NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of:
Federal Ministry
for the Environment, Nature Conservation,
Building and Nuclear Safety
of the Federal Republic of Germany

CLIMATE SERVICES FOR INFRASTRUCTURE BASELINE ASSESSMENT REPORT FOR THE NILE BASIN COUNTRIES

JUNE 2018

Deutscher Wetterdienst
Wetter und Klima aus einer Hand
DWD

engineerscanada
ingénieurscanada

Glossary/Abbreviations

ACMAD	African Centre of Meteorological Application for Development
ADB	African Development Bank
AGRHYMET	Centre Regional de Formation et d'Application en Agrométéorologie et Hydrologie Opérationnelle
BMUB	Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
CCS	Climate Change Scenarios
CD	Capacity development
CCAFS	Climate Change, Agriculture and Food Security
CIAT	International Center for Tropical Agriculture
CSIS	Climate Service Information System
CSI	Climate Services for Infrastructure
CPT	Cone Penetration Testing
DWD	German Meteorological Service (Deutscher Wetterdienst)
DWRM	Directorate of Water Resources Management-Uganda
DRR	Disaster Risk Reduction
EAC	East African Community
EIA	Environmental Impact Assessment
ENTRO	Eastern Nile Technical Regional Office
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
ENDRM	Ethiopia National Disaster Risk Management Commission
EPP	Ethiopian Electric Power
GHACOF	Greater Horn of African Climate Outlook Forums
GDP	Gross Domestic Product
GPCS	Global Production Centres
GCMs	Global climate models
GIZ	German Development Cooperation
GFCS	Global Framework of Climate Services
ICAO	International Civil Aviation Organization
ICPAC	IGAD Climate Prediction and Application Center
IGAD	Intergovernmental Authority on Development
IGEBU	Institut Géographique du Burundi
IKI	Germany's International Climate Initiative
IPCC	Intergovernmental Panel on Climate Change
INERA	Institut National pour l'Etude et la Recherche Agronomiques
IRI	International Research Institute for Climate and Society

KMD	Kenya Meteorological Services Department
KOICA	Korea International Cooperation Agency
MWELUP	Ministry of Water Environment, Land & Urban Planning-Burundi
MEEATU	Ministère de l'Eau, de l'Environnement, de l'Amenagement du Territoire et de l'Urbanisme
MOU	Memorandum of Understanding
NARO	National Agricultural Research Organisation-Uganda
NAP	National Adaptation Plan
NBI	Nile Basin Initiative
NCOF	National Climate Outlook Forum
NDC	National Determined Contributions
NELSAP-CU	Nile Equatorial Lakes Subsidiary Action Program Coordination Unit
NMHS	National Meteorological and Hydrological Service
NILE-COM	Nile Council of Ministers
NILE-SEC	Nile Secretariat
NILE-TAC	Nile Technical Advisory Committee
NMA	National Meteorological Authority-Ethiopia
NOAA	National Oceanic and Atmospheric Administration
OBPE	Office Burundais pour la Protection de l'Environnement
OM	Observations and Monitoring
OMM	Ocean Maritime Management
PANA-AFE	Programme d'Action National d'Adaptation au changement climatique en R.D du Congo.
PIEVC	Public Infrastructure and Engineering Vulnerability Committee
PPP	Private-Public Partnerships
PAGIRE	Plan d'Action de Gestion Intégrée des Ressources en eau
PRO	Public Relations Officers
RAB	Rwanda Agriculture Board
RCC	Regional Climate Centre
REDD	Reducing Emissions from Deforestation and Forest Degradation.
RCM	Regional Climate Model
RCOF	Regional Climate Outlook Forum
REGIDESO	Régie de Distribution d'Eau et d'Electricité du Congo Belge et du Rwanda-Urundi
RMP	Research, Modelling and Prediction
SCOT	Strength, Challenges, Opportunities and Threats
SDG	Sustainable Development Goals

SSMD	South Sudan Meteorological Department
SMA	Sudan Meteorological Authority
SNEL	Société nationale d'électricité
UIP	User Interface Platform
UK-MET	United Kingdom Meteorology
UNDP	United National Development Program
UNFCC	United Nations Framework Convention on Climate Change
UNMA	Uganda National Meteorological Authority
WB	World Bank
WFP	World Food Program, African Development Bank (ADB),
WMO	World Meteorology Organisation
WRF	Weather Research and Forecasting

Table of Contents

Table of Figures

List of Table

1. EXECUTIVE SUMMARY

Every year, emerging economies and developing countries invest billions in long-term infrastructure projects. However, their plans often fail to take account of future climate change. This leads to high risks of damage and misguided investments that harbour potentially serious consequences for the economy and society. Although the Global Climate Models (GCMs) don't seem to agree on the impact of climate change on the precipitation within the Nile Basin, nonetheless, prediction with regards to temperature suggest a trend towards the warming of surface temperature over the region; the impact of which would create extreme weather events like floods and droughts and in some cases, disasters that can lead to destruction of infrastructure especially water related ones.

Known as Climate Services, user-oriented climate information and products (e.g. risk and vulnerability analyses) that enable public and private decision-makers to manage climate risks and opportunities form a major cornerstone of measures to raise the resilience of national infrastructures. Many countries within the Nile Basin region so far lack the institutional, technical and service-related conditions they need to set up and mainstream climate services in their planning procedures and regulations. Amongst the first international initiatives to take up this challenge is the Global Framework for Climate Services (GFCS) of the World Meteorological Organization (WMO).

In order to enhance the provision of Climate Services for infrastructure investments, a baseline assessment of available Climate Services is done which are provided by National Meteorological and Hydrological Services (NMHS) in the Nile basin region. This baseline comprises all available and desired Climate Service products for the water sector as well as an assessment of the state of the Climate Service infrastructure regarding the NMHS's capacities and potential to generate useful and usable climate information products for water-related sectors. The classification of the NMHSs happens according the WMO categories for NMHS (WMO 2012). The baseline shall help to identify current strengths, challenges, opportunities and threats of Climate Service provision of the NMHS of the individual countries and subsequently disclose entry points for the enhancement of effective and user oriented climate information provision.

Altogether baselines for eight countries were produced based on data collected in interviews, surveys and workshops. These eight countries comprise Burundi, DR Congo, Ethiopia, Kenya, South Sudan, Sudan and Uganda. Information from Egypt and Tanzania are not available. Furthermore, users from all participating countries representing various water-related sectors like energy, agriculture, various water infrastructures (dams, irrigation, etc.) and construction were interviewed about their use and demands of climate information for their specific sectoral context.

The most important general results of the baselines in the Nile basin region can be summarized as follows:

- *Strengths*: most of the NMHS do meet the requirements of Category 1 (basic functions) and category 2 (essential services); meaning that they can perform the essential functions of: medium-range (synoptic scale) forecasts and warnings establish links with media and DRR communities; provide seasonal climate outlooks and climate monitoring; also provide hydrological data products for design and operation of water supply structures; water level and flow monitoring, short-term flow forecasts (low flows) and flood forecasting. But with engagements and collaborations with regional and international organisations, allow them to access services and products from categories 3 (full range) and 4 (advanced), for example

WMO and regional climate outlook forums like GHACOF and thus being able to provide a much improved service.

- Main *challenges* are general low capacities and available funds of the NMHS in all respects especially regarding technical equipment and infrastructure, man power and knowledge and skills. This general basic infrastructure only allows the operation, maintenance and thus provision of basic to essential climate information products. Knowhow and capacities are often not sufficient for sophisticated climatological statistics like climate indices and user-specific tailored information products. Furthermore, there is shortage of private sector players in the value chain of climate services apart from those who deal in the manufacture of equipment or support the dissemination of products. Some of the reasons cited are that the policies, regulatory and structural environment in most of the countries restrict participation of other entities which are not NHMS from involvement in climate services especially at the providers' side. In those cases where the private sector is involved, there are no cooperation agreements that allow for further engagement and collaboration.
- Beside the challenges, there are various *opportunities* in Climate Services in the Nile basin region: a wide range of data is available within the region and this includes climatological observation from various sources as well as impact data and socioeconomic information. Furthermore, most of the NHMS within the Nile basin have mandates to carryout research activities, some with fully pledged units. They also do share research responsibility with mainly University and agricultural organizations in their respective countries, part of the research results are then used in operational practice. Highly noted is the collaboration with other national, regional and international organizations such as: WMO, ICPAC, African Centre of Meteorological Application for Development (ACMAD), United National Development Program (UNDP), World Food Program (WFP), World Bank (WB), among many others. Most NHMS have dedicated persons to interact with the public and in some cases, the users come with their needs while in others, the Public Relations Officers (PROs) hold regular meetings, are involved in studies, and complete questionnaires and surveys. Additionally, users from various sectors have a broad awareness of the relevance of climate, climate change and the impacts for their specific contexts.
- The potential of the existing opportunities are limited due to various *threats*: the NHMSs are operating within legal, policy and strategic oriented environments. Their funding varies from national budgets to donor funding and in some incidences, internally generated funds. Thus, with exception of a few, most of the HHMS are still fully embedded in their government structures and not semi-autonomous. The consequences are that although most of these NHMS share data with WMO, they have policies that restrict free and open data sharing. Furthermore, due to missing link to the private sector, additional funding is hampered as well as the provision of a comprehensive portfolio of Climate Services as well as value-added sector specific products within a climate value chain. Beyond that gaps do exist especially with recognition and visibility of services including social-economic benefits of climate services within their governments which hamper the use and appraisal of Climate Services. This is supported by an interaction between user and providers which is mostly based on request and not so much supported by any formal agreements like MOUs or contracts which hampers the understanding and consideration of user needs in the provision and tailoring of climate services.

2. INTRODUCTION:

2.1. Project background

The project Enhancing Climate Services for Infrastructure Investments (CSI) forms part of Germany's International Climate Initiative (IKI). In accordance with a resolution by the German Bundestag the IKI receives backing from the country's Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB).

CSI aims to empower decision-makers to make greater use of Climate Services when planning infrastructure investments and thus help raise infrastructure resilience. In this way, it is helping to achieve the UN Sustainable Development Goal (SDG) 9.

To achieve its objective, CSI brings together all relevant private and public-sector actors along the Climate Service value chain. This includes climate data providers and the stakeholders, decision-makers and engineers who work with this data. All activities are purposefully integrated into the National Adaptation Plans (NAP) and National Determined Contributions (NDC) as part of a drive to promote NAP and NDC development and implementation.

CSI prioritises four areas. Specifically, it

- supports the provision and use of climate services,
- supports the integration of the use of Climate Services into infrastructure planning,
- pilots climate risk assessments for infrastructure,
- promotes international knowledge transfer and exchanges.

Establishing a sustainable interface between users (e.g. infrastructure planners, operators and owners) and Climate Service providers – referred to as a Climate Service User Interface Platform (UIP) – enables potential Climate Service users to participate in the development process. At the same time, it involves providers in the use of the information for infrastructure planning. The German National Meteorological Service (DWD) advises Climate Service providers and users on the delivery and use of Climate Services.

CSI also focuses on climate-sensitive infrastructure planning methods that take risks into account. Together with decision-makers, the project develops recommendations for adapting planning procedures and regulations in line with the climate-proofing approach, e.g. via cost-benefit analyses, the development of building standards or environmental impact assessments (EIA).

To identify climate risks, CSI is piloting a climate risk assessment for a specific infrastructure type in each of the partner countries, thereby creating a starting point for prioritising the various adaptation options. Engineers Canada is advising the partner countries on the risk assessment rollout. Based on the Public Infrastructure Engineering Vulnerability Committee (PIEVC) protocol that Engineers Canada developed to analyse climate risks to infrastructure, the project aims to build local capacity by means of a learning-by-doing approach. At the same time, it is compiling handouts and training materials to disseminate this approach and to operationalise the adapted planning procedures and regulations.

Furthermore, CSI shares its experience and best practices with national and international forums and posts them on AdaptationCommunity.net, amongst other sites.

2.2. Background and structure of report

2.2.1. Purpose

In order to enhance the provision and use of Climate Information the current state of a National Climate Services needs to be assessed and analysed. The state of a National Climate Service is defined as a snap-shot of the currently provided and actually used climate information infrastructure, products and services on a country or regional level. Such a baseline reflects actual and specific strengths, challenges, opportunities and threats of climate information provision. It furthermore serves as a starting point for the development of appropriate strategies, concepts and concrete measures to enhance the availability and supply of climate information products and services as well as their usability and thus impact on decision-making.

2.2.2. Scope

This assessment report provides no comprehensive baseline of the National Climate Services in the NBI region. Instead, it concentrates on the core area of the NBI which is the water sector or other sectors related to water. Object of the assessment is the inventory of climate information products and services which are actually or potentially relevant and currently available for the water sector. Furthermore, the assessment comprises the current use of Climate Services within this sector and the potential needs for Climate Services by relevant sectoral stakeholders in the individual countries.

2.2.3. Outputs and objectives

The baseline report provides an abstract of the National Climate Services in the NBI region in the context of the water sector. It provides an overview of relevant stakeholders for Climate Service provision and key actors of the water sector for each country. It furthermore lists currently available and used Climate Services for the specific sectoral context and identifies and classifies existing gaps and challenges in climate information use and provision. Beyond that strengths and opportunities of the prevalent National Climate Services are highlighted which qualifies the report to provide recommendations for short- and long-term measures and strategies to enhance Climate Services for infrastructure investments in the water sector within the NBI region. An outlook is given which will offer an insight into the next probable steps from this report and this would include two aspects of: 1) a policy brief coming out of this report and 2) this report providing basic information to support the activity on climate risk assessment for infrastructure in the Nile basin.

2.2.4. Structure of report

The baseline report is structured as follows: in the following chapter (2.3) the theoretical background for Climate Services is provided. This includes a definition and introduction into the concept of Climate Services and the concept of the Global Framework of Climate Services. In *chapter 3* the assessment concept is explicated and applied methods of data collection and analysis are presented as well as processes and procedures of implementation. In *chapter 4* the current situation of the individual countries of the NBI region is presented regarding current and expected climate risks and provided as well as used climate services. In *chapter 5* the results of all countries is evaluated by the classification of the NMHS of the individual countries and the identification of gaps and challenges in climate service provision. Conclusions and

recommendations based on the results are provided in *chapter 6* and *chapter 7* closes with an outlook.

2.3. Conceptual basis

2.3.1. Definition and scope of climate services

Since the concept of Climate Services is relatively new, various definitions and interpretations exist. The CSI project agreed on the definition provided by the World Meteorological Organization (WMO) in the context of the Global Framework of Climate Services (GFCS). The WMO defines Climate Services as follows:

"Providing climate information in a way that assists decision making by individuals and organizations. A service requires appropriate engagement along with an effective access mechanism and must respond to user needs" (WMO 2014a).

The general definition from WMO provides a rather loose delineation of the scope of Climate Services and gives thus room for interpretation. To get a better idea about the scope of Climate Services, the definition of the European Commission provides a more detailed definition which can be considered as supplement:

"Transformation of climate-related data — together with other relevant information — into customized products such as projections, forecasts, information, trends, economic analysis, assessments (including technology assessment), counselling on best practices, development and evaluation of solutions and any other service in relation to climate that may be of use for the society at large. As such, these services include data, information and knowledge that support adaptation, mitigation and disaster risk management" (EU 2015).

***Box1**: basic definitions, as used in GFCS Implementation Plan (WMO 2014a)*

Climate data: Historical and real-time climate observations along with direct model outputs covering historical and future periods. Information about how these observations and model outputs were generated ("metadata") should accompany all climate data.

Climate product: A derived synthesis of climate data. A product combines climate data with climate knowledge to add value.

Climate information: Climate data, climate products and/or climate knowledge.

The definitions above imply three fundamental characteristics of Climate Services which also distinguish Climate Services from climate data and climate information (Box 1). These characteristics are here defined as the three dimensions of Climate Services and refer to and merge the Climate Service elements defined by WMO (2014a) *[products; support; feedback]* and

IRI (2012) *[information; collaboration; policy & practice]*. The Climate Service dimensions are defined as follows:

- The *technical dimension* refers to the content of climate information and its relevance for a specific user, user-group or sector (e.g. parameters, indices, etc.). It also refers to the contextualization of climate information with respect to scale and resolution (temporal and spatial) but also format and style of presentation of climate information (e.g. maps, graphs, diagrams, etc.). And furthermore it comprises the quality of climate information and the provision and communication of meta-data and information on uncertainty along with the climate information.
- The s*ervice dimension* refers to dissemination and utilization of climate information. Dissemination comprises the provision of access to climate information (e.g. data policy, data platforms, etc.) but also promotion of climate information to enhance visibility and perception of the added value for the user. A critical aspect of dissemination is the timing of delivery and up-date frequency of climate information. Utilization refers to the support of the user in using climate information for his decision-context. This may comprise assistance for data interpretation, decision-support tools and advice for the implementation in decision-making processes as well as training and educational material on these issues.
- The *institutional dimension* refers the cooperation of relevant stakeholders which are involved in the production of a Climate Service. This implies the cooperation between various (climate) data and information providers as well as the relationship to users to guarantee usefulness and usability of climate information. But also cooperation to political stakeholders to ensure appropriate data policies mandates and guidelines for the use of climate information.

The Climate Service dimensions suggest that a Climate Service product goes beyond the purely technical level but also includes the provision, communication and advice on climate information as well as the interaction with users and other stakeholders. Furthermore, a Climate Service product has often to be considered as a joint product which involves the cooperation of several stakeholders. Such a cooperation may be characterized either by a concurrent and/or subsequent coproduction of a Climate Service product. An end-to-end production cycle which interlinks raw data and decision-making is characterized by one or several steps of value-adding which might be tailoring of data or provision of information and services, etc. to make climate information usable. This process is here described as climate value-chain which is required to produce and provide a Climate Service. The basic stakeholder of a Climate Service value chain can be classified as follows:

- *Providers*: providers of climate information collect, manage, archive and provide climate data and also basic climate diagnostic- and monitoring products as well as climate predictions and projections. Key providers on the national level are mainly National Meteorological and Hydrological Services (NMHS).
- *Intermediates*: intermediates have the function of value-adding and can be differentiated in two types: (1) technical intermediates refine basic climate data or information by tailoring and/or adding external data. Important stakeholders may be impact modelers, risk managers or authorities; (2) institutional intermediates or brokers have the function of communicators of climate information as well as advisors for decision-making. Private companies, NGOs or authorities are important stakeholders.

- *Users*: the term user predominantly targets on stakeholders who use climate information for decision-making in a practical context. Important stakeholders for infrastructure sectors are managers, planners, engineers or politicians. However, also intermediates are users of climate data and information which often causes discussions and confusion.

Consequently, each Climate Service is characterized by a specific climate-value chain. A climate value chain is always defined by at least one provider and one user. However, the number of intermediates may vary significantly depending on the complexity of purpose and context of a Climate Service application, and furthermore, on the type of end-user and his demands for Climate Services which reflects his capabilities and capacities to process, interpret and digest climate data and information. Besides the amount of stakeholders, also the type of stakeholders may vary or change regarding the context of the Climate Service application. Intermediates and also the users appear often in a very sector-specific context whereas providers take a rather consistent role for Climate Service provision.

2.3.2. Global Framework for Climate Services (GFCS)

The development of the Framework for Climate Services (GFCS) was initiated at the World Climate Conference-3 in 2009 in Geneva which was followed by a High Level Taskforce who developed the concept in a report which was published in 2011. The motivational background for the establishment of the GFCS was the perception that *"present capabilities to provide effective climate services fall far short of meeting present and future needs and of delivering the full potential benefits, particularly in developing countries"* (WCC-3 2009, p.2). The identified shortcoming primarily refers to the coordination of existing capabilities, infrastructures and programs and institutions which address individual aspects of climate services and often operate in isolation with varying degree of success. The purpose of the Framework is not to provide Climate Services but to coordinate, facilitate, and develop operational climate services where needed. The GFCS bridges the gap between climate service providers and users so that outputs become better assimilated by decision-makers. Thus, the vision of the GFCS is *"to enable society to manage better the risks and opportunities arising from climate variability and change, especially as they concern those who are most vulnerable to climate-related hazards"* (WMO 2014a, p.4). The goals of GFCS in support of this vision are:

1. Reducing the vulnerability of society to climate-related hazards through better provision of climate information;
2. Advancing the key global development goals through better provision of climate information;
3. Mainstreaming the use of climate information in decision-making;
4. Strengthening the engagement of providers and users of climate services;
5. Maximizing the utility of existing climate service infrastructure.

The structure of GFCS is based on five essential components which are required to enable the production and dissemination of effective climate services (Error! Reference source not found.). The characteristics of the five components of GFCS are briefly described:

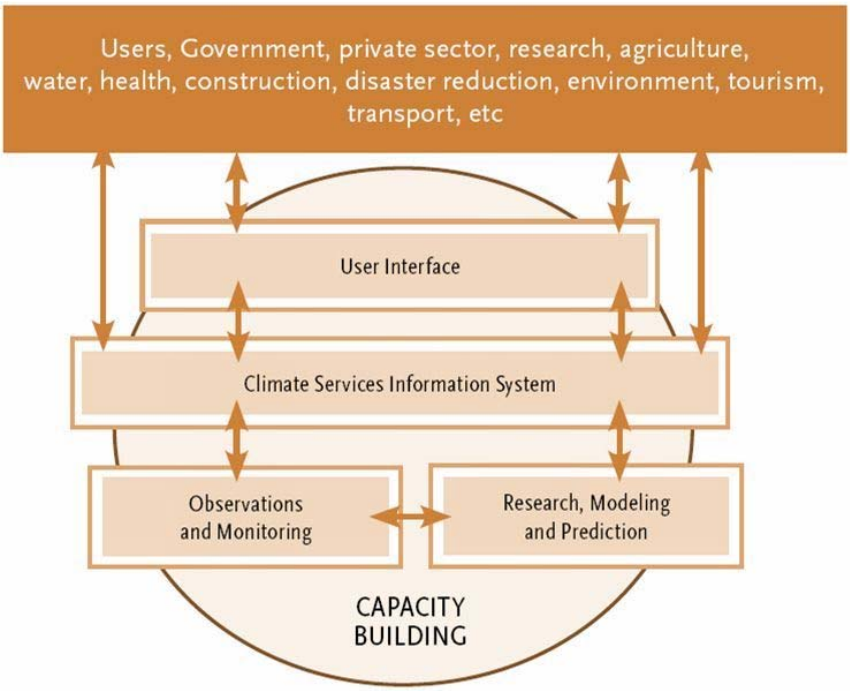

Figure 1: the five elements of the GFCS

- *Observations and Monitoring (OM):* OM helps ensure that the climate observations necessary to meet the needs of end-users are made, managed and disseminated, supported by relevant metadata. High-quality historical and real-time observations and data are required not only across the entire climate system but also relevant biological, environmental, and socio-economic variables so that the impacts of climate variability and change can be evaluated and addressed. Monitoring products such as extreme value statistics derived from high-quality climate observations are of prime importance to planning decisions, for instance regarding reducing disaster risk by developing appropriately resilient infrastructure (WMO 2014a, p. 9).
- *Research, Modelling and Prediction (RMP):* RMP fosters research towards continually improving the scientific quality of climate information, providing an evidence base for determining the impacts of climate change and variability and for evaluating the cost-effectiveness of using climate information. It supports the development and improvement of tools and methods that will facilitate the transition of research to operational climate service provision and engender practical applications of climate information. High-quality, reliable observation data and targeted dynamical model outputs will be developed to support the activities of the other pillars (WMO 2014a, p. 10).
- *Climate Services Information System (CSIS):* The CSIS is the principal mechanism through which information about climate (past, present and future) is routinely archived, analysed, modelled, exchanged and processed. The CSIS is the 'operational core' of the GFCS; it comprises a physical infrastructure of institutes, centres and computer capabilities that, together with professional human resources, develops, generates and distributes a wide range of climate information products and services to inform complex decision-making processes across a wide range of climate-sensitive activities and enterprises. Its functions include climate analysis and monitoring, assessment and attribution, prediction (monthly, seasonal, decadal) and projection (centennial scale). These functions comprise processes of data retrieval, analysis and assessment, re-analysis, diagnostics, interpretation, assessment,

attribution, generation and verification of predictions and projections and communication (including exchange/ dissemination of data and products). Knowing user requirements and understanding how users apply climate information will be essential for designing, disseminating and encouraging uptake of CSIS products and services (WMO 2014c, p. iii-iv).

- *User Interface Platform (UIP):* the UIP provides a structured means for users, climate researchers and climate data and information providers to interact at all levels. The objective of the UIP is to promote effective decision-making with respect to climate considerations by making sure that the right information, at the right time and in the right amount, is delivered, understood, and used. It can be defined further as a managed methodology, or a collection of methods, means, approaches, and processes of systematic and mutually beneficial collaboration. It enables interactions that help define user needs and provider capabilities, tries to reconcile the needs with those capabilities, and eventually promotes effective decisions based on climate information. To achieve its objective, the UIP is aiming for four outcomes: feedback, dialogue, outreach and evaluation. In considering the scope of the UIP it must be borne in mind that the Framework is not a centrally managed system. The methods for developing interactions between climate service users and providers will be determined on a case-by-case basis using available technologies and capabilities (WMO 2014d, p.1-2).
- *Capacity Development (CD):* CD tackles two separate but related activity areas: (i) the particular capacity development requirements identified in the other four pillars; and (ii) more broadly the basic requirements (national policies/legislation, institutions, infrastructure and personnel) to enable any GFCS related activities to occur. In the context of both activity areas capacity development actions under the Framework will facilitate and strengthen, not duplicate existing activities. They will also address needs from both the demand side and the supply side of climate services (WMO 2014b, p. iv-1).

The five components do not function as stand-alone entities but they need to interact to in order to make the production, delivery and application of Climate Services effective. Furthermore, they need to be considered as conceptual models which cannot be delineated clearly in practice and will cause some overlapping of functions and responsibilities. The functions and responsibilities of each element do not necessarily need to be covered by one institution but may be distributed to various stakeholders.

The fulfilment of the tasks covering the five elements as well as the coordination of the involved stakeholders on a national scale constitutes a National Climate Service. A well-organized National Climate Service has the capacities and capabilities to provide core climate products for all relevant sectors and for various demands and furthermore to facilitate end-to-end climate service provision due to a well-developed User Interface Platform with a wide interlinked network in various sectors and close continuous relationships to a wide range of users, user-groups and other relevant sectoral stakeholders.

3. METHODOLOGY:

3.1 Assessment concept

The objective of the assessment is to provide an abstract of the NCSs within the Nile Basin Region (NBR) in the context of the water sector. The National Climate Services will be characterized and described in this study by basically three outputs:
(1) a classification of the current state of NCSs according the WMO classification (WMO, 2012) (5.1). The NCS classification is assessed on the basis of the GFCS components. The state of each component within the NCS is analysed by considering the fulfilment of the required functions regarding the definitions of GFCS (see 2.3.2). The components reflect both, the currently available products and services as well as the capacities of the existing Climate Service infrastructure to potentially provide climate service products according possible user needs. The findings are visualized in a stakeholder map which identifies all relevant institutions that are part of the NCS of each country. Furthermore, the findings are summarized within a SCOT analysis by classifying each NCS's strengths, challenges, opportunities and threats.
(2) a list of currently existing gaps of climate service products which are actually or potentially useful for the water sector (5.2). This list is based on interviews with the NMHSs as well as key users from each country.
(3) a synopsis of the Climate Service users in the NBR and the general provision and use of in the NBR (5.3). This comprises a presentation of the dominant sectors using Climate Services and a list of all Climate Service products which are currently being used and desired by users of the water sector in the NBR. The main findings are again summarized within a SCOT analysis differentiating strengths, challenges, opportunities and threats of climate information provision and use in general in the NBR.
According to these analyses, entry points for specific measures to enhance the provision of climate services for infrastructure investments will be identified.

