Tanzania, there was lack of representation from the office during the national consultation and within the PDT during the first months of the programme. This challenge to legitimacy has been resolved through the inclusion of the VPO-DoE as a permanent member of the PDT since October 2014. In another example, TANDREC has been designated as the national steering mechanism for climate services. Although the aim is for TANDREC act as a platform for bringing practitioner level staff under it, several national level respondents indicated that the members of TANDREC are very high level officials (e.g. Permanent Secretaries and Directors of MDAs) who are not necessarily "in touch" with the on-the-ground realities of implementing climate services development and delivery or who do not have the time to devote to these issues. National level respondents also indicated that the high level status of these officials makes it very difficult to convene a meeting of TANDREC, meaning that it does not meet regularly or frequently. These factors may pose challenges to the legitimacy of climate services development in the future if action is not taken to ensure that TANDREC is effectively and sustainably linked with other existing national institutional structures and with stakeholders who are directly involved in the implementation of climate services production, delivery, and use at other scales.

Climate information and services have been identified by the project/programme as a potential tool to support climate adaptation planning and implementation in Tanzania. However, with regard to fairness, national level respondents indicated that there are underlying issues of equity surrounding climate mitigation and adaptation policies, including mismatches between the expectations of the international donor community under international agreements and current government capacities. (Yanda et al. 2015) Issues of fairness and equality with regard to responsibility for climate change impacts and adaptation were also raised at the district and local levels, where there were perceptions that Westerners in developed nations were the cause of climate change, but that populations in developing countries, such as those in Longido and Kiteto Districts, were responsible for dealing with the consequences even though their capacities to do so were much more limited. Kiteto Respondent #6 explains: "It's a problem of excess, if they compare with people from Europe, their capacity is different than people in Africa. There is a large difference. Compared with them, there is a big difference in capacity. We're lower, and they are higher". A focus on climate change issues driven primarily by external actors may displace other primary or immediate concerns facing national level actors, such as basic economic development issues. If climate services and other climate change issues are perceived as driven by external actors, this may reduce the legitimacy of processes and efforts to develop and deliver them. Furthermore, Yanda et al., (2015) identified a lack of capacity, specialized knowledge and dedicated financial resources within many of the ministries and at the district level to address climate change concerns. Such mismatches are likely to undermine the legitimacy of climate change-related activities, including climate services development. Indeed, research from Europe (Norway and the UK) shows that incorporation of climate concerns into local development agendas and action on adaptation is unlikely to occur in the absence of dedicated financial and human resources.

Legitimacy of climate service knowledge, access and use

The legitimacy of the knowledge or information embedded and transmitted through climate services also depends on the perception that it is open, transparent and fair. At the district level, scientific forecasts were seen to be more beneficial for people who had education, putting those with little or no education at a disadvantage. Kiteto Respondent #3 noted: "[The understanding of the forecasts] depends on the level of education. For me, I am able to understand the information, but for others who are not as aware of what is meant by the forecast…they may not be able to understand." Additionally, many district level respondents noted that the daily weather forecasts are mostly for 'city people' in Dar es Salaam or Arusha, who are often perceived to be wealthier or more educated. This highlights the potential for users to perceive biases or inequities embedded within climate information and services, with implications for who can benefit from them. Perceptions that climate information is for "other people" in urban areas may result in decreased uptake of information by rural populations.

The issue of differentiated abilities to access and use climate information at local levels was identified as an important issue to perceptions of legitimacy. UDSM Master's student research findings indicate that access to climate information was variable among respondent groups, as well as across socio-economic strata, gender, and age (Ngowi 2014). Unsurprisingly, access to climate information was higher among those who possessed information and communication tools, such as radios, televisions, or phones (Yanda et al. 2015, Malisa 2014). Delivery through mobile telephone (i.e. text message) was noted as the best means of distributing information to local scales. However, it was recognized that not all people have phones. Further, Ndunguru (2014) reported that some users were aware of information and communication technologies (ICTs) through which climate information might be available, such as the internet, but did not have the proficiency to use such technologies themselves in order to access the information. Additionally, several studies highlighted that the cost of accessing the internet through mobile phone networks was often prohibitive.

Furthermore, mass media and other digital communications have limited reach in both Kiteto and Longido. According to district officers, 40% of Kiteto District does not have mobile network coverage. Longido District faces similar challenges. Television and radio access is also limited in these rural areas. The challenge of limited radio channel and mobile network coverage in the districts are acknowledged in the CCAFS baseline survey (Coulibaly et al., 2015: 38; see also the Preliminary Baseline Report for Tanzania, pages 11 and 12). This is despite varying levels of *ownership* of radios and cell phones in the districts, where CCAFS baseline (2015) and radio/ICT scoping study (2014) report that cell phone ownership ranges from 50-82% for women, and 71-94% for men, in Kiteto and Longido districts respectively (Coulibaly et al., 2014; Hampson et al., 2015). Pastoralists were seen as less likely than other groups to be able receive climate information through the mass media, since they are often moving with their cattle through remote areas where they do not have reliable telephone networks or access to TV, radio, or newspapers. Thus, it will likely be necessary to utilize multiple channels to reach as many local residents as possible. This includes government extension agents and village assembly meetings, as noted in the CCAFS baseline study, since these formats facilitate the delivery of information to a large proportion of farmers and livestock keepers in rural communities and do not require ownership or access to communication assets such as radio, cell phone, or TV (Coulibaly et al., 2015: 39).