3.2 Methods

The basic methods for data collection are questionnaires. Altogether two questionnaires were developed: one for providers and one for the users. There is no extra questionnaire for intermediates, since the classification to a stakeholder type is often not that clear and causes discussion and confusion. The user-questionnaire is also suitable for intermediates since it asks for the purpose and output of the use of climate information which can refer to a decision-making process as well as to a product or service which will be used by another stakeholder. Although, the catalogue of questions is provided in the format of a questionnaires the required information can also be collected via other methods like interviews or workshops depending on the local situation.

Provider questionnaire: the structure and content of the provider questionnaire mainly addresses NMHSs since these are normally key stakeholder of the Climate Service provider group covering fundamental tasks of a National Climate Service. However, the questionnaire is also suitable for other Climate Service providers when skipping some of the questions. The provider questionnaire is compiled from several WMO questionnaires. This comprises a standard questionnaire from WMO which is use to observe the development of its members as well as three draft versions which also address the current status of Climate Services provided by NMHSs in the context of the national GFCS implementation.

User questionnaire: the user questionnaire was completely developed within the CSI project. However, ideas and experiences from other projects and programs addressing users and their need for Climate Services were considered (e.g. Bessembinder et al. 2012; Daly et al. 2016; BELSPO 2014). The scope and structure of the user questionnaire addresses a range of user types. This comprises experienced users who regularly use climate data and are able to process climate data for their context as well as user who have no experience with climate data. Less experienced users often require tailored products and help with interpretation of climate information as well as decision support. They are often not able to formulate their needs for specific climate information products. The questionnaire is structured in a way that a user is guided to identify his needs for climate information for his specific context.

3.3 Procedures and Schedules

The governance structure of the NBI was used to identify the participating institutions through support from the Nile Technical Advisory Committee (Nile-TAC) which is comprised of senior government officials (two from each of the member States). The Nile-TAC are technical officers in ministries in charge of water affairs in each NBI Member State and support the highest decision and policy-making body of NBI called the Nile Council of Ministers (Nile-COM).

The overall approach within the NBI was to administer the baseline questionnaire using different methods of: I) conducting a baseline survey via email, ii) direct face to face Interviews and iii) invite and conduct a forum on climate services for infrastructure. The Nile Basin Initiative (NBI) structure of the Nile Secretariat (Nile-Sec) provided a good basis for contact to both climate service providers and users in each NBI country. The interviewees were reached using the Nile-TAC members who provided contacts for each of their country participants; who were then invited to the CSI forum and also asked to complete the baseline questionnaire.

The forum was held over a 4 days, from the 5-8 February at the LAICO-Lake Victoria Hotel at Entebbe-Uganda. The attendance was of 52 participants with 5 participants (roughly 3 providers & 2 users) from 8 countries of the NBI. The workshop was deliberately designed to be participatory and consisted of key presentations and training on climate services for infrastructure, and a market place for presentations and plenary sessions for participants to share information and experience on climate services for infrastructure. In the workshop, the product and service matrix was shared and used as an exercise to gather baseline information from each country. Also, each country was requested to make presentations about the current status of climate services in their respective countries and this was further collaborated when each country worked on a Strength, Challenges, Opportunities and Threats (SCOT) analysis of climate services in their countries as presented to the plenary.

Prior to the attendance for the workshop, each of participants received the questionnaires via email and was requested to answer the questions as this would be useful for their participation at the workshop. It should be noted that the questionnaires which were designed separately for both Users and Providers was further divided into 3 parts each to ease the sharing within each recipient organisation. In the case of Uganda, direct interviews were done with the respective institutions. After the forum, the participants who had not attempted the questionnaire were sent reminders and finally, the participants who submitted completed questionnaire were from the following countries: Burundi, Democratic Republic of Congo, Ethiopia, Kenya, Rwanda, Sudan

and Uganda (Provider questionnaire); and Burundi, Democratic Republic of Congo, Kenya, Rwanda and Sudan (User questionnaire).

The participants to the workshop were profiled as: 1) Providers being those who have a primary role is the collection and provision of climate data and information but also the developers of climate products and services. They should be individuals working with national institutions that provide meteorological and hydrological services in their countries at senior positions of responsibility and involved in high level decision making, while 2) Users are those whose primary role is the utilization of climate data, information, products and services for application into their day to day work like design, operation and planning for water related infrastructure or representatives from national professional engineering associations whose responsibilities are related to enforcing engineering standards, building codes and design criteria. The identified and participating institutions are given in the table below:

Table 1: Key stakeholders who participated at the CSI forum, completed questionnaire and/or product matrix

Country:	CSI Provider Institution	CSI User Institution
BURUNDI	Ministry of Water Environment, Land & Urban Planning, MWELUP	Ministry of Energy and Mines
	Hydro-Meteorological Department	Ministry of Agriculture and Livestock
DEMOCRATIC REPUBLIC OF CONGO	Division METTELSAT, Ministry of Environment	National Hydraulic Services
	Division d'Agromet – METTELSAT, Ministry of Environment	Center for Rainfall Forecasting and Climate Change
ETHIOPIA	National Meteorological Agency	Ethiopian Construction Design and Supervision Works Corporation
	Hydrology and Water Quality Directorate, Ministry of Water Irrigation and Electricity	Hydro Power Plant Operation & Maintenance Directorate, Ethiopian Electric Power
KENYA	Forecasting Services, Kenya Meteorological Services Department-Ministry of Water & Irrigation	Water Infrastructure Department, Ministry of Water & Sanitation
	Hydrological Services, Kenya Meteorological Services Department, Ministry of Water & Irrigation	National Water conservation & Pipeline
RWANDA	Rwanda Water and Forestry Authority,	Rwanda Agriculture Board, Soil And Water Management Research Unit,
	Rwanda Meteorology Agency	
SOUTH SUDAN	Environmental Management and Sustainable Development-Ministry of Environment and Forestry	Directorate of Irrigation and Drainage-Ministry of Water Resources and Irrigation
	South Sudan Meteorological Department Juba International Airport Met Office	Ministry of Energy and Dams
	Hydrology Center - Dams Implementation Unit, Ministry of Water Resources Hydrology Center	Ministry of Water, Electricity and Irrigation

SUDAN	Dams Implementation Unit	
	Agro-Met Unit - Sudan Meteorological Authority Khartoum	Dams Implementation Unit - Ministry of Water Resources Irrigation and Electricity
UGANDA	Uganda National Meteorological Authority	
	Water Resources Planning and Regulations, DWRM, Ministry of Water and Environment	

4. CLIMATE CHANGE AND CLIMATE SERVICES (USE AND NEEDS) IN THE NILE BASIN

This chapter shall provide information describing the basin, the role of the NBI, the expected climate change risks and projections per country and the expected changes within the basin as a whole.

Introduction of the Nile Basin Initiative

The River Nile, arguably, the longest river in the world at 6,853 kilometres (4,258 miles) flows northwards from Africa's central heartland to the Mediterranean Sea through and/or by contribution of tributaries from 10 countries of Burundi, Democratic Republic of the Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania, and Uganda. The total basin size is approximately 3,400,000km^2.

In February, 1999, the Nile Basin Initiative (NBI) was set up as an intergovernmental partnership of the above named 10 Riparian/ Nile basin countries. The NBI operates through three (3) centres and one of them is the Nile Basin Initiative Secretariat (Nile-SEC) which is the executive arm of the Nile Basin Initiative (NBI). The Nile-Sec is jointly owned by all the 10 Member States and based in Entebbe, Uganda. It was established by the Nile Council of Ministers (Nile-COM) aimed at delivering critical services and products for sustainable development in the Basin through basin cooperation and water resource management. The other two are the Nile Equatorial Lakes Subsidiary Action Program Coordination Unit (NELSAP-CU) and Eastern Nile Technical Regional Office (ENTRO).

The partnership is guided by the shared objective to achieve sustainable socio-economic development through the equitable utilization of, and benefit from, the common Nile basin water resources and currently, the NBI is responsible or undertaking several infrastructure projects mainly in energy, irrigation and water management with nearly USD 1.5 billion of Investments realized and a further investment pipeline of approximately USD 6 billion being planned. Similarly, the NBI through its strategic vision plans for 25-30 dams within the basin that have a potential capacity of 200-400bcm by 2050 as contained in the NBI Report (2016). This would therefore require great effort from water resources managers and planners in putting this into consideration of the effects of climate change impacts onto the current and future development of water projects in the region. This will involve improving previous practices while looking towards new and innovative ways. One such way is through the Climate Services for Infrastructure (CSI) project as already described in Chapter 2.1 above.

Climate Change risks within the Nile Basin

The Nile Basin is one of the most important shared water basins in Africa with immerse climate variability from extreme aridity in the north, to the tropical rainforests in Central and East Africa. This affects the distribution of precipitation leading to significant differences in the wet and dry distribution period of some areas in the tropical region of the Nile basin (M. B. Butts et al, 2016). With regards to climate change, Africa is seen as one of the most vulnerable regions to weather and climate change impacts (IPCC 2007). It is suggested that the Nile basin water resources are highly sensitive to climate change (Conway et al., 2007) with flow projections in the near future (2020–2049) expected to reduce while the far future(2070–2099) shows both increasing and decreasing trends (M. B. Butts et al, 2016). Although the Global Climate Models (GCMs) don't

seem to agree on the impact of climate change on the precipitation within the Nile Basin, nonetheless, prediction with regards to temperature suggest a trend towards the warming of surface temperature over the region; the impact of which would create extreme weather events like floods and droughts and in some cases, disasters that can lead to destruction of infrastructure especially water related ones.

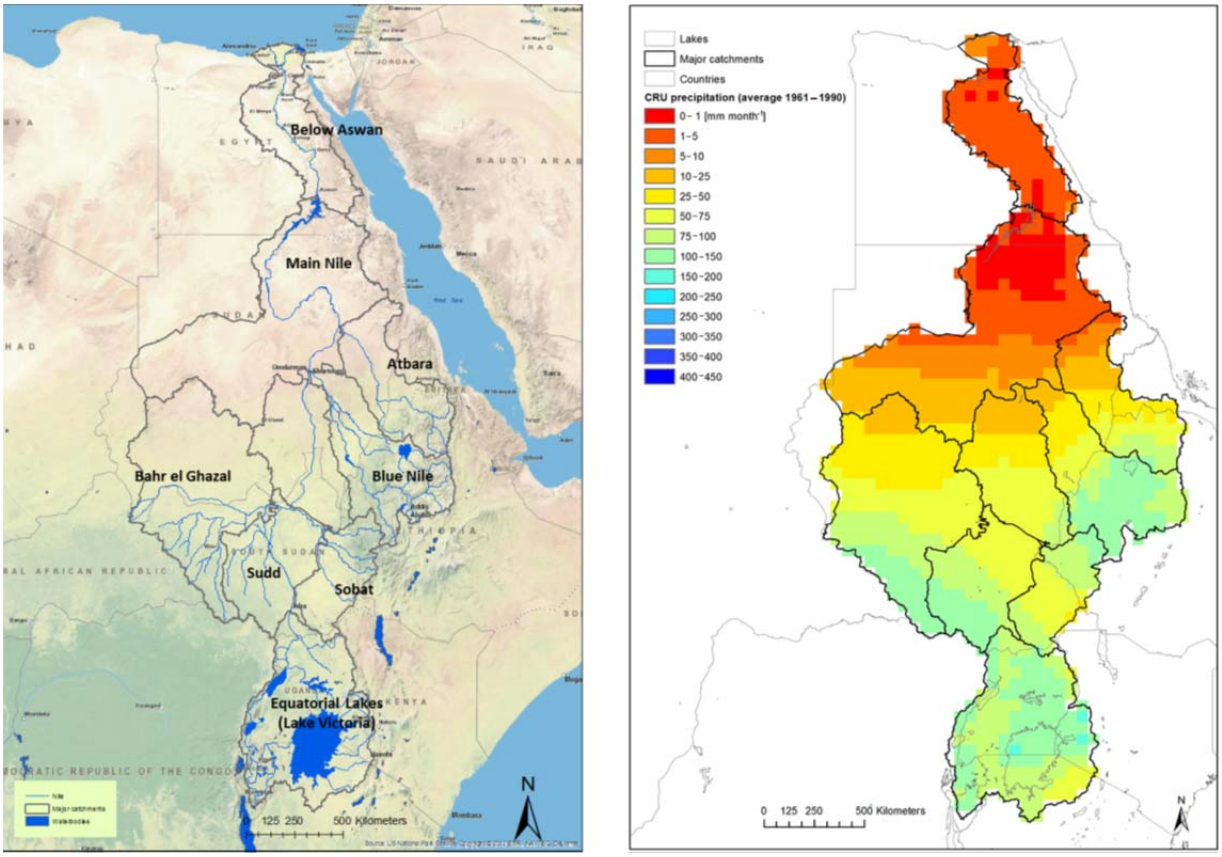

Figure 2: An overview of the Nile Basin (left) and distribution of annual average rainfall in mm/month for the period 1961–1990 (right), from CRU (Harris et al., 2014).

4.1 Climate Change and Climate Services in Burundi

The questionnaire was completed by a representative from the Ministry of Water, Environment, Land and Urban Planning (MWELUP), herein referred to as the Burundi NMHS. The information derived from the questionnaire, product matrix and independent research provides the climate change risks in the country, the climate services baseline and the use, needs and evaluation on climate services products with their portfolio.

4.1.1 Climate Change risks in Burundi

According to a study, climate change projections for Burundi by Liersch, Rivas et al (2014), the expected changes of temperature and precipitations for Burundi will be such as:

- Precipitation for Burundi is projected to generally increase with the eastern and southern parts of the country as well as the central plateau receiving more rainfall.
- While rainfall will increase during the rainy season, the months before the onset of the rainy season (August/September) might become drier. This would mean a likely prolongation of the dry season is projected by some of the models used.
- There is high probability that annual average air temperatures will steadily increase in Burundi over the 21st century with air temperatures expected to particularly increase in the dry season.
- The future surplus of water could likely increase the risk of extreme rainfalls.

4.1.2 Climate Services baseline of Burundi

This shall be used to provide an evaluation and summary of the results from the general questionnaires received from the NMHS and also the completed product matrix for services provided. The elements covered with the questionnaire and product matrix was within the general framework of applying the structure of Global Framework of climate services (GFCS) to the elements listed in the subsequent sub-chapters below:

i. Observations and monitoring (OM)

The objective of this sub-section is to identify the available data sources and the state of observing systems which may also include identification of the quality of available data management systems and mechanisms within the NBI countries.

The questionnaire was completed by a representative from the Ministry of Water, Environment, Land and Urban Planning (MWELUP), herein referred to as the Burundi NMHS. It was stated that the Burundi NMHS adheres to climate monitoring principles with most of the data sources and observation system measurements attributed to both atmospheric and terrestrial parameters. The ocean parameters are neither measured nor stored. Besides data and information generated within the country, the Burundi NMHS has access to observational data from neighbouring countries and also stores different sets of data which include: satellite data, re-analysis data and model data, both as Global Climate model (GCM) &Regional Climate Models (RCM). Unfortunately, the Burundi NMHS does not have gridded/ interpolated data or access to socio-economic and impact databases. It should also be noted that Burundi NMHS creates, archives and documents climate data sets and has the data stored in databases for the appropriate length and time. This also involves collecting and storing data and metadata into adequate databases although it is also planned to have improvements made to those databases. The Burundi NMHS does apply quality tests and has a data rescue program in place; this is done alongside sharing

data with World Meteorology Organisation (WMO) and Regional Climate Centres (RCC) for operational purposes and backup. This is done within the boarder obligation of not having restrictive policies to free and open sharing of data with other entities. Besides have this policy on data sharing, the Burundi NMHS also has other strategies for ensuring security, integrity, retention and technological migration for data archival processes and systems. Some of the notable challenges with data for the production of climate services as mentioned by the NMHS are technical capacity building and financial resource needs.

The Burundi NMHS did state some major challenges associated with observation network and data availability in the country which they admit these do limit the provision of climate services and products and these are:

- The few number of stations and technical equipment for providing qualitative data,
- Limited spatial coverage of observational network,
- Inadequate staffing levels and their capacities,
- Poor financial and technical resources.
- Weak means of communication and transmission of data from the observation stations.
- Limited data access and cooperation with other climate data provider with in the region and at international levels.

Despite all the challenges above, the Burundi NMHS has long-term strategies of managing the network and improving data availability and for this; they intend to make changes to the station network and this will be through relocation, automation and protection.

ii. Research, modelling and prediction (RMP)

This section is to identify the current research capacities and cooperation potential for product development and services orientation within the Nile basin countries.

The Burundi NMHS has a mandate to carryout research activities and with a fully pledged unit although it is not explicitly mentioned whether this unit has fully dedicated personnel or mechanisms of dealing with user requirements and operational service provisions. Also not mentioned is if some of the research results are used in operational practice with specific user needs and groups so that it could eventually lead to the development of new tools and knowledge for multi-disciplinary studies and applications such as smart agriculture, climate-health, climate-tourism, etc. Nevertheless, the NMHS indicated that they share research responsibility with mainly university, regional entities and agricultural organizations in Burundi and that these collaborations anchored mainly through MOUs. These NMHS are also involved in the development of new methods, tools and models but do mention that their immediate needs are those to do with capacity improvements, increase in financial resource and better equipment

iii. Climate Service Interface System (CSIS)

The objective of the baseline on this section is to identify the political embedment of the Service in the national and regional landscape of climate service providers and also identify the regular users, available dissemination and communication structures of the service, its visibility and needs and how providers and users interface.

The Burundi NMHS has not mentioned whether the institutional arrangements provide for a separate National Meteorological from the Hydrological services but there is a strong indication

that it is fully imbedded within government. Its role and contribution is clearly articulated within the National Disaster Risk Management Strategy and also within national and sector policies and strategies although not within the National Adaptation Plan. In Burundi, there exists a national policy, action plan and strategy on which roles and responsibility is well defined, for example in the generation, tailoring and communication of climate services. This though does not make it clear whether the NMHS does have the mandate to provide climate services but it has fully functional and dedicated units for the provision and production of climate products and services. It is also stated that there are no private or commercial service providers doing similar work of meteorological and hydrological observations like the NMHS but there is the mention of some commercial and private activities in climate services. The funding for the national action plan is from both the national budgets and donor funding and also there is collaboration with other national, regional and international organizations such as the WMO and United Nations Framework Convention on Climate Change (UNFCCC).

With regards to dissemination and sharing of information, it was not stated clearly whether there is a restricted policy for free data access for the public although they indicate various ways and channels in which they disseminate, seek visibility and market their products and services. This is mainly done in printed copies of bulletins sent by post, delivered via email and posted on various web pages although it is worth noting that meaning that the NMHS does not operate a website but try to ensure visibility through regular seasonal climate prediction presentations on national TV channels. There is no indication if the NMHS employs other methods like broadcast of interviews, use of local newspapers or carry out press conferences on radio or use brochures, pamphlets and issue sectoral-specific information and warnings on weather and climate. What has been stated is that the information when shared with the public conveys a degree of uncertainty and the NMHS employs the use of professional communicators to help convey the messages and warnings at large scales. The NMHS has also indicated that their information is mainstreamed into sector policies and this mainstreaming is guided by special methodology and tools. It is recognised that the way the messages are conveyed lead to misunderstanding and interpretation but nonetheless, recognize the need for visibility. They carry out marketing of climate services and products, besides the need to promote other societal awareness issues and that of climate change.

In terms of user interaction and feedback, the Burundi NMHS does recognize the need for feedback from their users to revise and improve their products. This interaction has helped the NMHS to get users assist in the design and development of products. Similarly, work with sector based research teams have helped develop applications and models while other products and services do directly plug into decisions support tools for public policy develops. It should also be noted that the NMHS provide users with risk assessments, risk management as well as advice on input of financial tools to assist in risk transfer. As can be seen in the table below, herein are leading sectors or organizations in collaboration with the NMHS for example: government, water resources, agriculture, emergency planning and response, scientific research etc and how “valuable” through ranking their engagement is. The least level of collaboration are with commercial entities, tourism, recreation & sports, environment protection, finance and innovations etc.

Table 2: Shows the collaborating partners of Burundi NHMA and the value of their products to these partners

User	Indicate if you provide climate services	*Rank	Indicate the type of products provided to the sectors					
			data services	climate monitoring	climate analysis and diagnostics	climate predictions	climate change projections	tailored products / early warning
Government	X☐	5	X	X		X	X	X
Local authorities	X☐	5	X	X		X	X	X
Scientific	X☐	5	X	X		X	X	X
Commercial	☐	1	X	X		X	X	X
Water resources	X☐	5	X	X		X	X	X
Agriculture	X☐	5	X	X		X	X	X
Fisheries	X☐	5	X	X		X	X	X
Forestry	X☐	4	X	X		X	X	X
Transport	X☐	5	X	X		X	X	X
Energy industry	X☐	5	X	X		X	X	X
Human Health	X☐	4	X	X		X	X	X
Tourism	X☐	3	X	X		X	X	X
Recreation, sport	☐	3	X	X		X	X	X
Aviation	X☐	5	X	X	X	X	X	X
Environmental protection	X☐	4	X	X	X	X	X	X
Building	X☐	5	X	X	X	X	X	X
Finance and insurance	X☐	1	X	X	X	X	X	X
Emergency planning and response	X☐	5	X	X	X	X	X	X

*Rank the importance of each sector for climate services, where ''1'' is the least important, ''5'' is the most important

iv. User interface platform (UIP)

The objective of the baseline on UIP is for the identification of the prominent users as well as the purpose and objectives of user-interaction and the mechanisms of user-interaction. This section also includes the identification of mechanisms to monitor and evaluate the impact/value of climate services.

It has been stated that the Burundi NMHS has a mandate to interact with the users directly although it is not clear if they have dedicated units for interacting with users and providing them

with climate services and information. They get to know user needs when the users come with their needs in form of specific requests, questions or problems while others use World Meteorology Organisation (WMO) mechanisms of Regional Climate Outlook Forums (RCOFs), National Climate Outlook Forums (NCOFs), climate watch systems etc. The NMHS is in preparation to conduct National climate outlook forum regularly to interact, enhance awareness and provide tailored products to users while the NMHS communicates seasonal outlooks to users through regional climate outlook forums. Some of the institutions and organisations that the NMHS interact with are agriculture, water resources, Disaster Risk Reduction (DRR), aviation and infrastructure at national level. They also have an established mechanism of interacting with media especially during emergency situations and also ensure regular meetings and interaction with ministries and sectors. The Burundi NMHS has specific sector help desks whose main function is getting feedback on existing products and also guiding and training on existing products. The NMHS has also indicated that there is a feedback loop from user needs back into research and also recognise that weak interaction with users on specific user programs limit user understanding of climate information. This is further compounded by lack of appropriate training program for users which limit their understanding of the application of climate information. Besides the above and in general terms, the NMHS gets to interact with users for numerous reasons and some include to meet their requests for example enquiry for weather forecasts; to get feedback on the usefulness and effectiveness of information and services provided; to ensure that the information requested for by user is truly the information that is needed to solve the problem of the user; also to identify user requirements on specific climate services and products; to provide advice and guidance on use and application of products and lastly to assist users to interpret and use climate predictions.

With regards to monitoring and evaluation, the NMHS does tract the use of provided climate services but not so much on the levels of satisfaction and in quality of service. They also identify and measure impacts of their services like disaster lose, crop yields, hydropower etc. and level of interest of products with users. The NMHS also does perform socio-economic study of climate services in order to demonstrate the value of products to users. It has not been stated though if it also does socio-economic analysis or cost-benefit analysis of climate services including if there is investment planning of climate sensitive sectors based on results of other socio-economic analysis.

v. Capacity development (CD)

The Burundi NMHS does not have policies on human resources development but has indicated that it involves itself in regional and international training programs to enhance capacities, most of which are organised around training courses, conferences and e-learning. The NMHS does extend trainings to user communities and it feels that these training activities do meet the needs and requirements of users. It has been acknowledged that some gaps do exist especially with lack of recognition and visibility of services within their governments and also lack of integration of climate services into social-economic benefits. Other problems cited include the lack of policies regarding the role of climate services in the overall social-economic development space. The NMHS also recognises that the lack of interaction with users limit the effectiveness of the user of climate information.

The Burundi NMHS mentioned computing facilities, equipment networks, internet access, financial resources, application software and building space as main challenges towards

improving products and services. With regards to improving HR capacities, the NMHS recognise the need for tailoring of climate information to specific sectors and special training on communication. The NMHS didn't indicate which areas of capacity are strengthened once staff is recruited.

4.1.3 Product portfolio in Burundi

The objective of section is for the identification of currently available climate information products and services. It will involve the results from both the questionnaire and the product matrix with the product matrix providing an in-depth and detailing of the questionnaire.

i. Climate data sets

Burundi has historical datasets from both atmospheric and terrestrial parameters which are stored and made available for both internal use and external use. The other form of data sets available is satellite data, rescued metadata and basic statistics on climate extremes such as temperature, precipitation, humidity, sunshine duration, frequency of occurrence, spatial mean etc while ocean data, gridded or interpolated data and model data is not available. It should also be noted that Burundi does not perform homogeneity tests and adjustments of time series when it comes to her data.

No further detail on climate data sets could be got because the product matrix was not completed by Burundi. Therefore in-depth information on what products are available and how each product type is developed or what procedures/capacities are used to develop these products cannot be provided. Also information about the current challenges and concerns are affecting climate services cannot be got. Lastly no detail is available on tailored climate information products and services for different sectors in Burundi cannot be completed.

ii. Climate diagnostics & monitoring products

The NMHS of Burundi does perform basic assessments and analysis (diagnostics) of spatial and temporal factors and processes including the use and derivation of products from satellite data for monitoring activities for both internal and external purposes. Similarly, the NMHS of Burundi does analyse spatial patterns of temperature, precipitation, etc. their anomalies, climatic zoning and apply advanced climate statistics and graphical products (including maps, analysis and graphs of precipitation, temperature, relative humidity, evapotranspiration, sunshine duration, cyclones etc. but mostly for internal observation purposes. Also from the literature provided, the NMHS also observes climate patterns for example tropical cyclones, monsoon, synoptic scale storms, spatial patterns of temperature, precipitation, etc. and their anomalies for climatic zoning. Other services offered by the Burundi NMHS is to develop and provide specialized climate analysis, prediction and monitoring products, tailored to the needs of specific users in general, but mostly for internal use. The NMHS is limited in other areas like analysis of highly sophisticated climatologically statistics and complex characteristics, incl. indices for specific users like for building design codes.

No further detail on climate diagnostics & monitoring products could be got because the product matrix was not completed by Burundi. Therefore in-depth information on products based on observed or reanalysis data for example statistical descriptions and valuation of climate data sets for individual parameters and indices (+ uncertainty) cannot be provided. Lastly no detail is available on climate watch, climate anomalies, recent events in the context of climatology and outlook on their development.

iii. Monthly and seasonal Long-term predictions

The Burundi NMHS develops and provides prediction products for mostly internal use and this is at seasonal and decadal scales but not monthly. These products do not have Information related to the degree of uncertainties or skill level but does analysis on climate extremes recorded in maps, graphs and images. This analysis done together with the assessment of current climate conditions in terms of averages, variance, thresholds, percentiles in weekly, 10-days, seasonal and annual time scales.