Several studies illustrated the gendered dimensions of access to climate information delivered. Zachariah (2014) and Ngowi (2014) found uneven access to climate information delivered

through mass media among men and women. Several reasons for this were noted. Men were most often the household member who was economically capable of possessing a radio or television. Thus, men generally had more access and control over media sources than women. Additionally, the reports found that culturally established gender roles often mean that women are performing household chores late into the night, thus decreasing their opportunity to hear or see climate information through mass media. In this way, women are often excluded from viewing or listening to radio and television programs, including the news bulletins through which climate information is issued despite their integral roles in managing household food security. Many women reported that they were reliant on their spouses to relay climate information from the radio or television (Ngowi 2014, Zacharia 2014). Language barriers are also an important factor in shaping the perceived legitimacy, or fairness, of information, since these can systematically enable particular groups to access and use this information more effectively, putting them at an advantage. For example, in both Longido and Kiteto Districts, large portion of the population speak Maasai more regularly than Swahili. This is especially true for women and the elderly, who generally have less access to educational opportunities to learn Swahili. Thus, forecasts that are only delivered in Swahili are not equally available to all district residents.

At the local level, while people wanted improved information with which they could better manage climate risks, such as climate services, the legitimacy of this information was also related to whether or not the information could actually be put to use. Respondents highlighted that in order to adapt, other resources (i.e., financial, human) will be needed. As has been shown in other studies (e.g. Vogel and O'Brien, 2006) it is clear that information alone is not be enough to fully support adaptation. Thus, without recognition of the need to link information with specific resources and capacities to act on the information, there is risk of disenfranchisement and undermining the legitimacy of climate information and services.

The politics of climate service knowledge

At the local level, advisories are an important element of complete climate services delivery and district-level actors are likely to play a key role in helping to develop and deliver climate-related advisories. However, it must be recognized that there is potential for such advice to have political implications. If it is perceived that information or knowledge is being used in an unfair way or that it is biased to advantage particular groups within society or to promote a particular policy agenda, it is likely that it will not be used for decision-making. For example, many pastoralists have faced increasing pressure to adopt more sedentary, agricultural livelihoods and increasingly struggle to maintain access to the land and water resources needed to sustain their herds under increased pressure from agricultural populations (Galvin 2009, Goldman and Riosmena 2013, Homewood et al. 2009). This has been accompanied by heavy emphasis within national policy making to prioritize and promote agricultural activities in Tanzania (e.g. Big Results Now) that may marginalize pastoral livelihoods. Additionally, the advice that is attached to climate information can enhance challenges to legitimacy. Within this context, recommendations that advise livestock keepers to sell off their livestock can be seen as politically motivated. In Longido District, many local level respondents stated that they would not trust information coming from anyone who told them to sell their livestock (Daly 2014).

Box 1: The Politics of Local Knowledge, Agricultural Inputs and Advice in Longido District

Climate information, advisories, and services will need to be sensitive to the context-based implications of recommendations about livelihood decisions. The following account illustrates that even 'simple' recommendations about agricultural practices that are attached to climate information, such as advice about fertilizer use, can be seen as controversial:

"Even the year before last, [local residents] held a strike because they said that these agricultural inputs that were brought by the agencies would convert and destroy the soil. The fertilizer was returned and [local residents] said that instead they should be given seeds. So they refused. They said: 'Here in this district, 95% of us have livestock, so why shouldn't we use our livestock [to supply fertilizer]? Why shouldn't we use the cattle dung, that gift from cattle, for the purposes of fertilizing instead of using your fertilizer that will destroy the land?' They have the notion that in those districts that use the synthetic fertilizer, all of their land has been destroyed. This is their perception. So they said: 'These people want us to destroy our land by using synthetic fertilizers, these fertilizers from Minjingu, the ones that have phosphate. We know what they are doing. We think that we should start to use the fertilizer from livestock because in our roots we have enough fertilizer. So, why should we change to synthetic fertilizers? We prefer that it would be seeds [that are brought as inputs].' They refused. If you look at the packages that are remaining…you will see that they refused. So, this fertilizer was returned and we provided seeds. There was even an investigation by the Comptroller General. They asked the residents, 'Why wasn't the fertilizer used and instead exchanged for seeds?' [The local residents] said: 'We ourselves refused!' Therefore, the agencies saw that the citizens in Longido refused the synthetic fertilizer. Indeed, it was the citizens themselves who refused. They said: 'Our soil has fertility, so why did you bring the synthetic fertilizers to destroy our land?' Therefore, even the investigator, the Head Comptroller, he finally said 'Wow, it appears that the citizens of Longido have indeed refused these fertilizers!'" (Longido Respondent #3)

Thus, it will be important for the GFCS programme and other climate service interventions to develop approaches to delivering information and working with district level stakeholders in order to appropriately contextualize and effectively communicate the advice that accompanies climate information.

Opportunities for citizens to engage with experts is one way of increasing transparency, as well for local stakeholders to contribute their own knowledge and expertise to knowledge production processes. In general, respondents expressed that opportunities to interact with providers of climate services, during meetings or presentations, opened up pathways for dialogue, thereby improving perceptions of the legitimacy of the climate information provided. The IIED project in Longido appears to have facilitated processes that have increased the legitimacy of information being provided about weather and climate by increasing district and local capacities, as well as facilitating iterative interactions between local stakeholders and TMA staff over the course of several years. This included providing capacity building and leadership trainings and workshops at the village, ward, and district level, with particular emphasis on ensuring involvement of local customary leaders across the district. Additionally, there were specific trainings about climate change, including many opportunities to receive trainings directly from TMA staff members but which also provided important networking opportunities among the

various participants across institutional scales, which was in itself another important means of circulating and debating scientific as well as local and indigenous knowledge about climate change and its impacts. However, it is important to note that the enhanced legitimacy of the process did not necessarily result in increased credibility and salience of climate information for all stakeholders. Similarly, the Participatory Integrated Climate Services for Agriculture (PICSA) approach implemented by WFP and CCAFS in partnership with the University of Reading as part of the GFCS-APA provided opportunities for district, ward, and village level extension officers to interact directly with representatives from TMA, offering opportunities for training and dialogue. The approach seeks to train extension officers to facilitate a step-by-step participatory approach to help farmers to integrate historical climate information and other forecast products within their decision-making and includes trainings by TMA on climate information. The PICSA trainings have been conducted in the target districts, Longido and Kiteto, along with several other districts in Tanzania. An important element of the approach is the 'Planning and Review' sessions, which are conducted 4-6 weeks following the initial training. This offers an opportunity for iterative, though not necessarily sustained, interaction between the training facilitators and extension officers.

Providing training to village government or customary leaders was considered important to ensuring access and use of climate information at local scales. However, it was also recognized that delivery of climate information could be affected by localized political dynamics, and this model rests upon the assumption that local leaders will share their knowledge with other community members upon returning to the village. This offers the potential for efficient pathways for delivering information to the largest number of recipients. In practice, however, this can create a situation in which local elites were better able to access and utilize opportunities to benefit from climate information, which can undermine the legitimacy of climate services. Several respondents at the district and village level noted that not all local leaders bother to share information they have received during trainings when they return back home. For this reason, there is a need to develop systems to ensure inclusion of less powerful and marginalized community members within climate services trainings. Similarly, it was noted in almost all of the Master's student reports that the climate information that is currently available at local scales often needs further clarification from experts, but such expert advice is not generally available, thereby excluding local users from equally benefiting from the information.

5 INDICATOR 4: Role of Indigenous Knowledge in Adaptation Decision-making

Indicator 4: Role of Indigenous Knowledge in adaptation decision-making	
Sub-indicator	
4.1 Awareness and Access	• Awareness of IK varied considerably across institutional scales. • IK was available to district level respondents, but not consistently or equally across all respondents. • The lack of systematic mechanisms for delivery of IK was seen as the primary barrier to the availability of IK at all scales; IK is transmitted through both formal and informal institutions at local levels. • Access to IK was considered to be 'coincidental' or 'by chance'. • Many district level respondents are already seeking out multiple sources of information and knowledge, including both indigenous and scientific.
4.2 Credibility of IK	• There were significant differences in perceptions of the credibility of IK across district and local levels. • The majority of local level respondents exhibited higher levels of trust in IK than in scientific climate information. Among district level respondents, however, levels of trust in IK were highly variable. • The long-term basis of IK was perceived as a key to enhancing its credibility at both district and local levels. • IK was seen as complementary or beneficial to scientific climate information; efforts to engage both kinds of knowledge are likely to enhance credibility, particularly at local levels. • Lack of standardization in the production of IK poses a challenge to perceptions of the credibility of IK, particularly at the district level. • At both the district and local levels, climatic, environmental, and social changes pose challenges to the credibility of IK.
4.3 Salience of IK	• IK was seen to be more relevant, particularly in terms of spatial specificity, at both the district and local levels. • IK about weather or climate was often accompanied by or is part of other complementary or contextualized knowledge, which enhances salience.

	• IK is also integrated within customary decision-making practices (both community and individual) which enhances the salience, particularly at the local level
4.4 Legitimacy of IK	• IK was perceived to be more legitimate, particularly at the local level, because it inclusive of diverse perspectives. • IK was perceived to be more legitimate, particularly at the local level, because it is transparent (does not require technical instrumentation) and can be validated at local scales. • Linkages between IK and customary leadership structures and customary decision-making enhances the legitimacy, particularly at the local level.

5.1 SUB-INDICATOR 4.1: Awareness of and Access to Indigenous Knowledge for Climate Adaptation Decision-making

Awareness of IK varied considerably across institutional scales. IK was available to district level respondents, but not consistently or equally across all respondents. In general, it was perceived by district officers to be more difficult to access IK than scientific information. This is, in part, related to the fact that many district officers do not originate from the districts in which they are currently posted. Access to IK was generally coincidental, but some district officers reported intentionally seeking out local experts to access IK. Many district level respondents reported that they are already seeking out multiple sources of information about weather and climate, both scientific and indigenous. The lack of a formalized system of delivery was seen as the primary barrier to the availability of IK at the district level. At the local level, a much higher proportion of respondents reported being able to access IK; however, this was also highly variable across sites.