The NMHS further issues and disseminates these products into specific advisories for user community and this is done as climate summaries, bulletins, reports, drought/flood maps and special statements for severe weather which is all done mostly for internal purposes. Apparently, the Burundi NMHS does not provide ENSO, SST and intra-seasonal variability products. There is also apparently limited access to and use of monthly to seasonal and longer climate predictions, provided by RCCs, Regional Climate Outlook Forum (RCOFs), and Global Production Centres (GPCs.)

iv. Climate projections

The Burundi NMHS participates in the review and assessment of past climate patterns on the state of climate for their country as provided by WMO reports. This is done for the purposes of analysis, interpretation and reanalysis of climate statements or products for the general public or for specific users which is then used for both internal and external purposes. The NMHS also does the development and/or interpretation of climate change scenarios for both internal and external purposes.

The Burundi NMHS has reported that it does not perform dynamical and/or statistical downscaling of Global Climate Models (GCM) and/or Regional Climate Models (RCM). It should also be noted that the Burundi NMHS does not participate in and contribute to RCOF and therefore limiting the sharing/exchanging information, products, services to other countries in the region, even during the periods of significant climate anomalies. The NMHS is also limited in performing reanalysis and adding value from national perspective to these products received form RCOFs, RCCs and GPCs.

v. Climate related hazards & secondary events

The Burundi NMHS does make analysis and provision of products relevant to El Nino and La Nina updates. This also includes Global Seasonal Climate Updates (GSCU) that contains information on ENSO and other climate extremes and variations driving phenomena for example NAO, PNA, IOD, etc. and mainly for internal purposes. The Burundi NMHS doesn't provide global and regional scale data resources as input into modelling, research and applications. Similarly, the NMHS is limited in the provision of high density, small scale specialized data resources used for studies of small scale processes and urban environment.

4.1.4 Current use and needs of Climate Services

This shall be a presentation and documentation of results from Burundi from the user representative and their context of climate information application, current use and needs for climate services.

i. Basic Information about the climate service user / beneficiary

For the case of Burundi, we had submission from two user groups and these were the Ministry of Energy and Mines and Ministry of Agriculture and Livestock.

ii. Experiences on climate (change), Impact and information

Ministry of Agriculture and Livestock has noted changes of seasons, floods and shortage of groundwater resources as the more pronounced climate-related hazards with limited data available for season changes and floods. The related impacts has been persistent energy shortage related to the change of seasons, a deterioration in the health of the populations related to the lack of safe water and a lack of financial resources to invest in sustainable development. The response from the government has been the developed of sector guidelines such as: Vision 2025 and various sectoral policies such as the National Water Policy, the National Water Strategy, National Strategy of Renewable Energies and the Action Plan for Integrated Water Resources Management (PAGIRE) and the Forest Policy. Other interventions has been initiation of high priority measures that have a high potential for scaling up and these included: (I) construction of hydropower plants to increase the access rate to electricity; (ii) the intensification of energy efficiency programs such as improved stoves and the distribution of economic lamps as already initiated by REGIDESO; (iii) intensification of reforestation programs (REDD and REDD +); (iv) promoting research and development, promoting the solar Energy and protecting water resources. Other measures were to put in place incentives for the mobilization of private investment under the public-private partnership in renewable energy.

The occurrence of hazards has changed in the near past with an indication of an increase and this is related to climate change although there has not been an assessment of organization or sector's vulnerability to climate change. Nonetheless, there is an indication of the future potential impacts as related to the Bugesera region already experiencing periods of severe weather disruption over the past two decades resulting in a decline in shortage of groundwater resources. Another example cited is that the costs of rehabilitating the ravines and some public infrastructure in the city of Bujumbura amounted to approximately more than US $ 8,600,000 in 2010. Meanwhile, during periods of heavy rainfall, there is a risk of contamination of water in boreholes through contact with surface water and consequently epidemics of cholera and other waterborne diseases.

iii. Sectoral planning, legal frameworks and organizational structures

The vision of the energy sector is to create sustainable conditions for the supply of safe, reliable, efficient, cost-effective and environmentally friendly energy for households and all branches of the national economy while that of the water supply and sanitation sectors is to create conditions where each person must have access to safe drinking water and sanitation at the reasonable price. The main tasks of the Ministry of Energy and Mines being:

- Design and implement the National Policy on Energy, Geology and Mines;
- Participate, in collaboration with the Ministry of Water, Environment, Spatial Planning and Town Planning (MEEATU), in the elaboration of the National Water Policy and the necessary reforms for a good management of water and sanitation;
- Develop an Energy Supply Program to ensure sustainable access of the population to modern energy sources;
- Promote renewable energies through adequate research and dissemination actions;
- Participate in energy exchange and partnership programs with regional and international institutions of which Burundi is a member;
- Ensure, in collaboration with other services concerned, the planning, construction and management of water, energy and basic sanitation infrastructures;
- Develop and monitor the department's investment projects

Meanwhile the organization's roles in the planning and implementation process of infrastructure projects like hydropower plants are:

- Develop an Energy Supply Program to ensure sustainable access of the population to modern energy sources,
- Choose technologies, the real needs of users, the availability of habitat and socio-economic infrastructures, habitat structure to allow for the reduction of capital costs and recurring expenses;
- Develop and monitor the Department's investment projects
- Rehabilitate and expand water supply or energy infrastructure;
- Promote progressive management and professional management of infrastructures by the local communities through the municipal water boards and water committees;
- Promote the involvement of the private sector in investment and management of infrastructure;
- Undertake an extensive program of construction and extension of improved latrines
- Promote rainwater harvesting systems for domestic use

With the above being mentioned, the planning of the sub-sector is considered according to two basic approaches of the demand approach whereby the decision to invest must be triggered by a demand expressed by the beneficiaries and the program approach puts forward the development of the entire sub-sector and giving rise to specific programs "Urban Program" and "Rural Program". These approaches have led to clearly defined outputs from the users in Burundi such as: development of energy and water supply infrastructure, connecting the urban population to electricity grid and water supply systems, regularly monitoring the investments and implementations program and services, etc. The beneficiaries being government institution, the industrial, civil society and NGOs; while on the other hand, some tasks are delegated and these include:

- The construction of Energy infrastructures;
- The construction the drinking water and sanitation network;
- the management of infrastructure to guarantee services sustainable;
- Promote progressive management and professional management of infrastructures by local communities for drinking water and sanitation.

The Burundi user sees the role of information in this infrastructure planning process as one of strengthening the system of meteorological and hydrological forecasts and early warning to prevent damage in the most exposed areas and adapt the management of the infrastructures accordingly. The climate Information is a decision support system (DSS) for planning and infrastructures management to ensure sustainable services.

With regards to the legal framework, there are apparently no laws or regulation which neither obligate the explicit consideration of climate (change) risks in your sector and none for either mitigation, adaptation nor risk management although the institution responsible should be the Ministry of Water, Environment, Spatial Planning and Town Planning (MEEATU). In Burundi, climate information is regulated in all steps of infrastructure planning such as in design of infrastructures and approvals. This does influence the costs of materials and eventually the cost infrastructure.

In Burundi, the precautionary principle is deeply considered in the countries laws especially under the environmental impact or social impact assessment guidelines for example; the Ministry has an elaborate the renewable energy strategy and energy policy. Furthermore, the Ministry has a

focal point on the topic of climate and climate change and this is in the form of climate data processing, national communication on climate change and also in climate data processing.
In the Ministry, climate information plays a very relevant role compared to other decision making criteria and also enters the process of decision making during the identification of the project site and the pre-feasibility studies of the project as well during the environmental impact study with the main drivers in order of relevance being: internal motivation, regulatory obligations, business interests and finally external motivation. The decision to take into account climate information is determined by The Ministry of Water, Environment, Spatial Planning and Town Planning.

iv. Climate information and decision-making

The specific purpose for which climate-related information required by the Ministry of Agriculture and Livestock is to develop mechanisms to adapt crop production trends according to the existing three crop productions seasons while for its relevance at various organizational levels within the Ministry of Energy and Mines, in the order of importance is: 1) infrastructure planning and implementation; 2) maintenance and organizational planning of existing infrastructure; 3) day-to-day operation management of existing infrastructures; 4) education and creation of awareness of staff and decision-makers; 4) strategic planning; and 5) development and implementation of risk management plans. While the degree of uncertainty is used for planning activities according to weather forecast and promoting drought resistant crop farming and awareness creation.
In Burundi, climate change is considered during decision-making through awareness creation, promoting water harvesting activities, irrigation schemes development, drought resistant crops and various programmes related to climate adaptation in the action plan.

Table 3: Climate risk management strategies being pursued or considered by users in Burundi

	Current climate conditions	Climate change			
Purpose	Implemented strategy	No option	Potential option	Planned option	Implemented option
Awareness creation	☒	☐	☐	☐	☒
Prevention: Protection (*e.g. protective constructions like dams*)	☒	☐	☐	☐	☒
Prevention: Transformation of object of concern (*e.g. change of building design, or specific components*)	☐	☐	☐	☐	☐
Prevention: Retreat (*e.g. relocation of constructions*)	☐	☐	☐	☐	☐
Contingency planning accommodating climate change risks	☒	☐	☐	☐	☐
Business continuity management accommodating climate change risks	☐	☐	☐	☐	☐
Early warning systems	☒	☐	☐	☒	☒
Responses to warnings (e.g.	☒	☐	☐	☐	☒

evacuation, temporal protection)					
Recovery planning	☒	☐	☐	☐	☒

v. Limitations on the use of climate information

Some of the product specific reasons the users of climate information in Burundi have given for not using or for the limited use of climate information as given in order of importance is: 1) the product is not available when required, 2) the product is of limited quality, 3) access to climate information is restricted/limited, 4) the information content is not understandable, 5) the product is not relevant for our context, 6) the product is not usable for our purpose, and 7) The existence of the product is not known. While the organisation specific reasons, in order of important include: 1) there is no legal obligation to use climate information, 2) the products is not freely available, 3) there are no capacities available to deal with climate information, 4) There is no need for climate information, 5) the cost-benefit value of the use of climate information is not profitable, 6) the relevance of climate information for decision-making is negligible, and 7) the added value of the product for our purpose is not evident.

vi. Capacities for climate information application/processing

For the purposes of improving technical and personnel capacity to process and interpret climate-related information, required improvements, in order of importance have to be made to: 1) technical equipment and skills, 2) Know-how and training, 3) number of staff and 4) funding. This notwithstanding, the user has stated that they currently don't have external support or advice on how to integrate climate-related information in decision-making processes and also that their staff have received no training on climate change and climate change adaptation but would gladly recommend the institutions of Institut Geographique Du Burundi (IGEBU) and Office Burundais pour la Protection de l'Environnement (OBPE).

vii. Current use and needs of climate information products and services

The Ministry responsible for Energy and Mines and the Ministry of Agriculture and Livestock of Burundi currently classify themselves as both end-users that apply climate information and value adders. They have a good assessment on the ability to formulate their needs on climate information products.

Furthermore, none of the activities regarding climate information 'processing' does any of the users do with own resources and this is also compounded by the fact that one major constraint is that products are sometimes available but not used. The two users also interact with the climate information providers to discuss gaps and needs of climate information products and to provide feedback and sometimes this interaction is only on request for example when climate information is queried or through regular user-group meetings and conferences. The interaction between the user and provider is mostly on request with neither contracts nor MoU between them but nonetheless, the requests of the users are always received and joint meetings organized accordingly. With regards to the technical details of the products that are used by the two ministries, herein is a brief description:

- The product description is one of variability of temperature and rain fall impacts on the soil. This assists the inspection, monitoring and reporting on farms and they come with space resolutions of provinces and agro-ecological zones presented as monthly reports.
- Another product description is one of Impacts of the weather externalities (drought and flood) on crop productions and they come with space resolutions of per provinces and agro-ecological zones and provided as semester reports.

4.1.5 Analysis and evaluation of user needs on climate services products

Table 4 Climate-related information (specific products and services) that is in use or needed by users in Burundi

<table>
<tr><td>This product type is being used directly for decision-making</td><td>This service is being used to enhance decision-making</td></tr>
<tr><td>• Climate data (e.g. raw or processed, gridded data, station data, etc. for specific parameters and regions)
• Data/statistics on climate impacts on terrestrial systems (e.g. impacts on ecosystems (vegetation etc.), geo-morphological impacts (soil erosion, landslides, etc.). For example: The variability of temperature and rain fall impacts on the soil where farms are inspected, monitored and reported on per provinces and agro-ecological zones and this is provided as Monthly report.
• Information/data on climate impacts/consequences for specific sectors (e.g. info on expected crop yields, losses, costs, damage, disruptions or fatalities for agriculture, transport, health, energy, etc.). For example: Impacts of the weather externalities such as drought and flood on crop productions which is provided per provinces and agro-ecological zones and as semester reports.</td><td rowspan="2">• This was not stated.</td></tr>
<tr><td>This product type is being used as input for follow-up products / services</td></tr>
<tr><td>• This was not stated.</td><td></td></tr>
<tr><td>This product type is desired/required but not (yet) being used/available</td><td>This service is desired/ required but not (yet) being used/ available.</td></tr>
<tr><td>• Climate statistic products (e.g. information about means and extremes for individual parameters for a specific region and period in form of maps, graphs, etc.)
• Information on regional climate conditions (e.g. review and analysis in form of bulletins, synthesis reports, statements, etc.)
• Analysis and interpretation of climate statements or products for specific users/sectors (e.g. analysis of consequences of past/prevalent climatic conditions for specific sectors)
• Hydrological data / statistics and events (e.g. discharge, floods, low-flows, etc.)
• Climate vulnerability/risk information in general or for specific sectors (e.g. data/info on exposures and sensitivities)</td><td>• Guidelines for selecting relevant climate information and assess its relevance
• Explanation of content/meaning of climate information is required (e.g. how to read the graphs?)
• Technical training, tools or support for data processing and product application
• Training, tools or support to assess the value/significance of the climate information for</td></tr>
</table>

• Climate forecasts/outlooks for specific parameters/events at various time scales (e.g. week, month, year, etc.) • Climate change impact data/model outputs (e.g. on ecosystems, water availability, etc.) • Training, workshops, lectures and information material on climate issues, e.g. climate change and its impacts (e.g. qualitative info/education material to raise awareness ; general or sector-specific) • Tools which support decision-making, strategy development and financial planning	the own context (e.g. interpretation of information on probability and uncertainty) • Advice or decision-support tools to integrate climate information in decision-making • Support for optional queries is desired
This **product type** is **provided** by our organization	This **service** is **provided** by our organization
• This was not stated.	• This was not stated.

4.2 Climate Change and Climate Services in DR. Congo

The NMHS of the DR. Congo is herein represented by the METTELSAT RD CONGO who participated at the CSI forum and also completed the questionnaire. The information derived from the questionnaire, product matrix and independent research provides the climate change risks in the country, the climate services baseline and the use, needs and evaluation on climate services products with their portfolio.

4.2.1 Climate Change risks in DR. Congo

A study- CSC (2013): Climate Change Scenarios for the Congo Basin suggests the following changes of temperature and precipitation over DR. Congo as described below:

- The mean temperature is projected to substantially increase in the future independent of the emission scenario and with a stronger increase under the high emission scenario.
- Not only are mean temperatures projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase.
- There shall be a moderate change in total precipitation with a tendency for a precipitation increase. These rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase with the intensity of rainfall extremes projected to increase but not in the frequency.

4.2.2 Climate Services for Infrastructure baseline of DR. Congo

This shall be used to provide an evaluation and summary of the results from the general questionnaires received from the NMHS and also the completed product matrix for services provided. The elements covered with the questionnaire and product matrix was within the general framework of applying the structure of Global Framework of climate services (GFCS) to the elements listed in the subsequent sub-chapters below:

i. Observations and monitoring (OM)

The objective of this sub-section is to identify the available data sources and the state of observing systems which may also include identification of the quality of available data management systems and mechanisms within the NBI countries.

The information deduced from the questionnaire states that the DR. Congo NMHS adheres to climate monitoring principles but did not give much more information on the sources of their data and observation system and whether these measurements come from ocean, atmosphere or terrestrial measurements. The DR. Congo NMHS has also indicated that besides in country observation, they have access to observational data from neighbouring countries and have available a wide range of data which include: gridded/ interpolated data, satellite data and re-analysis data. It was not state if the NMHS uses model data for example GCM & RCM but there is the indication that socio-economic and impact databases are in use. It should also be noted that the NMHS creates, archives and documents climate data sets and has them stored in databases for the appropriate length, time, resolutions and units. They also ensure that further observations are accumulated into time series. Although it has not been stated whether metadata is available, it has been implied that their databases are adequate for current needs and requirements with improvements planned. The NMHS does apply homogeneity tests of time series, quality control and also has a data rescue program in place. The DR. Congo NMHS does not share data with WMO-RCC for operational purposes and backup. The NMHS did not state whether they have restrictive policies towards free and open sharing of data or not. It was also not stated either if

they had strategies for ensuring security, integrity, retention and technological migration for data archival processes and systems.

The NMHS of DR. Congo does recognise major challenges associated with observation network and data availability that is limiting the provision of climate services and products which is mainly the limited number of stations and technical equipment for providing qualitative data. Despite the above challenges, it has not been stated whether the DR. Congo NMHS has long-term strategies of managing the network and improving data availability.

ii. Research, modelling and prediction (RMP)

This section is to identify the current research capacities and cooperation potential for product development and services orientation within the Nile basin countries.

DR. Congo NMHS has a mandate to carryout research activities although without a fully pledged unit and also, it is not clear if it has fully dedicated personnel or mechanisms of dealing with user requirements and operational service provisions. Some of the research results are used in operational practice with specific user needs and groups. The NMHS does share research responsibility with mainly universities, regional entities and agricultural organizations in DRC. The collaborations mechanism are not clearly mentioned but what has been stated is that there are developments of new tools and knowledge for multi-disciplinary studies and applications such as in smart agriculture, climate-health, climate-tourism, etc. Besides developing new tools and body of knowledge, they are still limited in developing new methods and new models. The main and current needs include the need for trainings and attachment to specific centres.

iii. Climate Service Interface System (CSIS)

The objective of the baseline on this section is to identify the political embedment of the Service in the national and regional landscape of climate service providers and also identify the regular users, available dissemination and communication structures of the service, its visibility and needs and how providers and users interface.

In the DR. Congo, the NMHS is imbedded within government although it seems that the National Meteorological and Hydrological services are separate institutions and this kind of institutional arrangement calls for better partnership and agreements between them. The NMHS' role and contribution is clearly mentioned within the National Disaster Risk Management Strategy and National and Sector policies and strategies. Similarly, there exists a national policy and strategy on climate services with clearly defined roles and responsibility for the NMHS in generation, tailoring and communication of climate services mentioned therein. But unfortunately, there is no mention of the existence of a National Adaptation Plan for climate services and also, it has not been indicated the funding sources for the NMHS and whether it is through the national budgets or through donor funding. The NMHS does collaborate with other national, regional and international organizations such as the WMO, African Centre of Meteorological Application for Development (ACMAD), Centre Regional de Formation et d'Application en Agrométéorologie et Hydrologie Opérationnelle (AGRHYMET), and SERVICE CLIMATIQUE DE LA SADC. This also lends to the fact that there are private and commercial services providers doing similar work of meteorological and hydrological observations alongside the NMHS but there is no mention of commercial and private players in climate services as a whole. It is stated through that there aren't any cooperation agreements with these private entities but their NMHS still takes a lead on providing climate services in the country.

The NMHS of DR. Congo does have a restricted policy for free data access for the public despite having various ways and channels to disseminate their products and services. This is done by printed copies sent by post, delivered via email, sent by facsimile and also through FTP downloads. It has not been stated if when information is shared with the public, the degree of uncertainty is conveyed. Similarly, the NMHS has not indicated if their information is mainstreamed into sector policies or guided by special methodology and tools. Neither has it stated whether the way the messages are conveyed lead to misunderstanding and interpretation nor have they indicated that they have professional communicators to help convey the messages and warnings at large scales. It has been stated that the NMHS does carry out marketing of climate services and products in the country and equally recognize the need for visibility. The NMHS did not mention whether it promotes societal awareness of climate change issues nor has it mentioned the operation of an organisational website but they have stated that they try to ensure visibility through regular seasonal climate prediction presentations on national TV channels but not in local newspapers. There is no indication if the NMHS employs other methods like broadcast of interviews and carrying out press conferences on radio or the use of brochures, pamphlets and issue sectoral-specific information and warnings on weather and climate.

In terms of user interaction and feedback, the DR. Congo NMHS does recognize the need for feedback from their users to revise and improve their products but it does not state whether the NMHS is assisted by users in the design and development of products nor have they indicated to work with sector based research teams to develop applications and models. It is also not clear if the NMHS provide users with risk assessments and risk management as well as advice on input into financial tools for risk transfer or if their product plugs directly into decisions support tools for public policy development. When it comes to which as leading sectors or organizations they are in collaboration with, the NMHS suggests only a few interactions such as with government, aviation, environmental protection, building, finance and insurance and emergency planning and response.

iv. User interface platform (UIP)

The objective of the baseline on UIP is for the identification of the prominent users as well as the purpose and objectives of user-interaction and the mechanisms of user-interaction. This section also includes the identification of mechanisms to monitor and evaluate the impact/value of climate services.

In DR. Congo, the NMHS has a mandate to interact with the users directly although it was not mentioned whether there is a unit fully dedicated for interacting with users despite the fact that up to 7 people are involved in communicating with users and providing them with climate information. It has also not been made clear if there is an established mechanism of interacting with media especially during emergency situations nor any planned meetings or interactions forums with ministries and sectors. Although they recognise that weak interaction with users on specific user programs limit user understanding of climate information for example there is Ignorance to safe use of resources and also lack of appropriate training program for users limit their understanding of the application of climate information. To this, the NMHS is in preparation to conduct National climate outlook forums (NCOF) regularly to interact and provide tailored products to users. Some of the institutions and organisations at national level that the NMHS interact with are Société nationale d'électricité (SNEL), Institut national pour l'étude agronomique du Congo belge (INERA), Projet de Renforcement de la résilience et de la capacité

d'adaptation des femmes et des enfants au changement climatique en République Démocratique du Congo (PANA), FAO, ENVIRONMENT, GESTION DES RESSOURCES EN EAU, and HYDRAULIQUE.
It was not clear if the NMHS has established a specific sector help desks whose main function would be to get feedback on existing products or on guiding and training on existing products nor has it been indicated that there is a feedback loop from user needs back into research. But nonetheless, they try to get to know user needs through many other means which include when the users come with their needs (specific requests, questions, problems); when the NMHS issues weather forecasts; to get feedback on the usefulness and effectiveness of information and services provided; also to identify user requirements on specific climate services and products; to provide advice and guidance on use and application of products and lastly, to assist users to interpret and use climate predictions.

With regards to monitoring and evaluation, it has not been stated whether the NMHS does tract the use of climate services and also the levels of satisfaction in quality of service. Although it is stated that the NMHS does indentify and measure impacts of their services on climate sensitive sectors like disaster lose, crop yields, hydropower etc. and level of interest of products with users. It has also not been mentioned if the NMHS does perform socio-economic study of climate services in order to demonstrate the value of products to users or if it does socio-economic analysis or cost-benefit analysis of climate services. To this, the NMHS does not do investment planning of climate sensitive sectors based on results of other socio-economic analysis or cost-benefit.

v. Capacity development (CD)

In DR. Congo, the NMHS does have policies on Human Resources Development and also involve itself in regional and international training programs to enhance capacities, most of which are organised around training courses, conferences and fellowships. The NMHS does extend trainings to user communities and it also feels that these training activities do meet the needs and requirements of users. This is also within the general realisation that the lack of interaction with users limits the effectiveness of the user of climate information. Fortunately, the NMHS recognises the need tailoring of climate information to specific sectors and special training on communication. Also mentioned is that once staff is recruited, they would need them to development capacities especially for climate services, interaction with users, research and development, data management and products development etc as key to improve climate services. It has been acknowledged that some gaps do exist especially with lack of recognition and visibility of services within their governments and also lack of integration of climate services into social-economic benefits. Other problems cited include: the lack of policies regarding the role of climate services in the overall social-economic development space, lack of improvement of organisational structure of the service and others mentioned such as limited computing facilities, equipment &networks, internet access, financial resources, application software and building space as main challenges towards improving products and services.

4.2.3 Product portfolio in DR. Congo

The objective of section is for the identification of currently available climate information products and services. It will involve the results from both the questionnaire and the product matrix with the product matrix providing an in-depth and detailing of the questionnaire.

i. Climate data sets

The NMHS of DR. Congo collects and stores historical datasets from terrestrial measurements and observations which is then made available for both internal use and external use. Other data sets such as satellite data, model data and rescued metadata are mostly for internal use while basic statistics on climate extremes for example temperature, precipitation, humidity, sunshine duration, frequency of occurrence, spatial mean etc are available for both internal and external use. It has been indicated that the NMHS does not collect nor store any ocean data and also gridded/ interpolated data is lacking. To the data sets available, the NMHS of DR. Congo does not perform homogeneity tests or adjustments of time series.

No further detail on climate data sets could be got because the product matrix was not completed by DR. Congo. Therefore in-depth information on what products are available and how each product type is developed or what procedures/capacities are used to develop these products cannot be provided. Also information about the current challenges and concerns are affecting climate services cannot be got. Lastly no detail is available on tailored climate information products and services for different sectors in DR. Congo cannot be completed.

ii. Climate diagnostics & monitoring products

The NMHS of DR. Congo performs advanced climate statistics and provides graphical products for example maps, analysis and graphs of precipitation, temperature, relative humidity, Eva-transpiration, sunshine duration, cyclones etc. which are then used for both internal and external purposes. Meanwhile the while NMHS does not derive products from satellite data for monitoring activities nor does it perform basic assessments and analysis (diagnostics) of spatial and temporal factors. There is no analysis for spatial patterns and climatic zoning of temperature, precipitation, etc. and their anomalies. The NMHS does not also develop nor provide specialized climate analysis, prediction and monitoring products.

No further detail on climate diagnostics & monitoring products could be got because the product matrix was not completed by NMHS-DR. Congo. Therefore in-depth information on products based on observed or reanalysis data for example statistical descriptions and valuation of climate data sets for individual parameters and indices (+ uncertainty) cannot be provided. Lastly no detail is available on climate watch, climate anomalies, recent events in the context of climatology and outlook on their development.

iii. Monthly and seasonal Long-term predictions

The NMHS of DR. Congo also develops and provides prediction products at monthly and decadal scales (but not seasonal scales) for both internal and external use and these products are produced with Information that gives the degree of uncertainties to the users. Other long-term products include the analysis of climate extremes into maps, graphs, images etc which is done together with the assessment of current (monthly) climate conditions in terms of averages, variance, thresholds, percentiles in weekly, 10-days, monthly, seasonal and annual time scale. The NMHS also provides ENSO, SST and intra-seasonal variability products although it has limited access to and use of monthly, seasonal and longer climate predictions provided by RCCs, Regional Climate Outlook Forum (RCOFs), and Global Production Centres (GPCs.).