The majority of the IK that is received at the district level is for seasonal or sub-seasonal conditions (i.e. weeks or months). However, there were also reports of receiving IK about decadal drought patterns (e.g. expectation of very severe drought once every 10 years) in both Kiteto and Longido. Additionally, it was reported that IK can also pertain to general patterns of seasonality over long periods of time (e.g. seasonal calendars for rainy/dry seasons). Further, IK that was available to district officers was not only about weather and climate, but also about other issues that can inform climate adaptation strategies. For example, this may include advice about the best locations for building dams or drilling boreholes based on the location of certain tree species or based on knowledge of past events that would indicate whether or not it might be a suitable location (e.g. runoff patterns). Linkages between experts on IK and other community members generally occur through informal institutions and interaction through day-to-day activities with family, friends, or neighbours. Additionally, some communities reported seeking out indigenous forecasters to request their advice. While there are not always systematic institutional pathways for delivering this information, it was reported that in some instances, this information is shared and discussed during formal village meetings with local government or customary leadership (sometimes both).

5.2 SUB-INDICATOR 4.2: Credibility of Indigenous Knowledge for Climate Adaptation Decision-making

There were significant differences in levels of trust in IK across district and local levels. The majority of local level respondents exhibited higher levels of trust in IK than in scientific climate information. Among district level respondents, however, levels of trust in IK were highly variable. Some reported trusting IK as much or more than scientific climate information. Others felt that scientific information was more credible because it was backed by more "systematic" proof.

At both the district and local levels, the credibility of IK was attributed to the fact it has been gathered over long periods of time and is "very researched knowledge" (Kiteto Respondent #5). Another reason that IK is trusted is because it is perceived to be highly adapted to the local environment and fits local decision-making contexts. IK was also perceived to use many different indicators, sometimes simultaneously, which helps to ensure credibility. Some respondents indicated that they have equal levels of trust in scientific and indigenous sources of information. According to Respondent #3, Kiteto:

"Myself, I currently believe both, because they all have benefits for our entire country and also in our places. Because those others that you have already found, they are recognized scientifically. And these indigenous ones are locally trusted and are relevant to the community."

In some cases, IK was seen as enhancing the credibility of scientific climate information when both were considered, since they were perceived as relying on different measurements and indicators at different spatial and temporal scales.

Several challenges to the credibility of IK were reported. At the district level, many respondents stated that the major challenge to the credibility of IK was that there was a lack of standards for generating observations and consistency across indicators and predictions. At both the district and local levels, climatic, environmental, and social changes were seen as affecting the credibility of IK. Tools such as seasonal calendars were seen as losing efficacy because of shifts in the rainy seasons that were attributed to climate change. Other respondents noted that environmental degradation had impacted the ability to use environmental indicators for predictions. The social processes involved in producing and transferring IK about weather and climate were also seen as deteriorating (Lori 2014), thereby decreasing the reliability of IK. In particular, the erosion of pathways for passing IK on to younger generations was seen as a major issue. (Lori 2014) Other changes that have affected the credibility of IK include in-migration, uptake of formal religion, and education.

5.3 SUB-INDICATOR 4.3: Salience of Indigenous Knowledge for Climate Adaptation Decision-making

IK was seen to be more locally relevant, particularly in terms of spatial specificity, at both the district and local levels. Additionally, the timing of IK predictions was noted to play a factor in the relevance. For example, while scientific seasonal predictions for the OND are not available until the end of August or early September, many respondents in Longido reported that indigenous predictions can be available as early as July, which was more useful. (Daly 2014) IK

that was used for these decisions was not only about weather, but was integrated and contextualized with knowledge of other social and environmental factors and this was seen as an added benefit. IK is also integrated within customary decision-making practices, which enhanced the salience at the local level. For example, IK about local tree species in the Upper Ruaha Catchment provide information about upcoming seasonal conditions, as well as play a role in customary water resource management and conservation strategies. (Lori 2014) Additionally, IK about seasonal calendars is often linked with multiple livelihood strategies, making it more useful.

5.4 SUB-INDICATOR 4.4: Legitimacy of Indigenous Knowledge for Climate Adaptation Decision-making

IK was perceived to be more legitimate, particularly at the local level, for several reasons. First, IK was seen as being more open to including multiple perspectives and enabled community members to play an active role in knowledge production. IK was also seen as more transparent, since it does not require highly technical instrumentation. Respondents at both the district and local level felt that IK was more open to processes of observation, enabling community members to empirically observe and validate the indicators used in indigenous forecasting "on the spot". IK was also seen as more easily accessible to all members of the community, in contrast to scientific information, which was perceived to require expert assistance to interpret. Finally, it was recognized that there was a need to respect and work within local systems of leadership and this was seen as important in providing legitimacy within processes of knowledge production, access, and use. IK was seen as being integrated within customary leadership structures and decision-making processes.