Specific advisories products are issued and disseminated into for user community using climate summaries, bulletins, reports, drought/flood maps and special statements for severe weather, most of which are for both internal and external purposes.

iv. Climate projections

DR. Congo's NMHS does do climate projections for the purposes of analysis, interpretation and reanalysis of climate statements and products for the general public and for specific users for both internal and external purposes. The NMHS also does the development and/or interpretation of climate change scenarios and also performs dynamical and/or statistical downscaling of GCM and/or RCMs. It should also be noted that the NMHS from DR Congo is limited in performing reanalysis and adding value from national perspective to these products received form RCOFs, RCCs and GPCs. The NMHS does not participate in the review and assessment of past climate patterns on the state of climate for their country as provided by WMO reports nor does it share and exchange information, products, services to other countries in the region, during the periods of significant climate anomalies.

v. Climate related hazards & secondary events

The NMHS of DR. Congo does provide global and regional scale data resources as input into modelling, research and applications but mostly for external use. It does not make analysis and provision of products relevant to El Nino and La Nina updates. The NMHS also does not make Global Seasonal Climate Updates (GSCU) that should contain information on ENSO and other climate extremes and variations driving phenomena for example NAO, PNA, IOD, etc. The NMHS from DR. Congo is also limited in the provision of high density, small scale specialized data resources used for studies of small scale processes and urban environment.

4.2.4 Current use and needs of Climate Services

This shall be a presentation and documentation of results from Burundi from the user representative and their context of climate information application, current use and needs for climate services.

i. Basic Information about the climate service user / beneficiary

For the case of DR. Congo, the submission was from three user groups and these were: Rainfall Forecasting and Climate Change Center in the Ministry of Environment, Ministry of Rural Development.

ii. Experiences on climate (change), Impact and information

The users from DR. Congo stated that the climate-related hazards and the valuable data related to climate services are in deforestation and infrastructure, a key challenge is old town buildings. The easily relatable impacts from climate-related hazards in the past is that there are changes in rain intensity and season duration, reduction in flood return periods and loss of human life due to landslides. This has been dealt with through the application of ecosystem based approach of re-vegetation and agro-forestry. The general trend has been that there has been the increase of the occurrence of hazards in the near past. Despite the fact that most organisations have not accessed climate related vulnerability, some expected potential impacts and consequences for example in the health sector are the high risk of cholera, malaria and flu.

iii. Sectoral planning, legal frameworks and organizational structures

The users stated that their vision and general tasks is the promotion of water resources exploitation and development within an integrated and sustainable way for the population's benefit. While, broadly, their role in planning and implementation process of infrastructure related projects is the monitoring and assessment impact of infrastructure project on the quality and the quantity of water resources. Infrastructure projects in DR. Congo are initiated by the Ministry of Civil works with key inputs to user ministries being that of forecasted rainfall,

temperature and water resources. Other multi-users and beneficiaries are NGOs, Water and sanitation programmes and forest service. The mentioned users do see the general role of climate information in this infrastructure planning process as that where it can be used to prevent infrastructure failure and adapt them to the future trend of the climate.

In DR. Congo, there exists laws and regulation which obligates the explicit consideration of climate (change) risks for example the LOI 015/25 which is related to water and LOI 11/009 which is related to fundamental principles of environment protection. The main focus of these laws or regulation or policy is mainly risk management (precautionary principle). Despite the existence of the above laws, the user doesn't find the climate information guidelines or regulatory framework relevant to their organization and equally the users find the climate laws, regulation or policy compared to other laws, regulation or policy not specifically relevant. Similarly, the precautionary principle is not a statutory requirement in the countries' laws and therefore the organizations view on the role of the 'precautionary principle' in the context of climate change is just a global view without specification.

With regards to organisational structures, there is no clear agreement about clear objectives and values related to addressing climate, climate-related issues and climate change although there is a focal point on the topic of climate or climate change and this is the working group on the Conference of Parties (COP).Climate information does enter the decision making process within the users organization because it is essential for the forest sector and the Congo River's flow while the main reason for using climate information in order of relevance are because of 1) Internal motivation, 2) external motivation, 3) business interests and Regulatory obligations. Climate (change) information does not play specifically relevant role in the users decision-making criteria.

iv. Climate information and decision-making

In DR. Congo, the specific purpose for which climate-related information is required by the user is to predict extreme event and reduce disaster risk impact while the relevance of climate information for decision-making processes at various organizational levels in order of importance is for strategically planning and development and implementation of risk management plans which are seen to be very relevant. Whereas education and creation of awareness of staff, infrastructure planning and implementation as seen as relevant; maintenance and organizational planning of existing infrastructure and day-to-day operation management of existing infrastructures as one of little relevance.

The users deal with uncertainty in climate information by accepting that minor uncertainty can be tolerated. The user also stated that disaster risk may be significantly addressed but not Climate risk or climate change in any decision-making processes

Table 5 Climate risk management strategies being pursued or considered by users in DR. Congo

	Current climate conditions	Climate change			
Purpose	Implemented strategy	No option	Potential option	Planned option	Implemented option
Awareness creation	☐	☒	☐	☐	☐

Prevention: Protection (*e.g. protective constructions like dams*)	☒	☐	☒	☐	☐
Prevention: Transformation of object of concern (*e.g. change of building design, or specific components*)	☐	☐	☐	☒	☐
Prevention: Retreat (*e.g. relocation of constructions*)	☒	☐	☐	☐	☒
Contingency planning accommodating climate change risks	☐	☐	☐	☐	☐
Business continuity management accommodating climate change risks	☐	☐	☐	☐	☐
Early warning systems	☒	☐	☒	☐	☒
Responses to warnings (e.g. evacuation, temporal protection)	☒	☐	☐	☐	☐
Recovery planning	☐	☐	☐	☒	☐

v. Limitations on the use of climate information

Some of the reasons for not using products is having limited and useful climate information for decision-making process. Others, in order of importance, is that product is not available when required and the product is of limited quality while others like there is limited access to climate information, the product is not relevant for our context, the information content is not understandable, the existence of the product is not known or the product is not usable for their purpose does not apply.

With regards to organizational reasons, the most considered reason is that there is restricted use of climate information for decision-making while others like the cost-benefit value of the use of climate information is not profitable and the added value of the product for their purpose is not evident does not apply. Similarly, those that still don't apply is that: there are no capacities available to deal with climate information, there is no need for climate information and there is no legal obligation to use climate information.

vi. Capacities for climate information application/processing

The users in DR, Congo feel that their technical and personnel capacity is not sufficient to process and interpret climate-related information with the highest needs being for technical equipment, skills, funding and training while the increase in number of staff is the least of their needs. Apparently, the user also receives external support and advice on how to integrate climate-related information in decision-making processes and these are from bilateral cooperation with Arab Republic of Egypt on project and business support and this relationship is institutionalized by regular exchange and regulated by MoU and contracts. The user's staff also received training on climate change and climate change adaptation and this is provided by the staff from UK MET Service.

vii. Current use and needs of climate information products and services

The DR. Congo users have classified themselves as an end-user that apply climate information and also as value-adders with a good ability to formulate your needs on climate information products. The activities regarding climate information 'processing' that the user does with their own resources are: data analysis, literature research and modelling and policy analysis. The user would desire to have climate change impact data and vulnerability/risk information and tools

which support decision-making, strategy development and financial planning. The user and provider of climate information and services have an institutionalized relation where they have regular interaction to discuss gaps and needs of climate information products and to provide feedback and this is mainly through: requests especially when climate information is queried, regular user-group meetings and conference and Institutionalized interaction. There are other stakeholders or sector-groups that ask about similar climate information from the same provider and they organize themselves into user groups to formulate your needs.

4.2.5 Analysis and evaluation of user needs on climate services products

Table 6: Climate-related information (specific products and services) that is in use or needed by users in DR. Congo

This **product type** is being **used** directly for **decision-making**	This **service** is being **used** to enhance **decision-making**
• Climate statistic products (e.g. information about means and extremes for individual parameters for a specific region and period in form of maps, graphs, etc.) • Hydrological data / statistics and events (e.g. discharge, floods, low-flows, etc.)	• Advice or decision-support tools to integrate climate information in decision-making
This **product type** is being used as input for follow-up products / services	
• Climate data (e.g. raw or processed, gridded data, station data, etc. for specific parameters and regions) • Information on regional climate conditions (e.g. review and analysis in form of bulletins, synthesis reports, statements, etc.) • Analysis and interpretation of climate statements or products for specific users/sectors (e.g. analysis of consequences of past/prevalent climatic conditions for specific sectors) • Data/statistics on climate impacts on terrestrial systems (e.g. impacts on ecosystems (vegetation etc.), geo-morphological impacts (soil erosion, landslides, etc.)	
This **product type** is **desired/required** but not (yet) being used/available	This **service** is **desired/ required** but not (yet) being used/ available.
• Data / statistics on hazardous climate events / extreme events (e.g. impact maps, magnitude-frequency analysis, etc.) • Information/data on climate impacts/consequences for specific sectors (e.g. info on expected crop yields, losses, costs, damage, disruptions or fatalities for agriculture, transport, health, energy, etc.) • Climate vulnerability/risk information in general or for specific sectors (e.g. data/info on exposures and sensitivities) • Climate change impact data/model outputs (e.g. on ecosystems, water availability, etc.) • Climate change vulnerability/risk information (e.g. maps for specific sector/region) • Training, workshops, lectures and information material on climate issues, e.g. climate change and its impacts (e.g. qualitative info/education material to raise awareness ;	• Guidelines for selecting relevant climate information and assess its relevance • Technical training, tools or support for data processing and product application • Training, tools or support to assess the value/significance of the climate information for the own context (*e.g. interpretation of information on probability and uncertainty*) • Support for optional queries is desired • None. Available climate-related products and formats can be processed/utilized

general or sector-specific) • Tools which support decision-making, strategy development and financial planning	
This **product type** is **provided** by our organization	This **service** is **provided** by our organization
• Tailored climate data/statistics (e.g. indices) for specific purpose (e.g. 'sector of concern') • Climate forecasts/outlooks for specific parameters/events at various time scales (e.g. week, month, year, etc.) • Climate change projections (e.g. model output data/maps for specific parameters, events, etc.)	• Explanation of content/meaning of climate information is required (e.g. how to read the graphs?)

4.3 Climate Change and Climate Services in Egypt

Neither questionnaire nor the product matrix was completed hence no information was availed on the climate services baseline and the use, needs and evaluation on climate services products with their portfolio for Egypt apart from climate change risks in the country done through independent research.

4.3.1 Climate Change risks in Egypt

According to the publication Climate Change Information Fact Sheet EGYPT (2015), herein are the projected changes in temperature and rainfall that will occur in Egypt.

- The mean annual temperature in the country is projected to increase by 1.07°C to 1.27°C by 2030 and maximum temperatures are projected to increase by 1.0°C to 1.22°C. Some of the increase will be highest in summer months of July-September with increases in the number of hot days (especially in summer), and decreases in the number of cool.
- The mean annual precipitation indicate high uncertainty in the direction and amount of change with some models suggesting a insignificant change of average annual rainfall change of 0 mm/day, and 0.1mm/day, by the middle of the 2030s and others indicating slight reductions in rainfall in Egypt for most months by midcentury-2050.

4.3.2 Climate Services for Infrastructure baseline of Egypt

There was no evaluation and summary of the results from the general questionnaires because the NMHS did not complete the questionnaire. Overall, the elements provided for under Global Framework of climate services (GFCS) such as: Observations and monitoring (OM); Research, modelling and prediction (RMP); Climate Service Interface System (CSIS); User interface platform (UIP); and Capacity development (CD) was not covered.

4.3.3 Product portfolio in Egypt

Similarly, the product matrix was not completed hence no information shall be provided on the level of services on: Climate data sets; Climate diagnostics & monitoring products; Monthly and seasonal Long-term predictions; Climate projections; and Climate related hazards & secondary events.

4.4 Climate Change and Climate Services in Ethiopia.

The questionnaire was completed by a representative from the NMHS of Ethiopia herein represented by National Meteorological Agency (NMA). The information derived from the questionnaire, product matrix and independent research provides the climate change risks in the country, the climate services baseline and the use, needs and evaluation on climate services products with their portfolio.

4.4.1 Climate Change risks in Ethiopia

The available literature on Ethiopia- Climate Change Information Fact Sheet Ethiopia (2015), indicate the following changes in temperature and precipitation within the country.

- The mean annual temperature in the country is projected to increase by 0.44°C, 0.92°C, and 1.4°C by 2030; Maximum temperatures are projected to increase by 0.93°C to 0.98°C, and minimum temperatures by 0.93°C and 1.05°C. All projections indicate substantial increases in the frequency of days and nights that are considered "hot" in

current climate. Annually, projections indicate that "hot" days will occur on 19-40% of days by the 2060s.

- Projections offered for mean annual rainfall averaged over the country project a wide range of changes in precipitation for Ethiopia, but tends toward increases. For example, an average annual rainfall increase of 0.1 to 0.2 mm/day by the middle of the 2030s although, generally the mean annual precipitation indicate high uncertainty in the direction and amount of change.

4.4.2 Climate Services for Infrastructure baseline of Ethiopia

This shall be used to provide an evaluation and summary of the results from the general questionnaires received from the NMHS and also the completed product matrix for services provided. The elements covered with the questionnaire and product matrix was within the general framework of applying the structure of Global Framework of climate services (GFCS) to the elements listed in the subsequent sub-chapters below:

i. Observations and monitoring (OM)

The objective of this sub-section is to identify the available data sources and the state of observing systems which may also include identification of the quality of available data management systems and mechanisms within the NBI countries.

The NMHS of Ethiopia herein represented by National Meteorological Agency (NMA) stated through the questionnaires that they adhere to climate monitoring principles with most of the data sources and observation system measurements attributed to both atmospheric and terrestrial parameters although ocean parameters are neither measured nor stored. The NMHS has access to observational data from neighbouring countries besides carrying out in country observations. It should be noted that the NMHS has its data in the form of gridded/ interpolated data, satellite data, re-analysis data and model data (both GCM & RCM). This model data is in the form of Weather Research and Forecasting Model (WRF), Geo-CLIM, and Cone Penetration Testing (CPT). In addition to this, Ethiopia NMHS does have access to socio-economic and impact databases. The same NMHS also creates archives and documents climate data sets stored in databases for the appropriate length, time, resolutions and units. This also involves collecting and storing data and metadata into databases although it was noted that the databases are inadequate. It is also worth noting that the NMHS does apply quality tests, homogeneity tests and have a data rescue program in place. Although the NMHS does share data with WMO-RCC for operational purposes and backup, it does have policies that restrict the free and open data sharing data with other entities. Nonetheless, the NMHS does have strategies for ensuring security, integrity, retention and technological migration for data archival processes and systems. Some of the notable challenges with data for the production of climate services as mentioned by the NMHS include: limited database connection with regional meteorological centres, limited climate outlook at local/district level and inadequate skill and manpower on modelling.

Apparently, the Ethiopia NMHS has as well established structure to integrate all basic systems into functioning observation systems although they recognise some major challenges in the observation network and data availability that is limiting the provision of climate services and products to be associated with poor spatial coverage of observational network; inadequate staffing levels and limited capacity; poor financial and technical resources and weak means of communication and transmission of data. Despite all the above challenges, it is unfortunate that the NMHS of Ethiopia did not mention whether long-term strategies of managing the network and improving data availability are planned.

ii. Research, modelling and prediction (RMP)

This section is to identify the current research capacities and cooperation potential for product development and services orientation within the Nile basin countries.

For the case of Ethiopia, the NMHS also has a mandate to carryout research activities and with a fully pledged unit, some of which have a fully dedicated personnel or mechanisms of dealing with user requirements and operational service provisions. Some of the research results are then used in operational practice with specific user needs and groups. This has led to the development of new tools and knowledge for multi-disciplinary studies and applications such as in smart agriculture, climate-health, climate-tourism, etc while others have led to the development of new methods and tools but not new models. They do collaborations with mainly University and agricultural organizations and these collaborations anchored mainly through MOUs. The main needs are for better capacity building, improved financial resources and adapt to fast changing technologies.

iii. Climate Service Interface System (CSIS)

The objective of the baseline on this section is to identify the political embedment of the Service in the national and regional landscape of climate service providers and also identify the regular users, available dissemination and communication structures of the service, its visibility and needs and how providers and users interface.

For the case of Ethiopia, the NMHS' role and contribution is clearly mentioned within the National Adaptation Plan, National Disaster Risk Management Strategy and National and Sector policies and strategies. It is also apparent that Ethiopia has a national policy, action plan and/or strategy on climate services with clearly defined roles and responsibility in generation, tailoring and communication of climate services are mentioned therein. The NMHS does have the mandate to provide climate services with fully functional and dedicated units for the provision and production of climate products and services. The funding for the national action plan varies from national budgets to donor funding and in some incidences, internally generated funds.

When it comes to the institutional arrangements, the NMHS of Ethiopia separate the National Meteorological and Hydrological services (NMHS) but have indicated that they are fully imbedded in government and they recognize the need for strengthening the cooperation and partnership amongst themselves. It has been stated that in Ethiopia, there are no private or commercial services providers doing similar work to the function of the NMHS but they mention collaboration with other national, regional and international organizations such as: WMO, IGAD Climate Prediction and Application Center (ICPAC), African Centre of Meteorological Application for Development (ACMAD), United National Development Program (UNDP), World Food Program (WFP), World Bank, African Development Bank, United Kingdom Meteorology (UKMET), Korea International Cooperation Agency (KOICA), International Research Institute for Climate and Society (IRI), OXFAM, etc.

With regards to data and information sharing, or there is no policy for free data access of hydrology and meteorology data for the public although they have indicated various ways and channels to disseminate, seek visibility and market their products and services. The information is given either as printed copies sent by post, delivered via email, delivered to recipient on recorded media for example via video tapes, by web page and also through FTP downloads. This

information when shared with the public conveys a degree of uncertainty. The NMHS also indicated that their information is also mainstreamed into sector policies and this mainstreaming is guided by special methodology and tools. It is recognised that the way the messages are conveyed lead to misunderstanding and interpretation but nonetheless, recognize the need for visibility. They have also indicated that they have professional communicators to help convey the messages and warnings at large scales. Although they don't carry out marketing of climate services and products, they promote societal awareness of climate change issues. The NMHS has also indicated that they operate a website but also ensure visibility through regular seasonal climate prediction presentations on national TV channels, in local newspapers, broadcast interviews and carry out press conferences on radio. Other than this, the NMHS also uses brochures, pamphlets and issue sectoral-specific information and warnings on weather and climate.

In terms of user interaction and feedback, the Ethiopia NMHS does recognize the need for feedback from their users to help revise and improve their products with the NMHS indicating that their users assist in the design and development of products and services. There was no indication as to whether the NMHS works with sector based research teams to develop applications and models. It should also be noted that the NMHS provides users with risk assessments and risk management as well as advice on input into financial tools for risk transfer. This and other products do directly plug into decisions support tools for public policy developments. As it will be seen in the table below, herein are leading sectors or organizations in collaboration with the NMHS and how "valuable" they are to the NMHS is indicated through ranking their engagements. The top institutions are: government, water resources, agriculture, emergency planning and response, scientific research etc. while the least "valuable" collaboration are with commercial entities, tourism, recreation & sports, environment protection, finance and innovations etc.

Table 7: Showing the type of use, the products provided and how valuable to that sector for in terms of climate service for the NMHS in Ethiopia.

User	Indicate if you provide climate services	*Rank	Indicate the type of products provided to the sectors					
			data services	climate monitoring	climate analysis and diagnostics	climate predictions	climate change projections	tailored products / early warning
Government	x☐	5	x	x	x	x	x	x
Local authorities	x☐	4	x	x	x	x	x	x
Scientific	x☐	5	x					
Commercial	x☐	2	x					
Water resources	x☐	5	x	x	x	x	x	x
Agriculture	x☐	5	x	x	x	x	x	x
Fisheries	☐	2	x					
Forestry	☐	3		x		x		

Transport	x☐	4	x	x	x	x	x	x
Energy industry	x☐	5	x	x	x	x	x	x
Human Health	x☐	4	x	x		x		
Tourism	x☐	3			x			
Recreation, sport	x☐	3				x		
Aviation	x☐	5	x	x	x	x	x	x
Environmental protection	x☐	5	x	x	x	x	x	x
Building	☐	2	x		x			x
Finance and insurance	x☐	4	x	x	x	x		x
Emergency planning and response	x☐	5	x	x	x	x	x	x

*Rank means the importance of each sector for climate services, where ''1'' is the least important, ''5'' is the most important

iv. User interface platform (UIP)

The objective of the baseline on UIP is for the identification of the prominent users as well as the purpose and objectives of user-interaction and the mechanisms of user-interaction. This section also includes the identification of mechanisms to monitor and evaluate the impact/value of climate services.

For the case of Ethiopia, although it has not been stated whether the NMHS has a mandate to interact with the users directly but it has indicated that it has a dedicated person to interact with users and to provide them with climate services and information. Some of the institutions and organisations at national level that the NMHS interact with are agriculture, water resources, construction, livestock, researchers, university scholars, students, environment, investments, Aviation, private companies, Non-Government Organisations, tourism, legal institutions, insurance companies, development partners etc. The NMHS has an established mechanism of interacting with media especially during emergency situations and also regular and planned meetings with ministries and sectors. This is done using specific sector help desks whose main function is getting feedback on existing products and a feedback loop from user needs back into research. In other cases, the NMHS gets to know user needs when the users come to them with their needs (specific requests, questions, and problems) or when the NMHS conducts dedicated enquiries, surveys through questionnaires and forums. National climate outlook forums are regularly held to interact, enhance awareness and provide tailored products to users while the NMHS communicates seasonal outlooks to users through WMO mechanisms like RCOFs, NCOFs, climate watch systems etc. The NMHS also interacts with users in order to meet their requests for example when it comes to the provision of weather forecasts, get feedback on the usefulness and effectiveness of information and services provided, to identify user requirements on specific climate services and products, to provide advice and guidance on use and application of products and lastly, to assist users to interpret and use climate predictions. Through this, they have recognised that the lack of specific user programs limit user understanding of climate information.

With regards to monitoring and evaluation, the Ethiopia NMHS does tract the quality of service including levels of satisfaction with users and also they identify and measure impacts of their services like disaster lose, crop yields, hydropower etc. and level of interest of products with users. The NMHS also does perform socio-economic study of climate services in order to demonstrate the value of products to users although it has not been stated if it also does cost-benefit analysis of climate services; but there was a clear indication of investment planning of climate sensitive sectors based on results other socio-economic analysis.

v. Capacity development (CD)

For the case of Ethiopia, the NMHS has policies on Human Resources Development and also involve themselves in regional and international training programs to enhance capacities, most of which are organised around training courses, conferences, curriculum development and fellowships with only the exception of e-learning which is not done. The NMHS recognise the need for specialised trainings in climate services, tailoring of climate information to specific sectors, special training on communication and also the need for additional staff to fulfil climate service tasks. Also mentioned is that once staff is recruited, they would need them to develop capacities especially for climate services, interaction with users, research and product development as key to improve climate services.

The NMHS recognises that the lack of interaction with users limit the effectiveness of the user of climate information but unfortunately, it does not extend trainings to user communities. It has been acknowledged that some gaps do exist especially with lack of recognition and visibility of services within their governments and also lack of integration of climate services into social-economic benefits. Other problems cited include the lack of policies regarding the role of climate services in the overall social-economic development space. The Ethiopia NMHS mentioned computing facilities, equipment networks, internet access and software, financial resources and building space as main challenges towards improving products and services.

4.4.3 Product portfolio in Ethiopia

The objective of section is for the identification of currently available climate information products and services. It will involve the results from both the questionnaire and the product matrix with the product matrix providing an in-depth and detailing of the questionnaire.

i. Climate data sets

Both terrestrial and atmospheric measurements and observations are collected and stored by Ethiopia NMHS as historical datasets and are also made available for both internal use and external use. With regards to other sets of data, gridded/ interpolated data and rescued metadata is available for both internal and external use and also similarly, satellite data is available but mostly for internal use. Basic statistics on climate extremes for example temperature, precipitation, humidity, sunshine duration, frequency of occurrence, spatial mean etc are also available for both internal and for external. Model data is lacking and ocean data is neither collected nor stored; meanwhile the Ethiopian NMHS does not perform homogeneity tests and adjustments of time series.

Information derived from the product type matrix on processed climate data indicate that the Ethiopia NMHS has some of the data available on rainfall and temperature which form part of derived product characteristics for sector-specific products related and compiled for weather data. The targeted main user is aviation and air transport. The products, data source and co-

production are by the National Meteorological Authority (NMA). The services offered are processed data per hour and the means of user-interaction is through briefing and document. One noticeable challenge is for capacity to be improved.

ii. Climate diagnostics & monitoring products

The NMHS of Ethiopia does analyse spatial patterns of temperature, precipitation and their anomalies including climatic zoning for both internal and external purposes. Similarly, the NMHS applies advanced climate statistics and graphical products for example analysis of maps and graphs of precipitation, temperature, relative humidity, eva-transpiration, sunshine duration, cyclones etc. for both internal and external purposes. Meanwhile, basic assessments and analysis especially diagnostics of spatial and temporal factors and processes involved in observed climate patterns for example tropical cyclones, monsoon, synoptic scale storms etc. is done but for mostly internal purposes. The development and provision of specialized climate analysis, prediction and monitoring products, tailored to the needs of specific users are also done mostly for internal purposes. Unfortunately, highly sophisticated climatologically statistics and complex characteristics, incl. indices for specific users like for building design codes and the use and derivation of products from satellite data for monitoring activities are not done by the NMHS of Ethiopia.

With regards to climate diagnostics as provided by the Ethiopia NMHS in the product matrix, the product characteristics are mainly for rainfall and temperature with sector-specific products being daily, Maximum, Minimum and Average values. The data source and co-production is by the National Meteorological Authority (NMA) which is Ethiopia's NMHS. The targeted users are those in flood management with services provided in daily format on a daily basis. The user-interaction is through regular data flow and given by a select committee. In this particular case, the gaps and needs have not been given.

iii. Monthly and seasonal Long-term predictions

The NMHS of Ethiopia develops and provides prediction products at monthly and seasonal scales which are used for both for internal and external purposes. It is also worth noting that these are neither provided at decadal scales nor provided with information in relation to the degree of uncertainties or skill level. The NMHS analyses climate extremes into maps, graphs and images which can be provided as monthly to seasonal outlooks. The assessment of current climate conditions is also made in terms of averages, variance, thresholds, and percentiles in weekly, monthly, seasonal and annual time scales.

Specific advisories for user community are issued and disseminated as climate summaries, bulletins, reports, drought/flood maps and special statements for severe weather for both internal and external purposes. The NMHS receives predictions provided by RCCs, Regional Climate Outlook Forum (RCOFs) and Global Production Centres (GPCs.) which are then made available for mostly internal use.

Information derived from the product matrix state that the NMHS of Ethiopia provides monthly, seasonal and decadal climate predictions whose product characteristics are of rainfall and the sector-specific products being monthly, seasonal and decadal rainfall prediction and rainfall for analogues years. The data sources and co-production is still the National Meteorological Authority (NMA) with the users being the MWIE, Ethiopian Electric Power (EEP) for Reservoir Management and hydrological forecast. The services offered is a report of the prediction and presented on the season while the means for user-interaction is through meetings and also web

based information sharing. The identified challenges are capacity, manpower, modelling and software.

With regards to climate monitoring, the product characteristics under consideration are flow where the sector-specific products are provided as daily flow, monthly, yearly and real time data. The data source & co-production is done by NMA and the department of Hydrology with expected users being EEP, design enterprises, inflow for reservoir management and the design of infrastructure. The specific services were not given but the means of user-interaction is through meeting and upon request. The needs include improvement of hydrological network, manpower and capacity for hydrological management.

iv. Climate projections

The NMHS of Ethiopia does the development and interpretation of climate change scenarios and also performs dynamical and statistical downscaling of GCM and RCM. It should also be noted that the Ethiopia NMHS performs reanalysis and adding value from national perspective to these products received form RCOFs, RCCs and GPCs. This also means the review and assessment of past climate patterns on the state of climate for their country as provided by WMO reports. It should be noted though that most of the above is done for mostly internal purposes except for sharing and exchange information, products, services to other countries in the region especially during the periods of significant climate anomalies; for purposes of analysis, interpretation and reanalysis of climate statements or products for general public or specific users for both internal and external purposes.

From the product matrix analysis, the Ethiopia NMHS did not give much information on climate change projections but only mentioning that the available product characteristics are rainfall. The other necessary information for example sector-specific products, data source & co-production, User & value, services types, user-interaction and the gaps and needs was not given.

v. Climate related hazards & secondary events

The NMHS of Ethiopia does analysis and provision of products relevant to El Nino, La Nina updates and Global Seasonal Climate Updates (GSCU) that contains information on ENSO and other climate extremes and variations driving phenomena for example NAO, PNA, IOD, etc but for mostly internal purposes. Meanwhile, it does not neither provide global and/or regional scale data resources as input into modelling, research and applications nor does it provide high density, small scale specialized data resources used for studies of small scale processes and urban environment.

With regards to climate-related hazards and impacts from the product matrix, the Ethiopia NMHS has indicated the product characteristics as those of extreme flow and rainfall with the key sector-specific products being maximum flow and rainfall. The data sources and co-production come from the National Meteorological Authority, hydrology and water quality directorate. The users are the Ethiopia National Disaster Risk Management Commission (NDRC) and infrastructure owners, flood management, dam operation during flood and drought. Key services are daily and real time data with the means and user-interaction through reports and meeting. No specific gaps and needs were highlighted.

4.5 Climate Change and Climate Services in Kenya

The questionnaire was completed by a representative from Kenya Meteorological Services Department (KMD). The information derived from the questionnaire, product matrix and

independent research provides the climate change risks in the country, the climate services baseline and the use, needs and evaluation on climate services products with their portfolio.

4.5.1 Climate Change risks in Kenya

According to the publication on climate change adaptation for Kenya (2012), a USAID Factsheet, herein are the projected changes in temperature and rainfall that will occur in Kenya.

- An average increase of 1.0-2.8°C in annual temperatures by the 2060s, and of 1.3-4.6°C by the 2090s from a backdrop of temperatures having risen by about 1.0°C since 1960, meaning that nearly an average of 0.21° per decade from historical observations.
- There will be changes in annual precipitation that range from a decrease of 6 percent to an increase of 26 percent from the 1970-99 average. This also suggests that a larger percentage of precipitation will fall during heavy rainfall events while presenting a case of an increase in the frequency and duration of droughts.

4.5.2 Climate Services for Infrastructure baseline of Kenya

This shall be used to provide an evaluation and summary of the results from the general questionnaires received from the NMHS and also the completed product matrix for services provided. The elements covered with the questionnaire and product matrix was within the general framework of applying the structure of Global Framework of climate services (GFCS) to the elements listed in the subsequent sub-chapters below:

i. Observations and monitoring (OM)

The objective of this sub-section is to identify the available data sources and the state of observing systems which may also include identification of the quality of available data management systems and mechanisms within the NBI countries.

Kenya Meteorological Services Department (KMD) participated in the survey and shall herein be referred to as the Kenya NMHS. It stated that it adheres to climate monitoring principles with most of the data sources and observation system being taken from all the three scopes of ocean, atmosphere and terrestrial measurements. The noticeable challenges for observation network and data availability which is limiting the provision of climate services and products within the NMHS are the limited number of stations and technical equipment for observing and providing qualitative data; poor spatial coverage of observational network around the whole country; weak financial and technical resources; and weak means of communication and transmission of data from observation stations. Furthermore, the NMHS still does not have a well established structure to integrate all basic systems into functioning observation systems which should also help in carrying out further observation into accumulated time series. Despite the above challenges, the NMHS of Kenya does have long-term strategies of managing the network and improving data availability for example through station change, relocation, automation and protection.

With regards to data, the Kenya NMHS has access to observational data from neighbouring countries with different data sources available, for example, gridded/ interpolated data, satellite data, re-analysis data and model data (GCM & RCM). They also have access to socio-economic and impact databases although they have stated that this is limited. Equally, the NMHS creates archives and documents climate data sets and have data stored in databases for the appropriate length, time, resolutions and units. The NMHS also collects and stores data and metadata into databases with further plans to improve the data bases. The NMHS does apply quality control,

homogeneity tests for time series and have a data rescue program in place. Other than that, the NMHS does share data with WMO-RCC for operational purposes and backup, although they have a restrictive protocol on open and free data sharing but may exchange data upon request. The NMHS also mentioned a plan to adopt well documented strategies for ensuring security, integrity, and retention policy and technology migration for data systems. Nonetheless, some challenges with data management which hinder the production of climate services do exist and noticeably is that there is a lot of un-digitalised.

ii. Research, modelling and prediction (RMP)

This section is to identify the current research capacities and cooperation potential for product development and services orientation within the Nile basin countries.

The NMHS of Kenya does have a fully pledged unit with fully dedicated personnel or mechanisms of dealing with user requirements and operational service provisions. This is done under a clear mandate to carryout research activities although there is also shared research responsibility with mainly regional entities, universities and agricultural organizations; these collaborations reinforced mainly through MOUs. These research results are often used in operational practice to determine specific user and group needs some of which has led to the development of new methods, tools, models and added to the body of and knowledge for multi-disciplinary studies and applications such as in smart agriculture, climate-health, climate-tourism, etc. the This NMHS are also involved in the development of new. The main needs highlighted include more funding for research projects.

iii. Climate Service Interface System (CSIS)

The objective of the baseline on this section is to identify the political embedment of the Service in the national and regional landscape of climate service providers and also identify the regular users, available dissemination and communication structures of the service, its visibility and needs and how providers and users interface.

The NMHS of Kenya has its roles and contributions clearly mentioned within the National Adaptation Plan (NAP) and similarly the national policy and strategy on climate services mention clearly the defined roles and responsibility for generation, tailoring and communication of climate services me. The NMHS does have the mandate to provide climate services with fully functional and dedicated units for the provision and production of climate products and services with most of its funding for the national action plan coming from their national budgets. What was not made clear is if the National Meteorological and Hydrological services operate as separate institutions but there is an indication and call for better administrative arrangements and coordination between the two agencies. Also, there is no mention if NMHS is fully imbedded within government or semi autonomous but there are indications that there are some private and commercial services providers doing similar work and function like the NMHS in providing both hydro-meteorological and climate service functions. There is also collaboration with other national, regional and international organizations such as EUMETSAT and ICPAC. In recognition of private players, it has not been stated what cooperation agreements exists with these private entities but a clear mention that their NMHS still takes a lead on providing climate services in the country.

The NMHS of Kenya does have a restricted policy for free data access for the public although they indicate various ways and channels to disseminate, and market their products and services. These

channels include: printed copies sent by post, delivered via email, posted on web page and sending through flash drive. The information which is shared with the public does conveys a degree of uncertainty and also a suggestion and the recognition that the way the messages are conveyed lead to misunderstanding and interpretation but nonetheless, recognize the need for visibility. The NMHS has indicated that their information is also mainstreamed into sector policies but it was not stated if this mainstreaming is guided by special methodology and tools. It is also indicated that the NMHS have professional communicators to help convey the messages and warnings at different scales besides helping with marketing of climate services and products and also the promotion of societal awareness of climate change issues. The NMHS does operate a website but also tries to ensure visibility through regular seasonal climate prediction presentations on national TV channels, in local newspapers and also through broadcast of interviews, press conferences on radio and the use of brochures, pamphlets and sectoral-specific information and warnings on weather and climate.

In terms of user interaction and feedback, the Kenya NMHS does recognize the need for feedback from their users to revise and improve their products with the NMHS indicating that their users assist in the design and development of products; some of which do directly plug into decisions support tools for public policy development. They have also indicated work with sector based research teams to develop applications and models, however, it should also be noted that the NMHS does not provide users with risk assessments and risk management nor advice on input into financial tools for risk transfer.
The table below are leading sectors or organizations in collaboration with the NMHS and their "valuable" to the NMHS through a ranking format of importance and level of engagement.

Table 8: Showing Kenya NMHS collaborating partners and the value of their products to these partners

User	Indicate if you provide climate services	Rank	Indicate the type of products provided to the sectors					
			data services	climate monitoring	climate analysis and diagnostics	climate predictions	climate change projections	tailored products / early warning
Government	√☐	5	×	×	×	×	×	×
Local authorities	√☐	5	×			×		×
Scientific	√☐	3	×					
Commercial	☐	2	×		×			
Water resources	√☐	5	×	×	×	×	×	×
Agriculture	√☐	5	×	×	×	×		×
Fisheries	√☐	2	×	×		×		
Forestry	√☐	3	×	×		×		
Transport	√☐	4	×	×	×			×
Energy industry	√☐	3	×	×	×			×

Human Health	√☐	4	×	×	×	×	×	×
Tourism	√☐	3	×	×				×
Recreation, sport	√☐	2	×					
Aviation	√☐	5	×	×	×	×		×
Environmental protection	√☐	3	×	×	×			
Building	√☐	3	×	×		×		×
Finance and insurance	√☐	4	×	×	×	×		×
Emergency planning and response	√☐	5	×	×	×	×		×

*Rank the importance of each sector for climate services, where ''1'' is the least important, ''5'' is the most important

iv. User interface platform (UIP)

The objective of the baseline on UIP is for the identification of the prominent users as well as the purpose and objectives of user-interaction and the mechanisms of user-interaction. This section also includes the identification of mechanisms to monitor and evaluate the impact/value of climate services.

For the case of Kenya, the NMHS has a dedicated unit for interacting with users and providing them with climate services and information which is provided for under their mandate. This unit is said to have up to 10 persons. The main national institutions and organisations that the NMHS interacts with is the National Disaster Operations Center. Though these units, they have an established mechanism of interacting with media especially during emergency situations which may also include planned regular meetings for interaction with ministries and sectors. On the other hand, It has not be indicated if the NMHS has specific sector help desks whose main function is getting feedback on existing products and also guiding and training on existing products. Other ways in which the gets to know user needs is when the users come with their needs for example specific requests, questions or problems while for others, it is through the use the WMO mechanisms of RCOFs, NCOFs, climate watch systems etc. which is used for example to communicate seasonal outlooks to users. The NMHS doesn't have feedback loop from user needs back into research but recognise that lack of interaction with users on specific user programs limit user understanding of climate information and also lack of appropriate training program for users limit their understanding of the application of climate information. The NMHS also interacts with users in order to provide advice and guidance on use and application of products and lastly, to assist users to interpret and use climate predictions.

With regards to monitoring and evaluation, the NMHS has not indicated that it tracts the use of climate services provided nor does it conduct and evaluate the levels of satisfaction in quality of service but what it does is to identify and measures impacts of their services on climate sensitive sectors and associated variables like on disaster lose, crop yields, hydropower etc. and level of interest of products with users. The NMHS has clearly stated that it does not perform socio-economic study of climate services in order to demonstrate the value of products to users and equally it does not perform socio-economic analysis or cost-benefit analysis of climate services

although it supports investment planning of climate sensitive sectors based on results of other socio-economic analysis.

v. Capacity development (CD)

In Kenya, their NMHS does have policies on Human Resources Development and also involve itself in regional and international training programs to enhance capacities, most of which are organised around training courses, conferences, e-learning, curriculum development and fellowships. Also in regards to improving HR capacities, the NMHS recognise the need tailoring of climate information to specific sectors and special training on communication. In order to do this, staff once recruited is trained in climate services, interaction with users, research and development, data management and products development as key to improve climate services.
The NMHS does extend trainings to user communities although they feel that the training activities do not meet the needs and requirements of users. This is within the broader recognition that the lack of interaction with users limits the effectiveness of the user of climate information. It has been acknowledged that some gaps do exist especially with lack of recognition and visibility of services within their governments and also lack of integration of climate services into social-economic benefits. Other problems cited include the lack of policies regarding the role of climate services in the overall social-economic development space and sometimes the need for improvement of organisational structure of the service. The Kenya NMHS mentioned computing facilities, equipment networks, internet access, financial resources, application software and building space as main challenges towards improving products and services.

4.5.3 Product portfolio in Kenya

The objective of section is for the identification of currently available climate information products and services. It will involve the results from both the questionnaire and the product matrix with the product matrix providing an in-depth and detailing of the questionnaire.

i. Climate data sets

Kenya NMHS does have historical datasets from terrestrial, ocean and atmospheric measurements and observations stored and made available but mostly for internal use. With regards to other sets of data, gridded/ interpolated data, metadata and model data are available for both internal and external uses whereas satellite data and basic statistics on climate extremes for example temperature, precipitation, humidity, sunshine duration, frequency of occurrence, spatial mean etc are mostly available for internal use. Its NMHS does perform homogeneity tests and adjustments of time series.

Information derived from the product type matrix indicate that the Kenya NMHS has rainfall, stream flow and evaporation as its product characteristics from which sector-specific products can be derived and compiled for example to produce catchment area rainfall. The data source & co-production is by observing stations from NMHS. The main target and use is for daily flood watch and update. The services offered are processed data per hour while the means of user-interaction is through community radio. Some noticeable gaps are inadequate monitoring network.

ii. Climate diagnostics & monitoring products

The NMHS-Kenya analyses spatial patterns of temperature, precipitation and their anomalies for climatic zoning and also perform advanced climate statistics and graphical products (including maps, analysis and graphs of precipitation, temperature, relative humidity, evapo-transpiration, sunshine duration, cyclones etc.) are done for internal and external purposes.
The Kenya-NMHS is also involved in the development and provision of specialized climate analysis, prediction and monitoring products and tailored to the needs of specific user for mostly internal purposes. Additionally, the basic assessments and diagnostics analysis of spatial and temporal factors and processes involved in observed climate patterns for example tropical cyclones, monsoon, synoptic scale storms and derived products from satellite data for monitoring activities is done for mostly internal purposes. What should be noted is that the NMHS of Kenya does not do sophisticated climatology statistics, incl. indices for specific users, complex characteristics for building design codes, etc.

Information from the product matrix on climate diagnostics as provided by the Kenya NMHS indicates that some of the product characteristics available are short duration rainfall with sector-specific products for example Intensity-Duration-Frequency curves is available. The data source and co-production is by having in place recording rain gauge stations by the NMHS and the targeted user being delivered to design and construction industry. The services provided include regular updates done through manuals. Some key challenges mentioned are the scarcity of recording gauge network.

iii. Monthly and seasonal Long-term predictions

Monthly, decadal and seasonal prediction products are developed, issued and disseminated by the Kenya NMHS with specific advisories for user communities given through climate summaries, bulletins, reports, drought/flood maps and special statements for severe weather but for mostly internal purposes. These analyses on climate extremes are then developed into maps, graphs and images which are done together with the assessment of current climate conditions in terms of averages, variance, thresholds and percentiles. The Kenya NMHS also received ENSO, SST and intra-seasonal variability products, monthly to seasonal and longer climate predictions as provided by RCCs, Regional Climate Outlook Forum (RCOFs) but not with Global Production Centres (GPCs). Suffice to note is that the Kenya NMHS reported to providing information related to the degree of uncertainties in its products.

As for long-term predictions as stated in the product matrix, the Kenya NMHS provides seasonal rainfall prediction as the relevant product with these products bearing characteristics with sector-specific products that include onset and cessation of rainfall for specific areas. The data sources and co-production is global data centre. The users are Agriculture and for food security while some of the services is issuing these products at least one month before start of season. The means for user-interaction is through participatory scenario planning. The identified challenges are lead time and model skills.

The Kenya NMHS offers climate monitoring products with characteristics that consider rainfall data transmission with sector-specific products being monthly rainfall. The data source & co-production is done by volunteer observers and the specific services are regular recording and transmission. The means for user-interaction are contracts and MOU and the noticeable needs identified as properly formulated contracts and MOU.

iv. Climate projections

The Kenya NMHS does the development and interpretation of climate change scenarios and also performs dynamical and statistical downscaling of GCMs; including the analysis and interpretation of climate statements and the production for general public and other specific users. This work also extends to adding value from national perspective to these products received form RCOFs, RCCs and GPCs. This also means the review and assessment of past climate patterns as provided by WMO reports on the state of climate for their country. All the above is done for mostly internal purposes while the sharing and exchange of information, products and services to other countries in the region especially during the periods of significant climate anomalies is done for mostly external purposes.
Climate change projections were not given by the Kenya NMHS as required by the product matrix. All the information on product characteristics, sector-specific products, data source & co-production, user & value, services types, User-interaction and the gaps and needs was not given.

v. Climate related hazards & secondary events

The NMHS of Kenya does provide both high density, small scale specialized data resources used for studies of small scale processes and urban environments. Also used are global and regional scale data resources as input into modelling, research and applications but mostly for external use. The NMHS also does make analysis and provision of products relevant to El Nino and La Nina updates, Global Seasonal Climate Updates (GSCU) that contains information on ENSO and other climate extremes and variations driving phenomena for example NAO, PNA, IOD, etc but for mostly internal purposes.
Information which was supposed to be derived from the product matrix on climate-related hazards and impacts was not completed by the Kenya NMHS. Also not given were product characteristics, sector-specific products, data source & co-production, user & value, services types, user-interaction means and the gaps.

4.5.4 Current use and needs of Climate Services

This shall be a presentation and documentation of results from Kenya from the user representative and their context of climate information application, current use and needs for climate services.

i. Basic Information about the climate service user / beneficiary

The climate service user from Kenya was represented by the National Water Conservation whose primary tasks are in dam design & construction including flood control works.

ii. Experiences on climate (change), Impact and information

The most relevant climate-related hazards for National Water Conservation is floods and droughts although there is limited data for these two hazards. The impact from climate-related hazards has been that floods routing structures being washed away which is further compounded because of lack of plans. The general understanding is that these impacts are climate change related and are expected to increase yet the sectors' vulnerability to climate change has not been accessed. Other expected impacts are slow river flows leading to water scarcity and excess flows leading to damage of infrastructure.

iii. Sectoral planning, legal frameworks and organizational structures

The National Water Conservation's vision is developing and managing national water works and infrastructure towards enhancing water security, flood mitigation and storage for multipurpose use while the general tasks include development of state schemes and spearhead dam

construction for water supplies, flood control and other multipurpose uses including land drainage and construction of dykes. In Kenya, infrastructure projects are mandated by the government who have done a study that came up with potential dam sites while for flood mitigation works, the requests come from the affected communities and forwarded for budget allocation. The National Water Conservation has outputs which include construction of dams and dykes with outcomes that have given water service providers and the community protection from floods. Secondary to this, the user's general role of climate information in infrastructure planning process is that historical climate information helps in determining expected amounts of flow and the kind of protection works needed to mitigate damage. The user sometimes delegates its tasks to contractors and supervising engineering consultants.

With regards to legal and regulatory requirements, there are no laws or regulation which obligate the explicit consideration of climate (change) risks and furthermore, it was not stated where these laws, regulation or policy focus either on mitigation, adaptation or risk management as a precautionary principle; although the use of climate information in regulation is only provided as a general guideline which is issued but not necessarily followed.

The National Water Conservation finds that climate laws, regulation or policy is more relevant when compared to other laws, regulation or policy. This can be seen by the application of the precautionary principle as statutory requirement in their country law especially with regards to environmental Impact or social impact assessments.

There is no clear agreement in the users' organization about objectives and values related to addressing climate, climate-related issues and climate change but a general consensus that the role of the 'precautionary principle' in the context of climate change could help with project acceptance, sustainability and resilience of the project.

The National Water Conservation has no focal point champion or working group on the topic of climate or climate change although climate information enters the process of decision making at the project inception/feasibility stage. Other relevant reasons as to why climate information is considered is to ensure safety and reliability of the infrastructure project, as an internal motivation tool and for regulatory obligations while the not so relevant is external motivation and as of business interests.

At the National Water Conservation, the design based on engineering design codes and best practices decides which climate information should be taken into account during decision-making processes and the time frame for such considerations is during the planning stage but the final decision is based on historical data.

iv. Climate information and decision-making

At National Water Conservation, the specific purpose that climate-related information is required is in the design operation and maintenance of dams and flood mitigation works. The highly relevant reasons for climate information to be used in decision-making processes at various organizational levels such as for strategic planning, infrastructure planning and implementation, maintenance and organizational planning of existing infrastructure, day-to-day operation management of existing infrastructures and implementation of risk management plans. The rest as education and increase of staff awareness and decision-makers is only seen as slightly relevant.

The National Water Conservation deals with uncertainty in climate information during the planning processes by working with probability to determine chances of exceedance and planning for such an eventuality. Secondly, uncertainty is not encouraged hence factors of safety are then applied while on the other hand, uncertainty will lead to loss of life and property. It can also be seen that the user organization has ever addressed disaster risk in general but not climate risk and climate change risk.

Table 9: Climate risk management strategies being pursued or considered by users in Kenya

	Current climate conditions	Climate change			
Purpose	Implemented strategy	No option	Potential option	Planned option	Implemented option
Awareness creation	☒	☐	☒	☐	☐
Prevention: Protection (*e.g. protective constructions like dams*)	☒	☐	☐	☐	☒
Prevention: Transformation of object of concern (*e.g. change of building design, or specific components*)	☐	☐	☒	☐	☐
Prevention: Retreat (*e.g. relocation of constructions*)	☐	☒	☐	☐	☐
Contingency planning accommodating climate change risks	☐	☐	☒	☐	☐
Business continuity management accommodating climate change risks	☐	☐	☒	☐	☐
Early warning systems	☐	☐	☒	☐	☐
Responses to warnings (e.g. evacuation, temporal protection)	☐	☐	☒	☐	☐
Recovery planning	☐	☐	☒	☐	☐

v. Limitations on the use of climate information

Some of the reasons why the product is not being used in the decision-making process that applies very much to the situation is that the product does not fit their purpose while that which simple applies are that: 1) the access to climate information is restricted/limited, 2) the product is not available when required for example because of inapt timing, 3) the product is of limited quality, 4) the product is not relevant for our context. The reason of fair significance is that product existence is not known while what which applies with very little is that the information content is not understandable. Similarly, at an organisational level, the reasons as to why there is limited use of climate information in the users' decision-making process that is of very high significance is that the products is not freely available. The rest like: there is no need for climate information, there is no legal obligation to use climate information, the cost-benefit value of the use of climate information does not profitable, the relevance of climate information for decision-

making is negligible, there is no added value of the product for their purpose and that there are no capacities available to deal with climate information are simply irrelevant.

vi. Capacities for climate information application/processing

For the user, technical and personnel capacity is considered not sufficient enough to process and interpret climate-related information. The highest needs mentioned are those associated to technical equipment and skills, know-how and training and number of staff. Funding, no access to external support and limit on advice of how to integrate climate-related information in decision-making processes are considered those of lesser significance.

Any relationship to an external service provider would simply be on request or under individual contracts. It is also important to note that the users' staffs have not received training on climate change and climate change adaptation and they are not sure on who would provide such training although they have engineers and hydrologists-staff who are actively working with climate information and disaster risk information.

vii. Current use and needs of climate information products and services

The National Water Conservation classifies itself as an end-user that applies climate information and thinks it has a good ability to formulate your needs on climate information products because it knows the kind of information they need as an end user and also because it uses its own resources for data analysis. It should be noted though that the user doesn't discuss gaps and needs of climate information products and to provide feedback with the climate information provider. There are other stakeholders and sector-groups that ask about similar climate information from the providers but each group organizes its self to formulate their needs and in their case, the relationship with the provider is an on-off relationship with individual contracts.

4.5.5 Analysis and evaluation of user needs on climate services products

Table 10: Climate-related information (specific products and services) that is in use or needed by users in Kenya

This **product type** is being **used** directly for **decision-making**	This **service** is being **used** to enhance **decision-making**
• Climate data (e.g. raw or processed, gridded data, station data, etc. for specific parameters and regions). *For example: Historical Meteorological and hydrological data which is given for monthly and yearly data sets for specific observing stations and printed out in hard copies for stations of interest.* • Climate statistic products (e.g. information about means and extremes for individual parameters for a specific region and period in form of maps, graphs, etc.). *For example: Historical Meteorological and hydrological data which could be trends of historical highs and lows as well as averages and submitted in tabular format as well as in form of graphs and maps.* • Tailored climate data/statistics (e.g. indices) for specific purpose (e.g. 'sector of concern'). *For example: Historical Hydrological data in the form of depth-area –duration curves of precipitation for given return periods that are presented in terms of graphs* • Data / statistics on hazardous climate events / extreme events (e.g. impact maps, magnitude-frequency analysis, etc.) *For example: Historical Hydrological Data in the form of PMP, PMF, return periods of rainfall, drought for a catchment in the form of Graphs, maps and curves in hard copy.* • Hydrological data / statistics and events (e.g. discharge, floods, low-flows, etc.). *For example: Historical Hydrological data (stream flow levels converted to flows) where rating curves for specific streams in a catchment are presented in terms of graphs and if possible, formulas.* • Others Estimation of sediment flow for current situation and also sediment flow occasioned by climate change. For example: Sediment transport in form of amount of sediment generated in a catchment and transported in the streams. The form of data required is blended data which is preferred and currently, this is presented as formulas based on land use.	• Information not provided
This **product type** is being used as input for follow-up products / services	

• Information on regional climate conditions (*e.g. review and analysis in form of bulletins, synthesis reports, statements, etc.*)	
This **product type** is **desired/required** but not (yet) being used/available	This **service** is **desired/ required** but not (yet) being used/ available.
• Data/statistics on climate impacts on terrestrial systems (e.g. impacts on ecosystems (vegetation etc.), geo-morphological impacts (soil erosion, landslides, etc.)) • Information/data on climate impacts/consequences for specific sectors (e.g. info on expected crop yields, losses, costs, damage, disruptions or fatalities for agriculture, transport, health, energy, etc.) • Climate vulnerability/risk information in general or for specific sectors (e.g. data/info on exposures and sensitivities) • Climate forecasts/outlooks for specific parameters/events at various time scales (e.g. week, month, year, etc.) • Climate change projections (e.g. model output data/maps for specific parameters, events, etc.) • Climate change impact data/model outputs (e.g. on ecosystems, water availability, etc.) • Climate change vulnerability/risk information (e.g. maps for specific sector/region) • Training, workshops, lectures and information material on climate issues, e.g. climate change and its impacts (e.g. qualitative info/education material to raise awareness ; general or sector-specific) • Tools which support decision-making, strategy development and financial planning • Others Estimation of sediment flow for current situation and also sediment flow occasioned by climate change. For example: Sediment transport in form of amount of sediment generated in a catchment and transported in the streams. The form of data required is blended data which is preferred and currently, this is presented as formulas based on land use.	• Guidelines for selecting relevant climate information and assess its relevance • Explanation of content/meaning of climate information is required (e.g. how to read the graphs?) • Technical training, tools or support for data processing and product application • Training, tools or support to assess the value/significance of the climate information for the own context (e.g. interpretation of information on probability and uncertainty) • Advice or decision-support tools to integrate climate information in decision-making • Support for optional queries is desired
This **product type** is **provided** by our organization	This **service** is **provided** by our organization
• Information not provided	• Information not provided

4.6 Climate Change and Climate Services in Rwanda

The questionnaire was completed by a representative from Rwanda Meteorological Agency (RMA. The information derived from the questionnaire, product matrix and independent research provides the climate change risks in the country, the climate services baseline and the use, needs and evaluation on climate services products with their portfolio.