6 Conclusion

Awareness of and access to climate information and services were reported to be variable across institutional scales. At the district and local levels, it will be particularly important to ensure that efforts are made to improve access and availability to address disparities in the systematic receipt of climate information, which are often influenced by differentiated access to information and communication technologies along gender and socio-economic strata. However, improving awareness of and access to climate information and services will only be the first step. The report findings indicate that respondents at all scales have low levels of satisfaction with current climate information, even when they are able to receive and attempt to use it for decision-making.

These findings highlight that issue of **credibility of climate information** was seen as paramount to enhancing user satisfaction at all institutional scales. It is well known that credibility takes a long time to establish and that users of climate information are often 'once burned, twice shy'. For some respondents, the use of 'science and technology' and 'technical expertise' was seen as automatically increasing the credibility of the information and enhancing the certainty of forecasts, such that they could be considered almost deterministically (i.e. 100% probability). This clearly overstates the capacities of science as a 'perfect' solution to the uncertainties of weather and climate variability. For this reason, it is not surprising that many respondents focused on instances when they had tried to use climate information unsuccessfully. Indeed, nearly all respondents were able to provide examples of when a weather or climate forecast had been 'wrong'. In general, respondents did acknowledge that there was always uncertainty involved when using a forecast or prediction – whether scientific or indigenous – but that it will still be necessary for them to be able to observe the benefits of using the forecast in practice and over time before they would use it. This indicates that improving the credibility of forecasts will be a long-term process, which will take place over years or decades. There is a need to be cautious about overstating the capacities of science to provide usable climate services. A key issue that emerged from the analysis is that the ways in which credibility are measured by producers of scientific climate information at the national level do not align with the ways in which district and local users assess credibility. Thus, while TMA may produce a forecast that is considered accurate by scientific measures, it is not seen the same way for users at local levels. Until this is addressed, scientists will continue to believe that they are producing reliable information, while local users will continue to mistrust it. This indicates that there is a need for active engagement and dialogue to establish shared understandings and ways of evaluating credibility that are perceived as valid, both among users and producers of climate information. It will also be important to recognize that perceptions of credibility are not static, but are continually evaluated based on accrued experience.

Two major challenges to the **salience of climate information** at all scales included mismatches between the timing of decision-making and the delivery of forecasts and predictions, as well as the limited spatial and temporal resolution of the information they provide. In some instances, it will be technically infeasible to adjust the timing of scientific climate information to fit with the timing of decision-making. At the same time, it is known that indigenous predictions might have information to offer at more relevant timescales. This illustrates that value that integrating IK and scientific climate information may have in terms of improving salience. Additionally, nearly all users reported that the way in which forecasts are currently packaged and communicated presents significant challenges to understanding and interpreting the information for practical decision-making. Some of these challenges can be addressed more immediately. For example, respondents at all scales desired more frequent communication of information, particular over the course of the rainy season, which would help users to make additional adjustments to a broader array of decisions. Additionally, improving and strengthening existing protocols for delivering information can potentially overcome delays in the delivery of information to district and local levels. Other challenges to the salience of information, particularly at district and local levels, may take much longer to address, or may not be technically feasible, at least in the foreseeable future. It will be important to balance user requests with current scientific capacities and to manage expectations accordingly. For example, enhancing the spatial resolution of seasonal forecasts to the village level is not possible, but district-level forecasts could go a long way toward addressing user needs. Additionally, the development of sub-seasonal predictions (e.g. prediction of dry spells) is not realistic within the time frame of this programme, but updates to seasonal forecasts and improved delivery of monthly outlooks and 10-day forecasts could help to better address user needs. Therefore, it will be necessary to respond to user needs whenever possible, while also being clear and frank about the benefits and limitations of scientific climate information and in what time frame.

The most significant challenges to the **legitimacy of climate information** are currently at local levels, but some of these are also present at the district level. A fundamental issue is that differentiated capacities to access, understand, and respond to climate information means that some segments of the population may benefit more than others through improved climate services provision. This can undermine perceptions of equity and fairness, thereby limiting the use of climate services. This highlights the need to develop specialized strategies for engaging least advantaged groups, especially at local levels, to benefit from climate service delivery. This will likely require approaches that not only improve capacities to receive and understanding climate information, but also to act upon it. The inclusion of multiple perspectives within knowledge production and decision-making is also key to enhancing the legitimacy of climate information. This report highlights that district level stakeholders are already playing a large role in mediating between different kinds of knowledge and incorporate these within some decisions. In this way, district level actors are likely to be key conduits for co-production processes in the future. To ensure the legitimacy of climate information, there is also the need to ensure that it is not perceived as 'political' or as serving ulterior motives. This will require understanding the social contexts in which advisories will be received. Ensuring that climate information and advisories are linked with local or customary leadership structures may help with this.

The **role of indigenous knowledge** was seen as important across all scales, but there were many challenges to ensuring its inclusion within climate services development. IK was reported

to gain its credibility through the long-term observations it is based on, as well as the experience that communities already have working with this knowledge. This has resulted in the perception that it is more accurate than scientific climate information, particularly at the local level. Additionally, IK was perceived to provide information at more appropriate spatial and temporal scales for local decision-making and was embedded within the local context. Another benefit of IK was that it was more broadly accessible since the environmental indicators upon which it is based do not require technical instruments and are more easily observed than scientific indicators. However, the current culture within most government institutions does not encourage the use of non-scientific information at the district or national level due to the perceived lack of standardization in both the production and delivery of IK. Additionally, climatic, environmental, and social change has negatively affected the credibility of IK at all scales. These findings highlight that local populations want to have a voice and a role within the production of climate information, rather than being passive recipients. The incorporation of IK within climate services development will play a key role in enhancing the legitimacy of these processes.

Importantly, these findings highlight that the perceived credibility, salience, and legitimacy are often interrelated and cannot be treated or considered separately. For example, while downscaling forecasts might improve the salience of climate information, if problems associated with the credibility and legitimacy are not also addressed, it may not improve the usability. Furthermore, it will be important to consider trade-offs between criteria. Continuing the previous example, downscaling forecasts may improve the salience, but it is possible that such efforts may reduce the scientific credibility. It will be important to evaluate the potential impacts and trade-offs across all three knowledge system criteria within future efforts to develop climate services in order to understand (and optimize) the potential benefits of these actions toward improved user satisfaction. Conversely, it will be useful to understand when and how actions to address one criterion may have co-benefits in others. For example, more frequent updates to the seasonal forecasts, including increased delivery of sub-seasonal (e.g. 10-day) forecasts, are likely to increase both the credibility and the salience of climate information. Similarly, delivery of climate information through multiple channels is likely to enhance both the salience and the legitimacy of climate services.

7 Recommendations

Based on these findings, the following 12 recommendations are offered:

1. **Increase awareness of the concept of climate services:** At all levels, the awareness of the concept of climate services is low. Developing an understanding of climate services, including the essential role of users in developing services, will be a necessary step to enabling users to communicate their climate information needs and to enhancing sustainable user interfaces. For all trainings related to climate services, it will be important to ensure that less powerful and marginalized segments of the population are included, not just local leaders.

2. **Adjust timing and frequency of delivery via mass media:** The infrequent or inconvenient timing of weather and climate forecasts within the media is a current barrier to climate information access. It is recommended to explore opportunities for increasing the frequency of announcements on television and radio and airing these during hours of the day when local populations will be better able to receive them more regularly.

3. **Employ multiple channels of delivery:** In order to maximize access to climate information at local levels, it is likely that multiple channels for enhancing delivery will need to be developed and utilized. While this will clearly include improved delivery of information through ICTs (e.g. radio and mobile phone), not all communities or segments of the population are currently able to access ICTs. It will also be important to develop complementary systems of delivery that build upon existing pathways for distributing information at local levels (e.g. ward development committees, Red Cross volunteer networks, village assemblies, customary leadership structures)

4. **Align investments in climate information distribution with expressed user needs:** There is a need to address the mismatches between user demands and the availability of specific climate information products. Daily forecasts were not deemed nearly as useful for decision-making at local scales, yet these were the most widely accessed. It is recommended that efforts to enhance deliver of climate information develop targeted approaches and investment strategies according to expressed user needs and preferences.

5. **Increase delivery of sub-seasonal climate information:** It is recommended that programme partners work to increase the delivery of sub-seasonal climate information. This should include providing updates to the seasonal forecast throughout the forecast period, as well as enhancing access to other sub-seasonal climate information products (e.g. 10-day Outlooks, Monthly Reviews and Outlooks, Agro-meteorological Bulletins).

6. **Formalize procedures for both vertical and horizontal distribution of climate information within government MDAs at all levels:** There is a need for the creation of standardized operation procedures and protocols at national, district, and local levels for systematic climate information delivery, both horizontally and vertically within and across institutional scales. These should include guidance on the timelines under which climate information should be delivered to ensure the timely delivery of information, as well as identify specific responsible parties. It is suggested that this could be a component of the development of the national 'Road Map' for climate services.

7. **Build capacities for actors at district and local scales to tailor climate information and advisories:** There is a need to ensure that the advice provided within climate services is appropriate to the local context. District and local level actors who have in-depth knowledge of local context will be best situated to undertake this task, but they are also struggling to successfully interpret the information they receive. It is recommended that the programme partners explore participatory approaches and trainings to enhance the capacity of district and local actors to interpret climate information, but also to formulate specific advisories. This will likely require multiple trainings and follow up to ensure fluency in the use of climate information for developing advice.

8. **Encourage innovation in climate services packaging and communication:** There is a need to develop more user-friendly formats for communicating climate services, particularly to enable less advantaged populations to understand and interpret climate information without expert assistance. It is recommended that programme partners develop experimental and participatory approaches to help 'think outside the box' of current communication practices. This will need to be an on-going and iterative process.

9. **Enhance access to information and training about climate change:** There is a need to improve access to information about long-term climate information at all institutional scales. It is recommended that the programme partners engage with the VPO-DoE, which is responsible for climate change communications, to identify entry points for linking the GFCS-APA with on-going efforts. For example, this may include linking with activities under the National Climate Change Communication Strategy, such as the suggested development of Community Information Centres.

10. **Manage expectations of scientific information:** It is recommended that programme partners develop strategies to actively engage with users to communicate the strengths and limitations of scientific information about weather and climate. It will also be important to be clear at the outset about current scientific capacities to meet specific user demands and the timelines under which demands may be met.