4.6.1 Climate Change risks within Rwanda

Available literature- climate change adaptation for Rwanda (2012), a USAID Factsheet, points to the following change in temperature and precipitation for Rwanda over the next decades:

- As already seen from historical data, there has been an average rise in annual temperatures of about 0.7-0.9°C since 1950 with a projected increase of average maximum and minimum monthly temperatures ranging from 1.5-2.7°C and 1.7-2.8°C, respectively.
- Although there are significant discrepancies between model predictions, most of the projections present an increase of average annual rainfall with seasonal variability. This intensification of heavy rainfall would mean that more rainfall will occur during only a few storms.

4.6.2 Climate Services for Infrastructure baseline of Rwanda

This shall be used to provide an evaluation and summary of the results from the general questionnaires received from the NMHS and also the completed product matrix for services provided. The elements covered with the questionnaire and product matrix was within the general framework of applying the structure of Global Framework of climate services (GFCS) to the elements listed in the subsequent sub-chapters below:

i. Observations and monitoring (OM)

The objective of this sub-section is to identify the available data sources and the state of observing systems which may also include identification of the quality of available data management systems and mechanisms within the NBI countries.

The Rwanda NMHS herein represented by the Rwanda Meteorological Agency (RMA) indicates adherence to climate monitoring principles with most of the data sources and observation system measurements being attributed to both atmosphere measurements including satellite images and terrestrial measurements with some parameters that is available as air temperature, wind speed, wind direction, relative humidity, pressure, solar radiation, sunshine duration, precipitation, soil temperature and moisture, etc). It was categorically stated that the NMHS does not make measurements from the oceans but does access to observational data from neighbouring countries. The other forms of data sets that are available as: gridded/ interpolated data, satellite data, re-analysis data and GCM & RCM model data. Unfortunately, access to socio-economic and impact databases are limited but nonetheless, the NMHS creates archives and documents climate data sets into appropriate length, time units and also collects and stores data and metadata into databases. These data which is stored in databases are recorded for the appropriate length, time, resolutions and units. There are plans to not only improve the data bases but also improve user-interface. The NMHS does apply quality control, homogeneity tests for time series and have a data rescue program in place. Other than that, the NMHS does share data with WMO-RCC for operational purposes and backup, all this under an open and free sharing of data protocol. The mentioned challenges with data management which hinder the production

of climate services include the limited capacity of staff to carry out data digitalisation and limited ability to diverse products and services.

Apparently, the NMHS has as well established structure to integrate all basic systems into functioning observation systems which also involves carrying out further observation into accumulated time series. The Rwanda NMHS highlights some noticeable challenges for observation network and data availability that is limiting the provision of climate services and products and these include inadequate number of stations and technical equipment for observing and providing qualitative data; poor distribution and spatial coverage of observational network especially around water bodies; limited knowledge of staff especially technicians on maintenance for example of the database management software; inability to manufacture spare parts; staffing levels and limited capacity which still need improvement; poor financial and technical resources make it very difficult to replace aging spares and leading to dependence on sponsored projects; weak means of communication and transmission of data from observation stations and also the regular breakdown of modems and power interruptions in automatic weather stations. Despite the challenges, the NMHS of Rwanda does have long-term strategies of managing the network and improving data availability for example through station change, relocation, automation and protection and also provide data on request.

ii. Research, modelling and prediction (RMP)

This section is to identify the current research capacities and cooperation potential for product development and services orientation within the Nile basin countries.

In Rwanda, the NMHS has a mandate to carryout research activities although it doesn't have a fully pledged unit and also no fully dedicated personnel or mechanisms of dealing with user requirements and operational service provisions. The NMHS does share some of the research responsibility for example the University of Rwanda, Rwanda Agriculture Board (RAB) and internationally with International Center for Tropical Agriculture (CIAT) and International Research Institute for Climate and Society (IRI) of the USA. Apparently, these partnerships and collaborations are not anchored under any formal arrangements like MOUs. Nonetheless, the research has led to results which can be used in operational practice with specific user groups for example; they have managed to see the development of new tools and knowledge for multi-disciplinary studies and applications such as smart agriculture, climate-health, climate-tourism, etc. The NMHS is also involved in the development of new methods and tools although not for models. The main needs highlighted include: improvement of research knowledge, partnership with other institutions, publishing of research findings.

iii. Climate Service Information System (CSIS)

The objective of the baseline on this section is to identify the political embedment of the Service in the national and regional landscape of climate service providers and also identify the regular users, available dissemination and communication structures of the service, its visibility and needs and how providers and users interface.

In Rwanda, the NMHS does have the mandate to provide climate services with fully functional and dedicated units for the provision and production of climate products and services. Its roles and contributions clearly mentioned within the National Adaptation Plan (NAP), National Disaster Risk Management Strategy and National and Sector policies and strategies. It is apparent that Rwanda has a national policy and strategy on climate services which offers clearly defined roles and responsibility as those for generation, tailoring and communication of climate services. The

funding for the national action plan is from their national budgets and also from donor support. It has been indicated that the National Meteorological and Hydrological services are separate institutions and therefore a call for better administrative arrangements and coordination between the two agencies including the need for strengthening partnership agreements between them. The NMHS is fully imbedded within government with a clear indication that there are no private or commercial services providers doing similar both work and function like the NMHS in providing both hydro-meteorological and climate service functions although some private companies or organisations do have their own weather stations. In recognition of other organisations within the same space, there are cooperation agreements like MOUs with research organisations and government agencies but the NMHS still takes a lead role on providing climate services in the country as provided for by the laws that establish the Rwanda Meteorological Agency. It is also mentioned that there is collaboration with other national, regional and international organizations such as: WMO, International Civil Aviation Organization (ICAO), and United Nations Framework Convention on Climate Change (UNFCCC), Intergovernmental Panel on Climate Change (IPCC), and ICPAC.

The NMHS of Rwanda does not have a restricted policy for free data access for the public and in fact they have a wide range of ways and channels to disseminate and market their products and services. These channels include printed copies of the information sent by post or delivered via email, posted on web page and through FTP downloads. With regards to the information that is shared with the public, the degree of uncertainty is not conveyed though they recognise that there is limited misunderstanding and interpretation in the way the messages are conveyed but nonetheless, recognize the need for improved visibility. This is probably compounded by the fact that they don't have professional communicators to help convey the messages and warnings nor do they carry out marketing of climate services and products or promote societal awareness of climate change issues. There are competences at the NMHS to integrate the information into relevant sectoral policies and this is done by mainstreaming into sector policies although this is not done or guided by any special methodology and tools. The NMHS does operate a website and this contains freely available climate products and services but admit to the limited use or visibility of presentations on national TV channels or in local newspapers. They also state that there is no broadcast of interviews or press conferences on radio or the use of brochures, pamphlets and sectoral-specific information and warnings on weather and climate.

In terms of user interaction and feedback, the Rwanda NMHS does recognize the need for feedback from their users to revise and improve their products with the NMHS indicating that their users assist in the design and development of products. They have also indicated work with sector based research teams have helped develop applications and models. However, it should be noted that the NMHS does not provide users with risk assessments and risk management nor advice on input into financial tools for risk transfer but have indicated that they have products and services that do directly plug into decisions support tools for public policy development. The table below indicates the leading sectors or organizations in collaboration with the NMHS and how "valuable" their engagement is. These entities include: government, water resources, agriculture, emergency planning and response, scientific research etc. while the least collaboration are with commercial entities, tourism, recreation & sports, environment protection, finance and innovations etc.

Table 11: Showing the NMHS of Rwanda's partners and the value of their products to these partners

User	Indicate if you provide climate services	Rank	Indicate the type of products provided to the sectors					
			data services	climate monitoring	climate analysis and diagnostics	climate predictions	climate change projections	tailored products / early warning
Government	☒	5	x	x	x	x	x	x
Local authorities	☐	5				x		
Scientific	☐	4	x		x			
Commercial	☐	3	x	x		x		x
Water resources	☐	4	x	x		x	x	
Agriculture	☐	5	x	x	x	x		x
Fisheries	☐	1						
Forestry	☐	2	x				x	
Transport	☐	2	x					x
Energy industry	☐	3	x	x		x		
Human Health	☐	3	x	x		x		
Tourism	☐	3		x		x		
Recreation, sport	☐	1						
Aviation	☐	5	x	x	x	x		x
Environmental protection	☐	3	x	x		x	x	
Building	☐	3	x					
Finance and insurance	☐	3	x	x		x		
Emergency planning and response	☐	4	x	x		x		x

- Rank the importance of each sector for climate services, where ''1'' is the least important, ''5'' is the most important

iv. User interface platform (UIP)

The objective of the baseline on UIP is for the identification of the prominent users as well as the purpose and objectives of user-interaction and the mechanisms of user-interaction. This section also includes the identification of mechanisms to monitor and evaluate the impact/value of climate services.

In Rwanda, the NMHS does not have a mandate to interact with the users directly and also do not have a dedicated unit for interacting with users and providing them with climate services and information. The main national institutions and organisations that the NMHS interacts with are

the University of Rwanda, Rwanda Water &Forestry Authority, and Hydro Power companies, Researchers, Meteo-Rwanda, Ministry of Disaster and Refugees, Rwanda Agricultural Board. It should be noted that there is no specific sector help desks to help in getting feedback on existing products and also guiding and training on existing product nor is there an established mechanism of interacting with media especially during emergency situations but at least they have planned regular meetings for interaction with ministries and sectors. To add to this, NMHS doesn't have feedback loop from user needs back into research nor does it communicate seasonal outlooks to users through regional climate outlook forums but it at least recognises that lack of interaction with users on specific user programs limit user understanding of climate information and also lack of appropriate training program for users limit their understanding of the application of climate information. Other ways in which the Rwanda NMHS gets to know user needs is when the users come with their needs (specific requests, questions, and problems) and also it interacts with users. Some of the reasons being to meet their requests for example provision of weather forecasts; to get feedback on the usefulness and effectiveness of information and services provided; to ensure that the information requested for by user is truly the information that is needed to solve the problem of the user; also to identify user requirements on specific climate services and products; to provide advice and guidance on use and application of products and lastly to advice and guidance on use and application of products.

With regards to monitoring and evaluation, the NMHS has indicated that it tracts the use of provided climate services but it does not conduct and evaluate the levels of satisfaction in quality of service. The NMHS indentifies and measures impacts of their services on climate sensitive sectors and associated variables like on disaster lose, crop yields, hydropower etc. and level of interest of products with users. The NMHS also does perform socio-economic study of climate services in order to demonstrate the value of products to users and equally does perform socio-economic analysis and cost-benefit analysis of climate services. It also supports investment planning of climate sensitive sectors based on results the socio-economic analysis or cost-benefit analysis of its climate services.

v. Capacity development (CD)

In Rwanda, the NMHS has policies on human resources development meaning that they involve themselves in regional and international training programs to enhance capacities through training courses, conferences, e-learning, and curriculum development and fellowships. Secondly, the NMHS recognises the high need for specialised trainings in climate services, tailoring of climate information to specific sectors, special training on communication-for example the communication strategy is not very comprehensive and also the need for additional staff to full fill climate service tasks. Also mentioned is that once staff is recruited, they would need them to development capacities especially for climate services, interaction with users, research and development, data management and products development as key to the improvement climate services. The NMHS also recognises that the lack of interaction with users limits the effectiveness of the user of climate information and in order to improve the situation, the NMHS does extend trainings to user communities although they feel that this may not adequately meet their needs.
It has been acknowledged that some gaps do exist especially with lack of recognition and visibility of services within their governments and also lack of integration of climate services into social-economic benefits. Other problems cited include the lack of policies regarding the role of climate services in the overall social-economic development space and sometimes the need for improvement of organisational structure of the service. The Rwanda NMHS mentioned

computing facilities, equipment networks, financial resources, application software, and building space as main challenges towards improving products and services.

4.6.3 Product portfolio in Rwanda

The objective of section is for the identification of currently available climate information products and services. It will involve the results from both the questionnaire and the product matrix with the product matrix providing an in-depth and detailing of the questionnaire.

i. Climate data sets

In Rwanda, only terrestrial historical datasets are stored and made available for both internal use and for external use. Metadata, rescued data and basic statistics on climate extremes for example temperature, precipitation, humidity, sunshine duration, frequency of occurrence, spatial mean etc are mostly available for internal use. The other forms of data, like gridded/ interpolated data sets available for both internal and external use. The country lacks satellite data and model data. The Rwanda NMHS does perform homogeneity tests and adjustments of time series when it comes to her data.

The product type matrix has provided Information that the processed climate data sets by the Rwanda NMHS are from rainfall, temperature, wind, Humidity, national water level, river flow, Lake water level, and groundwater and water quality. This forms the product characteristics of what is available at NMHS of Rwanda. What is derived as sector-specific products are related and compiled for daily, monthly and annual values. The data source and co-production is by Meteo-Rwanda and RWFA targeting mainly the users for flood analysis, hydrological analysis, infrastructure and research. Part of the services offered is processed as daily release of data. Sharing is done through MoU and also free access to the users. One noticeable challenge is inconsistency of data.

ii. Climate diagnostics & monitoring products

The Rwanda NMHS does not offer sophisticated climatology statistics for example indices for specific users such as complex characteristics for building design codes but does offer the use and derivation of products from satellite data for monitoring activities for mostly internal use. The NMHS also does perform basic assessments and diagnostics analysis of spatial and temporal factors and processes. The NMHS also observes climate patterns for example tropical cyclones, monsoon, synoptic scale storms, spatial patterns of temperature, precipitation, etc. and their anomalies for climatic zoning although this may be for mostly internal purposes. Also for mostly internal purposes, the analysis of spatial patterns of temperature, precipitation, and their anomalies including their climatic zoning and application in advanced climate statistics and graphical products like maps, analysis and graphs of precipitation, temperature, relative humidity, eva-transpiration, sunshine duration, cyclones etc is done. Lastly, the NMHS also develops and provides specialized climate analysis, prediction and monitoring products, tailored to the needs of specific users in general.

As provided for in the product matrix, the Rwanda NMHS has indicated that some of the product characteristics available are trending, analysis, risk maps, hydrographs, watershed mapping and demand. The associated sector-specific products provided include extreme events, seasonal and annual values. The data source and co-production is by Meteo-Rwanda and Rwanda Water and Forestry Authority (RWFA). The target user and value receivers are those who do flood analysis, hydrological analysis, infrastructure, research and agriculture. The services provided include daily production of the above information and this is shared through MoUs and in other cases free

access. The gaps and needs identified is inconsistency of data and malfunction of monitoring equipment.

iii. Monthly and seasonal Long-term predictions

The Rwanda NMHS also develops and provides long-term prediction products at decadal, monthly and seasonal scales for internal use only. The information is given with degree of uncertainties and disseminated as specific advisories products for community use through climate summaries, bulletins, reports, drought/flood maps and special statements for severe weather; although all this is done for mostly internal purposes.

The Rwanda NMHS does provide ENSO, SST and intra-seasonal variability products, monthly to seasonal but for mostly internal. While it received longer climate predictions, provided by RCCs, Regional Climate Outlook Forum (RCOFs) but not from Global Production Centres (GPCs.). It should be noted that the NMHS of Rwanda does not do analysis on climate extremes and place them into maps, graphs, images nor does it provide assessments of current climate conditions in terms of averages, variance, thresholds and percentiles.

With regards to Long-term predictions from the product matrix, the Rwanda NMHS provides monthly, seasonal and annual at country level with the most relevant product characteristics and sector-specific products being onset and cessation, time of occurrence, quantitative estimated of rainfall using radar. The data sources and co-production is Meteo-Rwanda and RWFA. The users of the products are agriculture, researchers, NGOs, Ministry of Infrastructures and Air transport with these services being offered as hourly and daily scales. The means for user-interaction is through MoU and free access. The identified gaps are inconsistency of data.

While for climate monitoring products, the characteristics are automatic and manual systems with sector-specific products being hourly, daily, five day, ten day and monthly, seasonal outlooks. The data source & co-production is done by Meteo-Rwanda and RWFA with specific services being hourly and daily values. The use of the service is for flood analysis, hydrological analysis, infrastructure, research and agriculture with the means for user-interaction is through MoU and free access. The needs that were identified are data gaps and tool (Software, equipments).

iv. Climate projections

The Rwanda NMHS does perform reanalysis and adding value from national perspective to products received form RCOFs, RCCs and GPCs which also means the review and assessment of past climate patterns on the state of climate for their country as provided by WMO reports. This work also extends to the development and/or interpretation of climate change scenarios and also performs dynamical and/or statistical downscaling of GCM and RCMs which also involves the analysis, interpretation and reanalysis of climate statements and the production for general public and other specific users; all the above is done for mostly internal purposes . The NMHS does not share and exchange information, products, services to other countries in the region especially during the periods of significant climate anomalies.

From the climate product matrix, climate change projections by the Rwanda NMHS provides for product characteristics that describe the seasons as rainfall variability, temperature trends, river flow, Lake water level and scenarios. With respect to sector-specific products, these are parameters that come on a seasonal basis while the data source & co-production is by Meteo-Rwanda and RWFA. The users were identified as modellers, water resources and planning. The

service types were median and long-term while the user-interaction is by MoUs and free access. The gaps and needs are modelling capability and interpretation.

v. Climate related hazards & secondary events

The Rwanda NMHS does provide global and regional scale data resources as inputs into modelling, research and applications but mostly for external use. It also does make analysis and provision of products relevant to El Nino and La Nina updates including Global Seasonal Climate Updates (GSCU) that contains information on ENSO and other climate extremes and variations driving phenomena for example NAO, PNA, IOD etc but this is for mostly internal purposes. It should be noted that the HHMS of Rwanda is limited in the provision of high density, small scale specialized data resources used for studies of small scale processes and urban environment.

With regards to climate-related hazards and impacts, the NMHS of Rwanda has indicated in the product matrix whose characteristics as those of flash floods, drought, lightning, wind, and mudslide and hell storm. The key sector-specific products being seasonality while the data sources and co-production come from Meteo-Rwanda, Red Cross, RWFA, Ministry of Agriculture and Animal Resources (MINAGRI) and Rwanda Environment Management Authority (REMA). The uses are the Ministry of Disaster Management and Refugee Affairs (MIDIMAR) and the Police. Key services are seasonal while the means of user-interaction not given but the specific gaps and needs were highlighted as lack of in place early warning systems and limited monitoring equipment.

4.6.4 Current use and needs of Climate Services

This shall be a presentation and documentation of results from Rwanda's user representative and their context of climate information application, current use and needs for climate services.

i. Basic Information about the climate service user / beneficiary

The Rwanda Agriculture Board completed the submission as the user of climate services in Rwanda.

ii. Experiences on climate (change), Impact and information

In Rwanda, the users' perspective and climate-related hazards are considered as relevant for their sector work in the past and therefore have data available on droughts, delayed onset of rainfall, landslides and flooding. The direct impacts have been increased risks of crop failures and the response from the Rwanda Agriculture Board has been establishment of irrigation infrastructure, erosion control infrastructure and wetland reclamation. The occurring trend related to these hazards is that this trend is increasing and it has been associated with climate change, for example the Eastern part of Rwanda is suffering from drought and the northern part suffering from landslides and flooding. Secondly, the Rwanda Agriculture Board has assessed the sector's vulnerability to climate change with data and maps showing the impact of climate change on maize production in Rwanda. Equally, the other expected impacts and consequences of climate change for the sector is crop failure.

iii. Sectoral planning, legal frameworks and organizational structures

The Rwanda Agriculture Board has the vision of improved food security and livelihoods of all Rwandans by transforming agriculture from subsistence into modern farming through generating research and extension innovations. This is hoped shall generate sustainable crop, animal husbandry and natural resource management. The mission of RAB is developing agriculture and animal husbandry through reform and using modern methods in crop and animal production,

research, agricultural extension, education and training of farmers in new technologies. Some of the responsibilities are: 1) To implement the national policy of agriculture and animal husbandry; 2) To contribute in determining policy in agriculture, animal husbandry, agricultural and animal husbandry research and technology; and 3) To provide farmers and consumers of agricultural products with information, techniques and services meant for improving their profession and supplying the internal market with increased and quality production thereby raising their agricultural and animal husbandry incomes.

The Rwanda Agriculture Board's role in the planning and implementation process of infrastructure project include a Land husbandry, Irrigation and mechanization department in charge of designing and establishment of irrigation and erosion control infrastructure whose output includes irrigation schemes, terraces and related infrastructures with the intention to benefit farmers. Sometimes RAB delegates' part of its tasks to cooperatives, for example water users associations are given the task of maintaining irrigation infrastructure and the transfer of money for terracing in respective districts and activities implemented. Generally, the Rwanda Agriculture Board role in using climate information during infrastructure planning is when climate information is used for the designing and maintenance of agricultural related infrastructure, for example having information on how much rainfall is expected would imply that water ways are planned well to reduce risks of erosion infrastructures damages.

With regards to laws and regulation, the Rwanda Agriculture Board is obligated to explicitly consider climate (change) risks in the sector and they provide references to land use and management. Some of the focus of these laws or regulation or policy is on mitigation, adaptation and risk management as a precautionary principle. These climate information guidelines and regulatory framework are seen to be relevant to the user and this is defined by both the Rwanda Agriculture Board and MINAGRI. These guidelines and regulatory framework are incorporated into planning, design and approvals for example when it comes to design, implementation and maintenance of an infrastructure. These climate laws, regulation and policy when compared to other laws, regulation and policy have been found to be relevant for the user although the precautionary principle for example environmental Impact or social impact assessment is not a statutory requirement in Rwanda national law. Furthermore, this is seen through preventive measures which are of utmost importance to the user; however adaptation also is an acceptable approach. With regards to organizational structures and frameworks, the Rwanda Agriculture Board has a clear agreement about its objectives and values related to addressing climate, climate-related issues and crop failure due to drought. The Rwanda Agriculture Board has a focal point champion and working group on the topic of climate or climate change in the context of GIS, climate change research and extension program which include both data collection and processing. This is further elaborated on how climate information enters the decision making process of Rwanda Agriculture Board when climate information is used for the whole process of climate change and agricultural planning, monitoring and evaluation. An example is demonstrated by having irrigation strategies designed to minimize damage. The main motivation for using climate information which is quite relevant to the user is internal motivation which appears in the organization's policy and business interests such as economic value; while external motivation and regulatory obligations are only seen as relevant. The role that climate (change) information plays in the users' decision-making criteria compared to others is considered very relevant and the type of climate information to take into account in their decision-making processes is decided by the whole management team but specifically high level planning team in collaboration with the technical team. When it comes to decision and policy-making processes, the Rwanda Agriculture Board is able to address new or update data and information and this is within the timeframes of seasonal information.

iv. Climate information and decision-making

At the Rwanda Agricultural Board, the specific purpose for climate-related information is required to help characterize seasons for agricultural production. Other reasons like for strategic planning, infrastructure planning and implementation, maintenance and organizational planning of existing infrastructure are seen as very relevant for decision-making processes. The day-to-day operation management of existing infrastructures and development and implementation of risk management plans are only seen as relevant. Finally, education and creation of awareness of staff and decision-makers are seen of little relevance. With regards to the uncertainty in climate information, the user deals with this in the planning processes by determining the degree of associated risk and level of tolerance. This is done for example through planning for quick interventions; the tolerated level of uncertainty is between 10-20%. The Rwanda Agricultural Board addresses climate risk, disaster risk and climate change in decision-making processes, this for example is done by planning soil erosion control measures when planning for agriculture in high rainfall and steep slope areas (North, West), providing small scale irrigation equipments in low rainfall areas (East).

Table 12: Climate risk management strategies being pursued or considered by users in Rwanda

	Current climate conditions	Climate change			
Purpose	**Implemented strategy**	**No option**	**Potential option**	**Planned option**	**Implemented option**
Awareness creation	☒	☐	☐	☐	☒
Prevention: Protection (*e.g. protective constructions like dams*)	☒	☐	☐	☐	☒
Prevention: Transformation of object of concern (*e.g. change of building design, or specific components*)	☐	☐	☒	☐	☐
Prevention: Retreat (*e.g. relocation of constructions*)	☐	☐	☒	☐	☐
Contingency planning accommodating climate change risks	☒	☐	☐	☐	☒
Business continuity management accommodating climate change risks	☒	☐	☐	☐	☒
Early warning systems	☐	☐	☒	☐	☐
Responses to warnings (e.g. evacuation,	☒	☐	☐	☐	☒

temporal protection)					
Recovery planning	☒	☐	☐	☐	☒

v. Limitations on the use of climate information

In reference to products during intervention, the Rwanda Agricultural Board offers the reasons as to why there is limited use of climate information as: 1) the information is not understandable, 2) the product is not available when required and 3) the product is of limited quality as those that apply. While on the other hand, reasons like restricted or limited access to climate information and the unknown existence of the product does not apply to RAB. The rest of reasons like the product is not relevant to the Rwanda context and the product is not usable for their purpose are seen as not relevant for the lack of use of the product. For the organizational reasons, they see no basis for reasons such as: 1) there is no need for climate information, 2) the products is not freely available, 3) there is no legal obligation to use climate information, 4) the cost-benefit value of the use of climate information does not profitable, 5) the relevance of climate information for decision-making is negligible and 6) the added value of the product for their purpose as not evident enough. Other reasons like there are no capacities available to deal with climate information as also not strong enough.

vi. Capacities for climate information application/processing

The Rwanda Agricultural Board sees its technical and personnel capacity to be sufficient to process and interpret climate-related information, although they would like to access external support and advice on how to integrate climate-related information in decision-making processes. Meteo Rwanda and Climate Change, Agriculture and Food Security (CCAFS) are the institutions responsible for climate information and their relationship regular exchange is facilitated MoUs and contracts. At the moment, Rwanda Agricultural Board has nearly 600 staffs with only 4 actively involved with climate information or disaster risk information and these staff members have received training on climate change and climate change adaptation from mainly CCAFS.

vii. Current use and needs of climate information products and services

The Rwanda Agricultural Board has classified itself as both a brokers who is asked for climate information and passes it on to other users and also a value-adders. They assess their ability to formulate their needs on climate information products as very good. The activities regarding climate information 'processing' which RAB does with its own resources are: data collection, data analysis, literature research, modelling, policy analysis, applied research and technology, capacity building and program coordination and management. The Rwanda Agricultural Board also interacts with the climate information provider to discuss gaps and needs of climate information products and to provide feedback and this is mainly Institutionalized interaction through regular meeting, MoU and contracts. In Rwanda, there also exist other stakeholders and sector-groups that ask about similar climate information as the Rwanda Agricultural Board and they actually organize themselves to formulate.