11. **Create opportunities to discuss various approaches to validating climate information:** It is suggested that programme partners create opportunities and forums to engage in open dialogues about the various ways in which stakeholders in different communities of practice and operating at different scales assess the credibility of climate information and how this currently shapes the usability of climate services. There is a need to explore ways of developing shared understandings of the meaning of credibility, or at the very least the need for multiple definitions of credibility, that reflect the realities of both users and producers of climate information at multiple scales.

12. **Develop participatory trials to generate empirical evidence of benefits:** It is recommended that additional participatory approaches are developed to 'test' the use of climate information at local scales in order to build a base of empirically based evidence that can support local level trust. For example, the Tanzania Red Cross Society has developed 'test plots' in Kiteto to enable residents to apply climate information for agricultural decision-making. It will be important that trials do not pose explicit risks to individuals' livelihoods (e.g. use of communal rather than individual plots). Additionally, these trials should be carefully designed to distinguish between multiple interventions (e.g., in cases where there simultaneous use of climate information and various agricultural inputs or 'treatments').

APPENDIX I: Summary of UDSM Student Research and Relevance to Social Science Thematic Contributions to the CSA in Africa Programme in Tanzania 2014 / 2015

No	Thematic Area	Research Title	Relevance of the study to the selected themes for GFCS Adaptation Programme in Africa
2014			
1	Case studies on demand side in each or sampled ecological zones	Impact of climate change and variability on beekeeping productivity in Kiteto District.	Provide reliable and timely availability of climate and weather information to suffice the producer and user interface on beekeeping productivity
2	Literature review and identification of key risks in the selected ecological zones	Assessing farmers' livelihood Vulnerability to Impact of Climate change. A case of Kilosa District.	To provide an insight on the socio-ecological perspective of the risks and possible remedies addressed for the livelihood of farmers in the era of Climate change
3	Literature review and identification of key risks in the selected ecological zones	Implications of land use and land Cover change on hydrology in a changing climate. A case of the Great Ruaha Catchment, Tanzania	To Provide an insight on the relationship between the socio-ecological perspectives with emphasis on indigenous knowledge on the preferred adaptation mechanism to climate change impacts and the changing hydrology.
4	Indigenous knowledge/ Traditional knowledge	Integration of indigenous knowledge in climate information prediction systems and its impacts in Mbarali District.	To provide link between Indigenous knowledge and scientific in climate information collection and dissemination.
5	Indigenous knowledge/ Traditional knowledge	The role of indigenous knowledge in weather forecasting and in climate	To provide information on the role of indigenous knowledge in weather forecasting, how such knowledge can be useful in adaptation to agriculture

		change adaptation to agriculture Mvomero District.	and to what extent the knowledge is taken into account by TMA
6	Literature review and identification of key risks in the selected ecological zones	Impact of climate variability on gender adaptation strategies to improve household food shortages in Magu District.	The study aims at linking the knowledge gap on understanding gender analysis in adaptation strategies in addressing household food shortage during the impact and risks of climate variability
7	Mapping of relevant institutions in Tanzania engaged in or related to the issuing and delivery of climate information	Assessing effectiveness of communicating climate data and information for water resources management, a case of Upper Great Ruaha Catchment	To provide an insight on the institutional modalities of communicating climate information, and the use of such climate information and data in managing freshwater resources
8	Literature review and identification of key risks in the selected ecological zones	Gender and adaptation to the climate change impacts: A case of agricultural communities in Mvomero District.	The study aim to assess the gender role and adaptation to climate change impact as well as the key climate change risks in a gendered climate change impacts.
9	Study on TMA procedures	Assess the effectiveness of Climate Information Delivery System in Tanzania.	Findings expected to bridge the communication gap between service providers (TMA), service application and all stakeholders including the public, and fostering dissemination of climate information to various sectors and the public in general.
2015			
1	Indigenous knowledge/ Traditional knowledge	Integrating local/indigenous and scientific weather and climate information into decision-making in Longido District.	To provide information on the role of indigenous knowledge in weather forecasting, how such knowledge can be useful in adaptation to agriculture and to what extent the knowledge is taken into account by TMA
2	Study on TMA procedures	Possibilities of delivering demand-driven climate information for climate change adaptation in rural communities in Longido District.	The study will assess the ability of end-users at selected local, District and national levels to communicate their information needs to TMA, and the feasibility of delivering the diverse types of information that the users demand in a format that suits their needs.
3	Study on TMA procedures	Feasibility of mobile phones in disseminating climate information for adaptation in rural communities in Kiteto District.	The study will examine dimensions of mobile phone use, including factors that enable or hinder mobile phone use at local scales, as well as how climate information is currently received, understood, and utilized. The study will include assessment of climate information demands in a variety of sectors.

APPENDIX II: Common Questions Included in Master's Student Research as Input Toward the GFCS Adaptation Programme in Tanzania

Household Questions:

1a) Are you aware of weather-related advisories issued by the Tanzanian Meteorological Agency (TMA)?
Yes / No

1b) If yes, what kind of advisories are you aware of?

Daily/weekly weather forecasts: Yes / No

Seasonal forecasts: Yes / No

Warnings about extreme events: Yes / No

Other (please explain) _____

1c) Have you received weather advisories at any time in the past 5 years? Yes / No

1d) If you have received weather advisories, how often do you receive them?

Every week or so_____

Every few months____

Several times per year_____

One time per year _____

Less frequently_____

1e) If yes:

What kind of advisory did you receive?

When did you receive it? Please list Year/Season/Month.

Who provided the information?

How did you hear the information?

Was the information correct/reliable? (Ask respondent to explain*)

Were you able to act on the information? Why or why not? (Ask the respondent to explain*)

2a) Do you rely on any local or indigenous sources of information about the weather when you make decisions about agriculture or livestock keeping? Yes / No

For example: for deciding when to plant crops, choosing what kinds of crops to plant and what kind of seeds to plant, where to plant, when to move livestock, etc.?

2b) Please explain which sources of information you use and for what purposes you use them/how you use the information?

2c) Is the local/indigenous weather information that you use: (Please choose one.)

very reliable____

somewhat reliable___

somewhat unreliable____

unreliable _____

Please explain why have you answered in the way you have. Can you give an example so that I can understand better?

APPENDIX 3: District Level Semi-structured Interview Protocol for Key Informants

INTERVIEW GUIDE FOR KEY INFORMANTS REGARDING CLIMATE SERVICES

District:

Interviewer:

Date:

Respondent's name:

Male/Female:

Age:

Level of education:

Number of children:

Primary occupation:

Secondary occupation:

Length of time lived in the community:

INTRODUCTION:

My name is _____. I am a researcher coming from _____. I am here today because I would like to discuss your experiences with climate risks and their impact on your professional activities and livelihood. This interview is part of research conducted for a larger project aimed at improving the availability and utility of climate information for citizens in Tanzania. This project is conducted in partnership with other organizations, both at the national level and international level. If you agree to participate in this interview, we will also talk about topics such as the availability and need for information about weather and climate change, and

how this has changed over the years. We will also be looking at the ways in which people access and use information about weather and climate change and how this can be improved.

Your participation today is voluntary and your responses will be seen only by the researchers who are involved in this project. We will not be using your names in any publication with the information that we collect today. There are no correct answers to these questions, so please feel free to answer honestly and freely. You are of course free not to answer any question and to leave the interview whenever you like. However, your views and experiences are very important to us. We cannot promise that you will benefit directly from this research, but we hope that the information that we are collecting will help to improve climate services and development activities in this country.

Are there any questions before we begin?

SECTION 1: Perceptions of Climate-related Risks

1. What climate risks has this area experienced over the past 10 years?

2. How do these risks affect your district? Do these climate risks materialize into problems for the community? Please explain.

3. Did you receive any information that is useful for adapting to problems caused by weather and climate? If so, what type of information did you receive and where did you get it from?

SECTION 2: Climate Services Demand and Supply

4. Have you ever received any information or warnings about weather or climate change from the national weather prediction agency (TMA) or from any other government offices? For example, do District officials receive information coming from ministries or agencies at the national level or from the Regional secretariat? If yes, how did you receive this information? For example, is it through the phone, email, mass media, civil society organisations, or other ways?

5. If you have received this information or other warnings – for example a seasonal forecast – did you find the information useful? Did you find it useful for your professional role here in the District? Did you find it useful as an ordinary citizen? Can you please explain? If you did receive such information or warnings, were they easy to understand? Why or why not? Please explain and give examples.

6. If you did receive such advisories, were they specific enough in terms of location and timing so that they were relevant to the decisions you make? Would you be able to provide advice to residents in the District about these kinds of decisions based on this information? Please explain.

7. If you did not receive any information, advisories, or warnings from TMA, what kind of information do you use to make decisions about climate risks?

SECTION 3: Perceptions of Current Usability and Potential for

8. Is indigenous knowledge a useful source of information related to the weather and climate change? If yes, please explain how you receive this information and what kinds of decisions it is useful for. If no, why do you think that indigenous knowledge is not useful?

9. If you did receive scientific information about the weather, did this information agree or disagree with the indigenous knowledge you receive? Please explain and give examples.

10. What kinds of information about weather or climate change do you trust most? Please list the kinds of information you trust and why you trust them the most. If you receive both indigenous knowledge or scientific information about the weather, which would you use? Please explain.

11. If you do not know about or receive information and warnings about weather that are coming from the TMA, what do you think is the reason for that? Do you think there is a problem with the ways in which information about the weather is distributed? How could these be improved. Please explain.

12. What kinds of information about weather or climate change do you want to receive? Please explain.

13. How could the current climate services/advisories be improved to make them more useful and to fulfil your specific needs? Please be specific.

14. What changes would you like to see regarding the availability and use of information about weather and climate in your District? How could this information be made more useful for you in your professional responsibility? What changes would you like to see in order for this information to be more useful for decisions about agriculture, health, and disaster risk management in the District?

Thank you for being so generous with your time today and for sharing your views and experiences.

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The research at CICERO concentrates on:

- Chemical processes in the atmosphere
- Impacts of climate change on human society and the natural environment caused by emissions of greenhouse gases
- Domestic and international climate policy instruments
- International negotiations on environmental agreements

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