4.6.5 Analysis and evaluation of user needs on climate services products

Table 13: Climate-related information (specific products and services) that is in use or needed by users in Rwanda

This **product type** is being **used** directly for **decision-making**	This **service** is being **used** to enhance **decision-making**
• Climate data (*e.g. raw or processed, gridded data, station data, etc. for specific parameters and regions*) • Information on regional climate conditions (e.g. review and analysis in form of bulletins, synthesis reports, statements, etc.) • Analysis and interpretation of climate statements or products for specific users/sectors (e.g. analysis of consequences of past/prevalent climatic conditions for specific sectors) • Hydrological data / statistics and events (e.g. discharge, floods, low-flows, etc.) • Data/statistics on climate impacts on terrestrial systems (e.g. impacts on ecosystems (vegetation etc.), geo-morphological impacts (soil erosion, landslides, etc.)) • Climate vulnerability/risk information in general or for specific sectors (e.g. data/info on exposures and sensitivities) • Climate forecasts/outlooks for specific parameters/events at various time scales (e.g. week, month, year, etc.) • Climate change projections (e.g. model output data/maps for specific parameters, events, etc.) • Climate change impact data/model outputs (e.g. on ecosystems, water availability, etc.) • Training, workshops, lectures and information material on climate issues, e.g. climate change and its impacts (*e.g. qualitative info/education material to raise awareness ; general or sector-specific*)	•
This **product type** is being used as input for follow-up products / services	
•	
This **product type** is **desired/required** but not (yet) being used/available	This **service** is **desired/ required** but not (yet) being used/ available.
• Tools which support decision-making, strategy development and financial planning	•
This **product type** is **provided** by our organization	This **service** is **provided** by our organization
• Climate statistic products (*e.g. information about means and extremes for individual*	• Guidelines for selecting relevant climate

parameters for a specific region and period in form of maps, graphs, etc.) • Tailored climate data/statistics (e.g. indices) for specific purpose (e.g. 'sector of concern') • Data / statistics on hazardous climate events/extreme events (e.g. impact maps, magnitude-frequency analysis, etc.) • Information/data on climate impacts/consequences for specific sectors (*e.g. info on expected crop yields, losses, costs, damage, disruptions or fatalities for agriculture, transport, health, energy, etc.*) • Climate change vulnerability/risk information (*e.g. maps for specific sector/region*)	information and assess its relevance • Explanation of content/meaning of climate information is required (e.g. how to read the graphs?) • Technical training, tools or support for data processing and product application • Training, tools or support to assess the value/significance of the climate information for the own context (e.g. interpretation of information on probability and uncertainty) • Advice or decision-support tools to integrate climate information in decision-making

4.7 Climate Change and Climate Services in South Sudan

The product matrix was completed by a representative from the South Sudan Meteorological Department (SSMD). The information derived from the product matrix and independent research provides the climate change risks in the country and products portfolio while the rest like climate services baseline and the use, needs and evaluation on climate services products was not possible to evaluate due to lack of information since their NHMS did not complete the questionnaire.

4.7.1 Climate Change risks in South Sudan

According to the study in the factsheet-Climate Change Risk Profile South Sudan (2016), the projected changes in temperature and precipitation in South Sudan will be as follows:

- All projections agree that South Sudan will get warmer by an average of 1°C by 2060, with lower increases in the south on the backdrop of changes which have already happened showing significant warming over the past 30 years, with the central and southern regions of South Sudan among the most rapidly warming locations on the globe, with station temperatures increasing as much as 0.4°C per decade.
- Projections of rainfall patterns are less certain with some models suggesting increases and others decreases. The current increased variability of rains, in terms of onset, duration and totals, is likely to continue such that if the current rainfall trends continue, the drying impacts could extend into West and North Bahr al-Ghazal, Warrap, Unity, Al Buhairat (Lakes) and Central Equatoria by 2025.

4.7.2 Climate Services for Infrastructure baseline of South Sudan

There was no evaluation and summary of the results from the general questionnaires because the NMHS did not complete the questionnaire. Only the product matrix was completed hence information shall be provided on the level of services. Overall, the elements provided for under Global Framework of climate services (GFCS) such as: Observations and monitoring (OM); Research, modelling and prediction (RMP); Climate Service Interface System (CSIS); User interface platform (UIP); and Capacity development (CD) was not covered.

4.7.3 Product portfolio in South Sudan

The objective of section is for the identification of currently available climate information products and services. It will involve the results from both the questionnaire and the product matrix with the product matrix providing an in-depth and detailing of the questionnaire.

i. Climate data sets

Although South Sudan NMHS did not complete the questionnaire, they completed the product matrix and from their submission, the Information provided indicate that the processed climate data sets are: rainfall data, temperature, wind speed and direction which form the product characteristics. The sector-specific products were not given but the data source & co-production is by South Sudan Meteorological Department (SSMD) and the main targets and those receiving this information are water resource engineers and hydrologists. The services offered not given but the means of user-interaction is through MOUs, regular meetings and interpretation. The noticeable gap is that of few and poor networks distribution.

ii. Climate diagnostics & monitoring products

Although South Sudan Meteorological Department (SSMD) did not complete the questionnaire, they completed the product matrix and from their submission, it has been indicated that the

NMHS has product characteristics used for forecast such as monthly and seasonally values. The relevant sector-specific products were not given but the data source and co-production is by the SSMD and ICPAC while the services provided is in dissemination &interpretation. The means of user-interaction is not given although the gaps and needs were given as low personnel & institution capacity.

iii. Monthly and seasonal Long-term predictions

Although South Sudan NMHS completed the product matrix during and submitted that for Long-term predictions, temperature and rainfall data is provided. All other elements were not given for example which the sector-specific products, what are the data sources and co-production agents and who are the users and how are the users sort. Neither were the challenges, gaps and needs identified. Similarly, for the product characteristics mentioned included rainfall data and temperature, wind speed &direction and the sector-specific products was not given. The data source & co-production is done by observation stations. The specific services were given as hard copies and FM radios with means of user-interaction as MOUs. The needs that were identified included personnel & institution capacity is low.

iv. Climate projections and climate related hazards & secondary events

Other elements like climate projections and climate related hazards & secondary events was not analysed because the NMHS did not fully complete the product matrix, therefore no data and information was available.

4.8 Climate Change and Climate Services in the Sudan

The questionnaire was completed by representatives from Sudan Meteorological Authority (SMA). The information derived from the questionnaire, product matrix and independent research provides the climate change risks in the country, the climate services baseline and the use, needs and evaluation on climate services products with their portfolio.

4.8.1 Climate Change risks in the Sudan

The Climate Change Risk Profile Sudan (2016) publication suggests the following changes in temperature and precipitation over the Sudan. Projected changes in climate include:

- There will be rising temperatures, by 0.5°C to as much as3°C by 2050, with a more extreme temperature rise in the north. Temperature increases will intensify the impacts of drought through increased evapo-transpiration and reduced soil moisture.
- Slight increases in rainfall (4 percent per decade), coupled with increased variability. The Sahara Desert is advancing at an estimated rate of 1.5 kilometres a year, and if current rainfall trends continue, the desert will continue to advance southward.

4.8.2 Climate Services for Infrastructure baseline of the Sudan

This shall be used to provide an evaluation and summary of the results from the general questionnaires received from the NMHS and also the completed product matrix for services provided. The elements covered with the questionnaire and product matrix was within the general framework of applying the structure of Global Framework of climate services (GFCS) to the elements listed in the subsequent sub-chapters below:

i. Observations and monitoring (OM)

The objective of this sub-section is to identify the available data sources and the state of observing systems which may also include identification of the quality of available data management systems and mechanisms within the NBI countries.

The NMHS of the Sudan was herein represented by the Sudan Meteorological Authority (SMA) which participated in answering the questionnaire. The NMHS indicates adherence to climate monitoring principles with most of the data sources and observation system measure attributed to both atmospheric (e.g. wind, temperature, dew point, pressure, relative humidity, air temperature, wind, relative humidity, pressure, clouds, sunshine duration, precipitation, visibility, present weather, cloud base, etc) and terrestrial parameters while stating that ocean parameters were neither measured nor stored. Unfortunately, the Sudan NMHS did not indicate whether it has access to observational data from neighbouring countries nor access to socio-economic and impact databases which they stated are limited. They nonetheless, indicated that they have: gridded/ interpolated data, satellite data, re-analysis data and model data (GCM & RCM) for which the NMHS creates archives and documents climate data sets into appropriate length, time units. The NMHS also collects and stores data and metadata into databases with a much improved user-interface planned. Quality control, homogeneity tests and data rescue programs have been established and also noticeable; the NMHS does share data with WMO-RCC for operational purposes and backup. There are challenges with data management which hinder the production of climate services and the prominent ones is the need to update the current database and provide high specification servers and equipment.
With regards to observational networks, it should be noted that the NMHS has as well established structure to integrate all basic systems into functioning observation systems although they are limited in carrying out further observation into accumulated time series. Some of the noticeable challenges include weak means of communication and transmission of data from observation stations; inadequate number of stations and technical equipment for observing and providing qualitative data; limited capacity and staff numbers which still need improvement; not a well distributed spatial coverage of observational network and poor financial and technical resources.
Despite the above challenges, the NMHS of the Sudan does have long-term strategies of managing the network and improving data availability for example through station change, relocation, automation and protection.

ii. Research, modelling and prediction (RMP)

This section is to identify the current research capacities and cooperation potential for product development and services orientation within the Nile basin countries.
Similar to most NMHS in the region, the Sudan NMHS also has a mandate to carryout research activities with a fully pledged unit which is actually a research division. This division has fully dedicated personnel or mechanisms of dealing with user requirements and operational service provisions. The division shares research responsibility with many organisations for example with the Ministry of Higher Education where these partnerships and collaborations are done mainly through MOUs. Results from the research are being used in operational practice with specific user needs under consideration. Some of this has led to the development of new tools and knowledge for multi-disciplinary studies and applications in smart agriculture, climate-health, climate-tourism, etc. although this has not translated into the development of new methods, model or tools yet. The main needs highlighted include finding funds for research projects and conferences.

iii. Climate Service Interface System (CSIS)

The objective of the baseline on this section is to identify the political embedment of the Service in the national and regional landscape of climate service providers and also identify the regular users, available dissemination and communication structures of the service, its visibility and needs and how providers and users interface.

Sudan

The Sudan NMHS is fully imbedded within government although there are two separate as the National Meteorological and Hydrological services and therefore a call for better administrative arrangements and coordination between the two agencies including the need for strengthening partnership agreements between them. The role and contributions of NMHS are clearly mentioned within the National Adaptation Plan (NAP), National Disaster Risk Management Strategy and National and Sector policies and strategies. It is apparent though that in Sudan, there is no national policy and strategy on climate services which clearly defines the roles and responsibility as that of generation, tailoring and communication of climate services.

The NMHS does have the mandate to provide climate services with fully functional and dedicated units for the provision and production of climate products and services and this mandate as provided for in the national action plan is mainly funded through donor support. There is the indication that the there are no private or commercial services providers doing similar both work and function like the NMHS in providing both hydro-meteorological and climate service functions. But there is mention of collaboration with other national, regional and international organizations such as: WMO, UN ENVIRONMENT and ICPAC.

In order to disseminate and market their products and services, they employ a wide range of ways and channels which include: printed copies sent by post, delivered via email, and posting on web pages although it has been made clear that the Sudan NMHS does have a restricted policy for free data access for the public. With regards to the information that is shared with the public, the degree of uncertainty is also conveyed and also the recognition that there is limited misunderstanding and interpretation from the way the messages are conveyed but nonetheless, recognize the need for improved visibility. There are competences at the NMHS to integrate the information into relevant sectoral policies but what is not mentioned is whether this done or guided using any special methodology and tools. The NMHS does say they don't use professional communicators to help convey the messages and warnings but say the NMHS does carry out marketing of climate services and products and also promote societal awareness of climate change issues. The NMHS does operate a website and this contains freely available climate products and services but admit to limited use or visibility of presentations on national TV channels or the production of sectoral specific information and warnings in newspapers, apps, newsletters etc. However, there are broadcast of interviews or press conferences on radio and also the use of brochures, pamphlets etc. to ensure increased visibility.

In terms of user interaction and feedback, the Sudan NMHS does recognize the need for feedback from their users to revise and improve their products with the NMHS indicating that their users assist in the design and development of products. They have also indicated work with sector based research teams to develop applications and models. However, it should also be noted that the NMHS does not provide users with risk assessments and risk management nor advice on input into financial tools for risk transfer. However, they have indicated that they have products and services that do directly plug into decisions support tools for public policy development.

As can be seen in the table below, herein are leading sectors or organizations in collaboration with the NMHS and how "valuable" their engagement is.

Table 14: Showing the Sudan NMHS partners and the value of their products to these partners

User	Indicate if you provide climate services	Rank	Indicate the type of products provided to the sectors					
			data services	climate monitoring	climate analysis and diagnostics	climate predictions	climate change projections	tailored products / early warning
Government	☒	5	Reports	Bulletins	Maps & Graphs	Forum		Warnings
Local authorities	☒	5	Reports	Bulletins	Maps & Graphs	Workshops		Warnings
Scientific	☒	4	Raw Data		Maps & Graphs			
Commercial	☒	3	Reports	Bulletins	Maps & Graphs			
Water resources	☒	5	Reports	Bulletins	Maps & Graphs	Forum		Warnings
Agriculture	☒	5	Reports	Bulletins	Maps & Graphs	Forum		Warnings
Fisheries	☐	1				Forum		
Forestry	☒	3	Reports	Bulletins	Maps & Graphs	Forum		
Transport	☐	3	Raw Data					Warnings
Energy industry	☒	3	Raw Data		Maps & Graphs			
Human Health	☒	5	Reports	Bulletins	Maps & Graphs	Forum		Warnings
Tourism	☐	1						Warnings
Recreation, sport	☐	1						Warnings
Aviation	☒	5	Reports	Bulletins	Maps & Graphs	Forum		Warnings
Environmental protection	☒	1						Warnings
Building	☒	4	Raw Data		Maps & Graphs			Warnings
Finance and insurance	☒	5	Reports	Bulletins	Maps & Graphs	Forum		Warnings
Emergency planning and response	☒	5	Reports	Bulletins	Maps & Graphs	Forum		Warnings

*Rank the importance of each sector for climate services, where ''1'' is the least important, ''5'' is the most important

iv. User interface platform (UIP)

The objective of the baseline on UIP is for the identification of the prominent users as well as the purpose and objectives of user-interaction and the mechanisms of user-interaction. This section also includes the identification of mechanisms to monitor and evaluate the impact/value of climate services.

In the Sudan, the NMHS does have does have four dedicated units for interacting with users and providing them with climate services and these include: Agro-met, Data Center, Early warning

section and Forecast section within a framework and mandate to interact with the users directly. The main national institutions and organisations that the NMHS interacts with are in agriculture, water resources, environment, natural resources and physical development, NGOs (WFP and FAO), Disaster Risk Bodies, universities and research. Otherwise, users' needs are quarried when they come with their needs for example specific requests and questions. This may also be through dedicated enquiries and surveys by questionnaires and also through WMO mechanisms such as RCOFs, NCOFs and Climate watch surveys etc. To add to this use-interaction means, the NMHS does have an established mechanism of interacting with media especially during emergency situations and also have planned regular meetings for interaction with ministries.
It should be noted that there is no specific sector help desks to getting feedback on existing products and also guiding and training on existing products but there exists feedback loop from user needs back into research. The NMHS recognises that the lack of interaction with users on specific user programs limit user understanding of climate information but not the lack of appropriate training program for users. The NMHS does not communicate seasonal outlooks to users through regional climate outlook forums but also holds national climate outlook forums as a mechanism to interact with users to enhance their awareness and provide tailor information for specific users groups.

With regards to monitoring and evaluation, the NMHS does not tract the use of provided climate services but has stated that it does conduct and evaluate the levels of satisfaction in quality of service. The NMHS identifies and measures impacts of their services on climate sensitive sectors and associated variables like on disaster lose, crop yields, hydropower etc. and level of interest of products with users. The NMHS also does perform socio-economic study of climate services in order to demonstrate the value of products to users and equally does perform cost-benefit analysis of climate services. It also supports investment planning of climate sensitive sectors based on results of socio-economic analysis.

v. Capacity development (CD)

In the Sudan, the NMHS has policies on human resources development and enhance this through regional and international training programs that involve training courses, conferences, e-learning and curriculum development to enhance capacities. Other measures include the need for specialised trainings in climate services, tailoring of climate information to specific sectors, special training on communication for example the communication strategy is not very comprehensive and also the need for additional staff to full fill climate service tasks. This also involves the training of staff in climate services, interaction with users and data management, seen as key areas for the improvement of climate services.
The NMHS also acknowledges that some gaps do exist especially with the lack of policies regarding the role of climate services in the overall social-economic development space while it indicates that for them, the lack of interaction with users does not limit the effectiveness of the user of climate information but nonetheless they still extend trainings to user communities and it feels that this is adequate for the user requirements at the moment. The Sudan NMHS mentioned computing facilities, equipment networks, financial resources, application software and building space as main challenges towards improving products and services.

4.8.3 Product portfolio in the Sudan

The objective of section is for the identification of currently available climate information products and services. It will involve the results from both the questionnaire and the product matrix with the product matrix providing an in-depth and detailing of the questionnaire.

i. Climate data sets

The Sudan NMHS does have historical datasets from atmospheric measurements and observations. This is stored and made available for mostly internal while terrestrial and ocean historical datasets are stored and made available for mostly external use. Satellite data and metadata rescue are mostly available for internal use whereas gridded/ interpolated data, model data and basic statistics on climate extremes for example temperature, precipitation, humidity, sunshine duration, frequency of occurrence, spatial mean etc are available for mostly external uses. The NMHS of the Sudan does perform homogeneity tests and adjustments of time series when it comes to her data.

The product type matrix does provide information that the available processed climate data sets are for rainfall, evaporation/PET, and NDVI time series which form the larger part of product characteristics from the NMHS. The sector-specific products derived and compiled from this is for studying trends and coefficient of variation. This may include gridded data for selected areas. The data source and co-production by CHG gridded data through ICPAC targeting mainly the users in 1) Ministry of Agriculture, Policy & monitoring; 2-Water Resources, Irrigation and Electricity, Design and operation; 3-Disaster risk management bodies, policy and monitoring; 4- Food security sector (Governmental & NGOS).The services offered are forecast, bulletins and warning alerts which form part of the processed products. This is made available through webpage and the means of user-interaction is through routine meetings and feedback. Some noticeable need is improving observation network and capacity building.

ii. Climate diagnostics & monitoring products

For mostly internal purposes, the NMHS of the Sudan does perform basic assessments and diagnostics analysis of spatial and temporal factors and processes involved in observed climate patterns for example tropical cyclones, monsoon, synoptic scale storms etc. Meanwhile for the use of products derived from satellite data for monitoring activities or for analysis of spatial patterns of temperature, precipitation and their anomalies including climatic zoning, the NMHS will apply this for mostly external purposes. Also done by the Sudan NMHS is the application of advanced climate statistics and graphical products for example maps, analysis and graphs of precipitation, temperature, relative humidity, evapo-transpiration, sunshine duration, cyclones etc. but also for mostly external purposes. With regards to the development and provision of specialized climate analysis, prediction and monitoring of products tailored to the needs of specific users, the NMHS is also involved in this. Worthy to note is that the NMHS uses and provides highly sophisticated climatology statistics but limited in complex characteristics for specific users who would need indices for activities like for building design codes.

Information given in the product matrix indicate that the Sudan NMHS indicate that some of the climate diagnostic product characteristics provided are time Series, statistical analysis &indices. The more sector-specific products being tailored are those that describe the climate condition, with extremes, trends and coefficient of variation. The data source and co-production is by Sudan Meteorological Authority through specialized divisions or units and the targeted users are those in the Irrigation department and flood monitoring bodies with services provided in improving

products format. The user-interaction is through contracts & MoUs for data and products. In this particular case, the gaps mentioned are in upgrade of modelling skills and improving capabilities.

iii. Monthly and seasonal Long-term predictions

In Sudan, the NMHS does develop and provide prediction products on monthly, decadal and seasonal scales with some of the information provided with the degree of uncertainties or skill level. It is also worth noting that the NMHS does analysis on climate extremes into maps, graphs, images and provides monthly to seasonal outlooks to the country. Also done is an assessment of current climate conditions in terms of averages, variance, thresholds and percentiles in weekly, 10-days, monthly, seasonal and annual time scales. The NMHS also issues and disseminates products that are in the form of specific advisories for community use. These are provided as climate summaries into bulletins, reports, drought/flood maps and special statements for severe weather. Predictions provided by RCCs, Regional Climate Outlook Forum (RCOFs), and Global Production Centres are also available but mostly for external use.

The section of product matrix on climate monitoring and long-term climate predictions was not given by the Sudan NMHS. The information needed was to help better understand monitoring and monthly/ seasonal/ decadal climate predictions better. All the information on product characteristics, sector-specific products, data source & co-production, user & value, services types, user-interaction and the gaps and needs was not given.

iv. Climate projections

In Sudan, the NMHS does the development and interpretation of climate change scenarios and interpretation of climate statements including the production for general public and other specific users. This work also extends to adding value from national perspective to these products received form RCOFs, RCCs and GPCs. This also means the sharing and exchange of information, products and services to other countries in the region especially during the periods of significant climate anomalies and also the review and assessment of past climate patterns as provided by WMO reports on the state of climate for their country. All the above is done for mostly external purposes while on the contrary, reanalysis, performing dynamical and/or statistical downscaling of Global Climate Models (GCM) and/Regional Climate Models including the analysis and running Global and/or Regional Climate Models is done for mostly internal purposes.

The section of product matrix on Climate change projections was not given by the Sudan NMHS. The information needed was to help better understand Climate change projections better. All the information on product characteristics, sector-specific products, data source & co-production, User & value, services types, User-interaction and the gaps and needs was not given.

v. Climate related hazards & secondary events

In Sudan, the NMHS indicated that it does provide both global and/or regional scale data resources as input into modelling, research and applications. The information is also needed for the provision of high density, small scale specialized data resources used for studies of small scale processes and urban environment but mostly for external use only. Meanwhile, the NMHS also does make analysis and provision of products relevant to El Nino and La Nina updates, Global Seasonal Climate Updates (GSCU) that contains information on ENSO and other climate extremes and variations driving phenomena for example NAO, PNA, IOD, etc but for internal purposes only.
The section from the product matrix on climate-related hazards and impacts were very limited in available information and therefore those related to product characteristics, sector-specific

products, data source & co-production, users, services types, user-interaction and the gaps were not given.

4.8.4 Current use and needs of Climate Services

This shall be a presentation and documentation of results from Sudan's user representative and their context of climate information application, current use and needs for climate services.

i. Basic Information about the climate service user / beneficiary

The Sudan submission was from the user- the Ministry of Water Resources Irrigation and Electricity (MWRIE).

ii. Experiences on climate (change), Impact and information

MWRIE of Sudan stated that the climate-related hazards and valuable data which are collected are those related to floods and droughts. They are keen on this information because floods damaged some monitoring stations and offices in 1988 and 1998. . The organization eventually dealt with this through using non-structural methods such as flood early warning system. MWRIE has since noted that there has been an increase in the occurrence of the mentioned hazards in the near past which has been attributed to climate change but the finding is not based on data. For example, the frequency of extreme floods changed but no evidence weather due to climate change or natural cycle (1946, 1975, 1988), (1996, 1998, 2006, 2007, 2013, 2014,2017). Although MWRIE has not assessed its vulnerability to climate change, the potential impacts and consequences to be expected from climate change, it is expected that these Impacts shall be on flood control structures and reservoir management, impacts to power generation , Impacts on monitoring network and also impacts on irrigation system (canalization).

iii. Sectoral planning, legal frameworks and organizational structures

MWRIE's vision, tasks and functions as provided for by the Presidential Decree No. (29) For the year 2012 are as follows:

In the field of water resources:

- Develop policies and plans for development, development, modernization and rationalization of water resources
- Monitoring the water resources in the country and collecting and analyzing the information and data of the country
- Develop policies, programs and projects for the development of drinking water for cities and rural areas and work on the development of drinking water and its derivatives according to international standards
- Preparing, developing and updating engineering and standard designs for drinking water projects and supervision of project implementation
- Conducting scientific research in the fields of hydraulic water, irrigation equipment, rivers, floods, waterways and all related to the development and modernization of the operation of irrigation and water resources.

In the field of electricity and dams

- Put in place the general policies and rules related to the generation, transmission and distribution of electric power from various sources and the approval of general plans and programs for electricity and their translation into projects and follow-up their implementation

- Organization and control of activities related to the generation, transmission and distribution of electrical energy
- Supervising public bodies and private, public and mixed companies engaged in the generation, distribution and sale of electrical energy
- Proposing the state plan in the field of building dams and following up their implementation and technical supervision of dams for the purposes of electric generation
- Implementation of related projects related to the construction and management of dams until it is transferred to the competent authority
- Providing technical advice to the State in all matters pertaining to the electricity industry
- Determining electricity prices and price lists
- Setting specifications, patterns and technical parameters for equipment, machinery and electronic devices to ensure the electrical system in Sudan, and determine the conditions and controls of public safety to be available in electrical installations and electrical wiring works
- The conclusion of contracts and agreements on behalf of the State in the field of electric power and dams and the approval of contracts for the supply of electricity with companies and granting licenses to invest in this area
- Specifying specifications and standards for the import, installation and operation of thermal generators and monitoring the occupational safety of workers and the risks that may be exposed to the public and the practical institutions
- Encouraging investment in the field of energy generation, distribution and resource development in coordination with the relevant authorities
- Proposing the environmental controls and conditions to be provided when using the electricity technologies and following up their implementation in accordance with the environmental laws
- Develop the use of alternative energies in the production of electricity

MWRIE is responsible for planning, designing and implementing all Governmental projects of Water Resources, irrigation and Electricity. The projects are initiated by the Minister and Undersecretary for large-scale Dams and Irrigation projects according to the Master Plan while other projects are initiated by the Director General of the concerned general directorate. Some of the outputs of MWRIE are provision of hydrological data and information to support water resources management and decision making by the Hydrology Center. The Hydrological Information system are to monitor the Nile and reservoir water levels on an hourly basis, Nile flows on a daily basis, water balance on an annual basis, the reservoir capacity after every 2-3 years, including flood and low flow forecast and reservoir management modelling (cascade modelling). The main users of this work are the Dams Authority, Irrigated Agricultural Authorities and Civil Defence Authority and NGOs (Floods and low flow). MWRIE doesn't delegate part of your tasks while recognising that the general role of climate information for them in infrastructure is for operational purposes and not planning process.

With regards to the legal and regulation functions, there are no laws which obligate the explicit consideration of climate (change) risks for MWRIE and also similarly, there are no agreements for MWRIE in regards to organizational structures and frameworks that require its objectives and values to relate or for addressing climate, climate-related issues and climate change. MWRIE is motivated in using climate information because of Internal motivation and to a little extent for external motivation such as public relations and in no way is it a regulatory obligation or for business interests. Meanwhile, MWRIE finds that climate (change) information play a relevant

role compared to other decision-making criteria when it comes to prioritization of decision making although at the moment, it is not yet established on who decides which climate information to take into account in decision-making or on whether the organizations decision or policy-making processes is able to address new or updated data and information

iv. Climate information and decision-making

The MWRIE's has specific purposes as related to climate-related information and these include the design of dams (reservoirs evaporation), design of irrigated agriculture projects (crops water requirements), flood early warning system models (real-time climate data as input to satellite-based rainfall estimation, rainfall-runoff and flood routing models. Similarly, the information is used as climate model input to planning and DSS models and for seasonal rainfall forecast for flood period (JUNE-SEPTEMBER) for planning. Other uses would be: 1) day-to-day operation management of existing infrastructures, 2) infrastructure planning and implementation, and 3) education and creation of awareness of staff and decision-makers are seen as relevant in various decision-making levels. Other aspects like to use climate information for strategic planning plays a limited role and then others like maintenance and organizational planning of existing infrastructure and the development and implementation of risk management plans are of no consequence. Meanwhile MWRIE deals and has a level of tolerance of uncertainty in climate information in the planning processes by looking at the outputs in climate change models as misleading especially concerning rainfall.

MWRIE has ever addressed climate change risk and even considers it in the decision-making processes by producing future scenarios to study impacts of upstream development

Table 15: Climate risk management strategies being pursued or considered by users in the Sudan

	Current climate conditions	Climate change			
Purpose	**Implemented strategy**	**No option**	**Potential option**	**Planned option**	**Implemented option**
Awareness creation	☒	☐	☒	☐	☐
Prevention: Protection (*e.g. protective constructions like dams*)	☐	☒	☐	☐	☐
Prevention: Transformation of object of concern (*e.g. change of building design, or specific components*)	☐	☒	☐	☐	☐
Prevention: Retreat (*e.g. relocation of constructions*)	☐	☒	☐	☐	☐
Contingency planning accommodating climate change risks	☐	☐	☐	☐	☐

Business continuity management accommodating climate change risks	☐	☒	☐	☐	☐
Early warning systems	☒	☐	☒	☐	☐
Responses to warnings (e.g. evacuation, temporal protection)	☐	☐	☐	☐	☒
Recovery planning	☐	☐	☐	☐	☐

v. Limitations on the use of climate information

MWRIE of the Sudan's has product related reasons that are very significant for not using climate information and these are that: access to climate information is restricted/limited and 2) the product is not available when required. Others like the product are of limited quality and the product is not usable for their purpose is seen as slightly relevant. While the least reasons being that: 1) the product is not relevant for their context, 2) the information content is not understandable and 3) that the existence of the product is not known are not considered at all. While for the organizational reasons, the only reasons given for lack of use of climate information is that there are available capacities to deal with climate information and this slightly applies.

vi. Capacities for climate information application/processing

According to MWRIE, technical and personnel capacity is not sufficient to process and interpret climate-related information with their highest need being for technical equipment and skills, know-how and training. Funding and the number of staff are not of consequences. They equally state that they don't have access to external support or advice on how to integrate climate-related information in decision-making process. In consequence therefore, is that their staff have not received training on climate change and climate change adaptation and neither do they know who would be able to provide training on climate change.

vii. Current use and needs of climate information products and services

The MWRIE has classified itself as end-users that applies climate information and also as value-adders with intermediate ability to formulate their needs on climate information products. It is also noted that MWRIE does not do any activities regarding climate information 'processing' with its own resources but it does interact with Sudan's climate information providers to discuss gaps and needs of climate information products and to provide feedback and this is by Institutionalized interaction such as regular meeting, MoU and contracts.

Examples of current needs and use are given below as:

- For effective Nile catchment management located in upstream countries, they are interested in climate data and information from Ethiopian High lands and Lakes plateau but receive limited cooperation and interest from the Ethiopia National Meteorological Authority.
- It is still difficult to get climate data/information as requested for in real-time and in useable format
- For design of dams, irrigation of agricultural projects and for hydrological research yet historical climate data is very expensive.

- MWRIE is also not in the know of other stakeholders or sector-groups that ask about similar climate information or have special climate information needs.

4.8.5 Analysis and evaluation of user needs on climate services products

Table 16: Climate-related information (specific products and services) that is in use or needed by users in the Sudan

This **product type** is being **used** directly for **decision-making**	This **service** is being **used** to enhance **decision-making**
• Climate statistic products (e.g. information about means and extremes for individual parameters for a specific region and period in form of maps, graphs, etc.) • Data / statistics on hazardous climate events / extreme events (*e.g. impact maps, magnitude-frequency analysis, etc.*) • Climate forecasts/outlooks for specific parameters/events at various time scales (e.g. week, month, year, etc.) • Climate change projections (e.g. model output data/maps for specific parameters, events, etc.)	•
This **product type** is being used as input for follow-up products / services	
• Climate change impact data/model outputs (*e.g. on ecosystems, water availability, etc.*)	
This **product type** is **desired** Climate data (e.g. raw or processed, gridded data, station data, etc. for specific parameters and regions) **/required** but not (yet) being used/available	This **service** is **desired/ required** but not (yet) being used/ available.
• Tailored climate data/statistics (e.g. indices) for specific purpose (*e.g. 'sector of concern'*) • Information on regional climate conditions (e.g. review and analysis in form of bulletins, synthesis reports, statements, etc.) • Analysis and interpretation of climate statements or products for specific users/sectors (e.g. analysis of consequences of past/prevalent climatic conditions for specific sectors) • Data/statistics on climate impacts on terrestrial systems (e.g. impacts on ecosystems (vegetation etc.), geo-morphological impacts (soil erosion, landslides, etc.)) • Information/data on climate impacts/consequences for specific sectors (e.g. info	• Guidelines for selecting relevant climate information and assess its relevance • Explanation of content/meaning of climate information is required (e.g. how to read the graphs?) • Technical training, tools or support for data processing and product application • Training, tools or support to assess the value/significance of the climate information for the own context (e.g. interpretation of information on probability and uncertainty) • Advice or decision-support tools to integrate climate

on expected crop yields, losses, costs, damage, disruptions or fatalities for agriculture, transport, health, energy, etc.) • Climate vulnerability/risk information in general or for specific sectors (e.g. data/info on exposures and sensitivities) • Climate change vulnerability/risk information (e.g. maps for specific sector/region) • Training, workshops, lectures and information material on climate issues, e.g. climate change and its impacts (e.g. qualitative info/education material to raise awareness ; general or sector-specific) • Tools which support decision-making, strategy development and financial planning	information in decision-making • Support for optional queries is desired
This **product type** is **provided** by our organization	This **service** is **provided** by our organization
• Hydrological data / statistics and events (*e.g. discharge, floods, low-flows, etc.*)	•

4.9 Climate Change and Climate Services in Tanzania

Neither questionnaire nor the product matrix was completed hence no information was availed on the climate services baseline and the use, needs and evaluation on climate services products with their portfolio for Tanzania apart from climate change risks in the country done through independent research.

4.9.1 Climate Change risks in Tanzania

The Tanzania Climate Vulnerability Profile (2013) report indicates the following changes in temperature and precipitation for Tanzania which has a tropical climate with regional variation due to its varied topography and herein is the summary:

- The north and east regions experience a bimodal rainfall pattern, with short rains from October to December and long rains from March to May while the south, west, and central regions experience a unimodal rainfall pattern, with a wet season from October until April or May.
- The temperature changes have seen average annual temperatures increased by 1°c since the 1960s and are projected to rise by 1-2.7°c by the 2060s and 1.5-4.5°c by the 2090s compared to the 1970-1999 baselines;
- While precipitation figures from 1960-2006 show that annual rainfall in Tanzania has decreased at an average rate of 3.3 percent per decade. Rainfall patterns have become more variable, with an increase in the amount of precipitation falling in isolated events. The current projections show an annual precipitation ranging from a decrease of 1 percent to an increase of 18 percent by the 2060s from the 1970-1999 average.

4.9.2 Climate Services for Infrastructure baseline of Tanzania

There was no evaluation and summary of the results from the general questionnaires because the NMHS did not complete the questionnaire. Overall, the elements provided for under Global Framework of climate services (GFCS) such as: Observations and monitoring (OM); Research, modelling and prediction (RMP); Climate Service Interface System (CSIS); User interface platform (UIP); and Capacity development (CD) was not covered

4.9.3 Product portfolio in Tanzania

Similarly, the product matrix was not completed hence no information shall be provided on the level of services on: Climate data sets; Climate diagnostics & monitoring products; Monthly and seasonal Long-term predictions; Climate projections; and Climate related hazards & secondary events.

4.10 Climate Change and Climate Services in Uganda.

The questionnaire was completed by representatives from the Uganda National Meteorological Authority (UNMA). The information derived from the questionnaire, product matrix and independent research provides the climate change risks in the country, the climate services baseline and the use, needs and evaluation on climate services products with their portfolio.

4.10.1 Climate Change risks in Uganda

According to the Uganda Climate Vulnerability Profile (2013) report, Uganda which has a tropical climate with two wet seasons from October to December and from March to May will see changes in precipitation and temperature as follows:

- The average temperatures in Uganda has been rising by about 1.3°C since 1960 and are projected to increase by 1°C by the 2030s compared to the 1970-1999 average;
- While when it comes to precipitation, the annual rainfall has decreased at a rate of about 3.5 percent per decade since 1960, with the greatest reductions during the long wet season between March and May. Projections of rainfall in Uganda are uncertain, ranging from a decrease of 7 percent to an increase of up to14 percent by the 2030s compared to the 1970-1999 observed average.

4.10.2 Climate Services for Infrastructure baseline of Uganda

This shall be used to provide an evaluation and summary of the results from the general questionnaires received from the NMHS and also the completed product matrix for services provided. The elements covered with the questionnaire and product matrix was within the general framework of applying the structure of Global Framework of climate services (GFCS) to the elements listed in the subsequent sub-chapters below:

i. Observations and monitoring (OM)

The objective of this sub-section is to identify the available data sources and the state of observing systems which may also include identification of the quality of available data management systems and mechanisms within the NBI countries.

The Uganda National Meteorological Authority (UNMA) completed the questionnaire. It has been herein represented as the NMHS and has indicated that adheres to climate monitoring principles. Most of the country data sources and observation system are from both atmosphere, terrestrial measurements and apparently, the NMHS of Uganda has access to observational data from neighbouring countries but no measurements from the oceans. The other forms of data sets available include gridded/ interpolated data, satellite data, re-analysis data and model but access to socio-economic and impact databases is limited but somewhat available. The NMHS creates archives and documents climate data sets into appropriate length, time units and also collects and stores data and metadata into databases within the appropriate length, time, resolutions and units. There are plans to not only improve the data bases but also their user-interface. The NMHS does apply quality control, homogeneity tests for time series and have a data rescue program in place. Other than that, the NMHS does share data with WMO-RCC for operational purposes and backup, although they are yet to establish a fully open and free sharing of data protocol with other entities. The NMHS also mentioned a plan to adopt well documented strategies for ensuring security, integrity, and retention policy and technology migration for data systems for example the migration from alphanumerical to Table Driven Code systems. Nonetheless, some challenges with data management include limited servers and computing capacities, transmission of data from the field, un-digitalised data etc.

The NMHS does not have a well established structure to integrate all basic systems into functioning observation systems which should also carrying out further observation into accumulated time series. This is further compounded by other challenges for observation network and data availability as those of limited number of stations and technical equipment for observing and providing qualitative data; poor distribution and spatial coverage of observational network around the whole country; limited number, knowledge and skill of staff on different aspects of provision of climate services at the NMHS; poor financial and technical resources make

it very difficult to replace aging spares and leading to dependence on sponsored projects and also weak means of communication and transmission of data from observation stations.

Despite the above challenges, the NMHS of Uganda does have long-term strategies of managing the network and improving data availability for example through station change, relocation, automation and protection.

ii. Research, modelling and prediction (RMP)

This section is to identify the current research capacities and cooperation potential for product development and services orientation within the Nile basin countries.

For the case of Uganda, the NMHS has a mandate to carryout research activities with a fully pledged Directorate of Research and Training. This directorate has fully dedicated personnel or mechanisms of dealing with user requirements and operational service provisions. These research results are then used in operational practice with specific user needs which has lead to the development of new tools and knowledge for multi-disciplinary studies and applications such as in smart agriculture, climate-health, climate-tourism, etc. Also worth noting is that they do share research responsibility with mainly with Makerere University, National Agricultural Research Organisation (NARO), and apparently, these partnerships and collaborations are done mainly through MOUs. The NMHS is involved in the development of new methods, model or tools for example CLIMSOFT and CLICOM. The main needs highlighted include skilled manpower, funding, dissemination and conferences.

iii. Climate Service Interface System (CSIS)

The objective of the baseline on this section is to identify the political embedment of the Service in the national and regional landscape of climate service providers and also identify the regular users, available dissemination and communication structures of the service, its visibility and needs and how providers and users interface.

For the case of Uganda, the NMHS has its roles and contributions clearly mentioned within the National Adaptation Plan (NAP), National Disaster Risk Management Strategy and National and Sector policies and strategies like the climate change policy and UNMA ACT-2012. Also, the NMHS does have the mandate to provide climate services with fully functional and dedicated units for the provision and production of climate products and services. Since there is a separate National Meteorological and Hydrological services within the institutional arrangements, there is a clear call for better administrative arrangements and coordination between the two agencies including the need for strengthening partnership agreements between them. There is the indication that the NMHS is fully imbedded within government but represented as an authority meaning it has semi-autonomous functions. Within the same space, there are some private or commercial services providers doing similar work and function like the NMHS in providing both hydro-meteorological and climate service functions for example NARO and also collaboration with other national, regional and international organizations such as: WMO, IRI, NOA, GIZ and ICPAC.

In order to disseminate and market their products and services, they employ a wide range of ways and channels which include: printed copies sent by post, delivered via email, recorded media like video tapes, CDs etc, through FTP downloads and posting on web pages. With regards to the information that is shared with the public, the degree of uncertainty is also conveyed.

There are competences at the NMHS to integrate the information into relevant sectoral policies and this is done by mainstreaming into sector policies although it is not done or guided using any special methodology and tools. The NMHS does say that there is limited misunderstanding and interpretation from the way the messages are conveyed but nonetheless, recognize the need for improved visibility. They don't professional communicators to help convey the messages and warnings at large scales nor do they carry out marketing of climate services and products although they promote societal awareness of climate change issues. This is boasted by the use and visibility of presentations on national TV channels or the production of sectoral specific information and warnings in newspapers, apps, newsletters etc. They have also mentioned interviews or press conferences on radio and also the use of brochures, pamphlets etc. to ensure increased visibility. The NMHS does operate a website and this contains freely available climate products and services and it was also stated that the Uganda NMHS does not have a restricted policy for free data access for the public.

In terms of user interaction and feedback, the Uganda NMHS does recognize the need for feedback from their users to revise and improve their products with the NMHS indicating that their users assist in the design and development of products but a limitation on working with sector based research teams to develop applications and models. However, it should also be noted that the NMHS does not provide users with risk assessments and risk management nor advice on input into financial tools for risk transfer. However, they have indicated that they have products and services that do directly plug into decisions support tools for public policy development. As can be seen in the table below, herein are leading sectors or organizations in collaboration with the NMHS.

Table 17: Showing the Uganda NMHS partners and the value of their products to these partners

User	Indicate if you provide climate services	Rank	Indicate the type of products provided to the sectors					
			data services	climate monitoring	climate analysis and diagnostics	climate predictions	climate change projections	tailored products / early warning
Government	☒	5	x	x	x	x	x	x
Local authorities	☒	3		x		x		
Scientific	☒	5	x	x	x		x	
Commercial	☒	3	x	x		x		x
Water resources	☒	5	x	x		x	x	
Agriculture	☒	5	x	x	x	x	x	x
Fisheries	☒	4		x				
Forestry	☒	4	x	x			x	
Transport	☒	4	x	x			x	x
Energy industry	☒	5	x	x		x		

Human Health	☒	4		x		x		
Tourism	☒	3		x		x		
Recreation, sport	☒	2		x				
Aviation	☒	5	x	x	x	x		x
Environmental protection	☒	4	x	x		x	x	
Building	☒	4	x					
Finance and insurance	☒	3	x	x		x		
Emergency planning and response	☒	4	x	x		x		x

*Rank the importance of each sector for climate services, where ''1'' is the least important, ''5'' is the most important

iv. User interface platform (UIP)

The objective of the baseline on UIP is for the identification of the prominent users as well as the purpose and objectives of user-interaction and the mechanisms of user-interaction. This section also includes the identification of mechanisms to monitor and evaluate the impact/value of climate services.

For the case of Uganda, the NMHS does have a mandate to interact with the users directly and this is provided for in the UNMA ACT although it may not have dedicated units for interacting with users and providing them with climate services, it does have a Public Relations Officer (PRO) who is provided for similar assignments and more. There is also an established mechanism of interacting with media especially during emergency situations and in this case is the Uganda Media Center. In addition to this, there are also planned regular meetings for interaction with ministries and sectors through the Disaster Risk Reduction platform and the main national institutions and organisations that the NMHS interacts with are in agriculture, water resources and Office of the Prime Minister on issues of Disaster Risk Reduction. The NMHS does communicate seasonal outlooks to users through regional climate outlook forums but also holds national climate outlook forums as a mechanism to interact with users to enhance their awareness and provide tailor information for specific users groups

Although there is no specific sector help desk to help in getting feedback on existing products and also guiding and training on existing product, the NMHS gets to know user needs by making specific requests, asking questions and conducting dedicated enquiries and market. The NMHS has indicated that there is no feedback loop from user needs back into research but recognises that the lack of appropriate training program for users does limit their understanding of the application of climate information. This may not be the same impression on the lack of interaction with users on specific user programs being a reason for limited user understanding of climate information.

With regards to monitoring and evaluation, the NMHS has indicated that it tracts the use of climate services they have provided. It also states that it does (but irregularly) conduct and evaluate the levels of satisfaction in quality of service. In addition, it states that there is no clear

way of doing it. The NMHS doesn't identify and measures impacts of their services on climate sensitive sectors and associated variables like on disaster lose, crop yields, hydropower etc but generally, it does monitor for all sectors depending on level of interest of products with users. The NMHS also does not perform socio-economic study of climate services in order to demonstrate the value of products to users and equally nor does it perform socio-economic analysis or cost-benefit analysis of climate services. It also doesn't support investment planning of climate sensitive sectors based on results of socio-economic or cost-benefit analysis.

v. Capacity development (CD)

For the case of Uganda, the NMHS has policies on human resources development and therefore enhance capacities through training courses, conferences, e-learning and fellowships also at regional and international levels. This may also involve specialised trainings in climate services, tailoring of climate information to specific sectors, special training on communication for example the communication strategy is seen as not very comprehensive and also the need for additional staff to full fill climate service tasks. Also mentioned is that once staff is recruited, they would need them to development capacities especially for climate services, interaction with users, research and development, data management and products development seen as key to improve climate services. The NMHS also recognises that the lack of interaction with users limits the effectiveness of the user of climate information and therefore they extend trainings to user communities although they feel the need to strengthen it.

It has been acknowledged that some gaps do exist especially with lack of recognition and visibility of services within their governments and also lack of integration of climate services into social-economic benefits. Other problems cited include the lack of policies regarding the role of climate services in the overall social-economic development space and sometimes the need for improvement of organisational structure of the service. The Uganda NMHS also mentioned computing facilities, equipment networks, internet access especially dedicated lines for data transfer, financial resources, low staffing levels, remuneration, power outrages and building space as main challenges towards improving products and services.

4.10.3 Product portfolio in Uganda

The objective of section is for the identification of currently available climate information products and services. It will involve the results from both the questionnaire and the product matrix with the product matrix providing an in-depth and detailing of the questionnaire.

i. Climate data sets

For the case of Uganda, the NMHS stores and makes available both terrestrial and atmospheric historical datasets which is used for both internal and external purposes. Ocean data is neither collected nor stored but other forms of data exist too and as such, the following example is given and available for both internal and external use: rescued metadata, model data and basic statistics on climate extremes for example temperature, precipitation, humidity, sunshine duration, frequency of occurrence, spatial mean etc. Gridded/ interpolated data and satellite data are available but mostly for internal use. The Uganda NMHS does not perform homogeneity tests and adjustments of time series when it comes to data.

The Information derived from the product type matrix states that processed climate data sets are sourced and co-produced with Directorate of Water Resources Management (DWRM) and Uganda National Meteorological Authority (UNMA). The product characteristics are temperature, precipitation, pressure, wind speed/direction, sunshine, evaporation, visibility, flow water, water

quality, Meta data and seasonal forecast. The products derived for the sector-specific are products related and compiled for Hydrological Year Books, Forecasts, Flow and Stage Time series, Aviation/Aircraft data and seasonal bulletin. The main users are airport control systems, National water and Sewerage Corporation (NWSC), Irrigation managers, road construction contractors, hydropower development & operating entities. The services offered are SMS alerts at hourly intervals and the means of user-interaction is through MoU, written requests, stakeholder meetings, contractual obligations and sector review meetings. The major challenges inadequate funding, obsolete equipments and limited skilled human resource.

ii. Climate diagnostics & monitoring products

For Uganda's case, the NMHS does provide climate diagnostics & monitoring products for both internal and external use and these include the use of derived products from satellite data for monitoring activities; performance of basic assessments and analysis (diagnostics) of spatial and temporal factors and processes; and observation of climate patterns for example tropical cyclones, monsoon, synoptic scale storms, spatial patterns of temperature, precipitation, etc. and their anomalies for climatic zoning. Similarly, the NMHS also does apply advanced climate statistics and graphical products that include maps, analysis and graphs of precipitation, temperature, relative humidity, evapo-transpiration, sunshine duration, cyclones etc and also helps develop and provide specialized climate analysis, prediction and monitoring products, tailored to the needs of specific users for both in internal and external use. Also mentioned is limited ability to perform highly sophisticated climatologically statistics and complex characteristics, incl. indices for specific users like for building design codes.

With regards to climate diagnostics, the product matrix does mention that the Uganda NMHS has product characteristics for monthly and daily values with the sector-specific products being yearly/seasonally/monthly/daily/hourly parameters. The data source and co-production is climate forecasts from ICPAC while the service is wind speed & direction etc. The targeted uses are those in drought predictions, design floods, annual flow projections, and design flood. No information was give for the other aspects of the matrix such as user-interaction means and the gaps and needs.

iii. Monthly and seasonal Long-term predictions

For Uganda's case, the NMHS does develop and provide prediction products at decadal, monthly, and seasonal scales. The degree of uncertainties is also added to the products while being issued and disseminated into specific advisories for user community as either climate summaries, bulletins, reports, drought/flood maps and special statements for severe weather. The issuing and disseminating specific advisories to the user community but all the above is for other external and internal use. The NMHS does analysis on climate extremes into maps, graphs, images which is done together with the assessment of current climate conditions in terms of averages, variance, thresholds and percentiles. The NMHS also provides ENSO, SST and intra-seasonal variability products and monthly to seasonal and longer climate predictions which is further augmented products from RCCs, Regional Climate Outlook Forum (RCOFs).

The information derived from the product matrix on Uganda's long-term predictions by the NMHS provides monthly, seasonal and decadal climate predictions. The product characteristics are forecasts with sector-specific products that have forecasts scales, real time data. The data sources and co-production was given as UNMA and DWRM while they are used for user's annual totals, minimum and maximum flows, below normal and above normal rainfall averages. No

information was given for the other aspects of the matrix such as the service types, user-interaction means and the gaps and needs to improve predictions.

With regards to climate monitoring, the product matrix listed characteristics under consideration as Telemetric/Manual and automatic stations while the data source & co-production is done by Telemetry, SMS, RT (Radio Communication) and Telephone, satellite data,. No information was given for the other aspects of the matrix such as who are the users and with what are the interaction means and the gaps.

iv. Climate projections

For Uganda's case, the NMHS does the development and interpretation of climate change scenarios and interpretation of climate statements which includes production for general public and other specific users. This also means reviewing and making assessment of past climate patterns as provided by WMO reports on the state of climate for their country which also includes reanalysis, performing dynamical and/or statistical downscaling of Global Climate Models (GCM) and/Regional Climate Models. This also includes the analysis and running Global and/or Regional Climate Models is done for both external and internal purposes. This work also extends to adding value from national perspective to these products received form RCOFs, RCCs and GPCs. It is only the sharing and exchange of information, products and services to other countries in the region especially during the periods of significant climate anomalies that is done for mostly external purposes.

From the completed product matrix, the Uganda NMHS did give information on climate change projections by mentioning that the available product characteristics on GCMs and RCMs are not used. Sector-specific products from GCMs and RCMs are not also used. The data source & co-production of the GCMs and RCMs are ICPAC and IGAD membership. The other necessary information for example, potential users, services types, user-interaction and the gaps and needs was not given.

v. Climate related hazards & secondary events

For Uganda's case, the NMHS does make analysis and provision of products relevant to El Nino and La Nina updates, Global Seasonal Climate Updates (GSCU) that contains information on ENSO and other climate extremes and variations driving phenomena for example NAO, PNA, IOD, etc for both internal and external purposes. The same is also done by providing global and/or regional scale data resources as input into modelling, research and applications for mostly external purposes. It should be noted that unfortunately, the NMHS from Uganda does not provide high density, small scale specialized data resources used for studies of small scale processes and urban environment.

From the product matrix on climate-related hazards and impacts, the product characteristics provided are drought and flood events by the Uganda NMHS. The data sources and co-production coming are from both floods and droughts. All other information on sector-specific products, data user & value, services types, user-interaction and the gaps and needs was not given.

5. EVALUATION OF RESULTS

This evaluation shall be done by looking at four result areas dealing with the categorization of climate information products, current state of the National Climate Service, identification of specific CS gaps on the product level and summary and evaluation of the state of the National Climate Services.

5.1 Categorization of climate information products, Current state and evaluation of the National Climate Service

This shall be done by categorization of NMHSs into the four categories according to climate services, CDSIP (2012) or (WMO 2012, chapter 3.2) and a representation of actors using GIZ's Cooperation Management for Practitioners, (Capacity Works, 2015), an actors' landscape for the NMHS has been developed to show the more prominent actors and how they relate to the key stakeholder in climate services-NMHS (regional, private or international). Included is a SCOT analysis of climate services.

Table 18: Categorization of NMHS according to CDSIP (2012)

Level of Service	Weather Services	Climate Services	Hydrology Services	Description of capacity needed to meet service level
Category 1 - Basic	➢ Weather observations ➢ Weather Data Management ➢ Interaction with weather data and product users	➢ Climate observations ➢ Climate Data Management ➢ Interaction with climate data and product users	➢ Hydrological observations ➢ Hydrological Data Management ➢ Interaction with hydrology data and product users	➢ Small network of quality controlled observations ➢ Basic data processing, archiving and communication systems ➢ Little or no backup / offsite storage, or contingency options ➢ Rudimentary staff (observers and some meteorologists trained to BIP standards) ➢ No 24 /7 operation ➢ Rudimentary QMS ➢ No R&D
Category 2 - Essential	➢ Medium-range (synoptic scale) forecasts and warnings ➢ Established links with media and DRR communities	➢ Seasonal Climate outlooks ➢ Climate monitoring	➢ Hydrological data products for design and operation of water supply structures ➢ Water level and flow monitoring ➢ Short-term flow forecasts (low flows) ➢ Flood forecasting	➢ Able to integrate and take observations from other parties ➢ Well-established protocols for emergencies, backup of data and minimum offsite facilities ➢ Staff (observers and meteorologists trained to BIP standards) ➢ 24/7 operation. ➢ QMS well established ➢ Access most NWP data/products from other centers ➢ Small R&D ➢ Some partnerships as junior members

Category 3 – Full	➢ Specialized weather products for wide range of sectors ➢ Well integrated into DRR communities and mature links with media	➢ Specialized climate products ➢ Decadal climate prediction ➢ Long-term climate projections	➢ Seasonal stream flow outlooks ➢ Specialized hydrology products	➢ Advanced observation equipment ➢ Runs own NWP suite ➢ R&D ➢ Well educated/trained staff ➢ Own training group ➢ Developed library and information services ➢ Active partnerships with NMHSs taking a leading role
Category 4 - Advanced	➢ Customized weather products ➢ Weather application tools.	➢ Customized climate products ➢ Climate application tools	➢ Customized hydrology products ➢ Hydrology application tools	➢ Advanced observations ➢ Leading R&D ➢ Well developed ETR

5.1.1 Actors' landscape and GFCS categorisation of Burundi NMHS

According to the GFCS categorisation CDSIP (2012), herein is the current state of national Climate Service. It shows a network of climate service providers, their functions and their interrelationships with the NHMS.

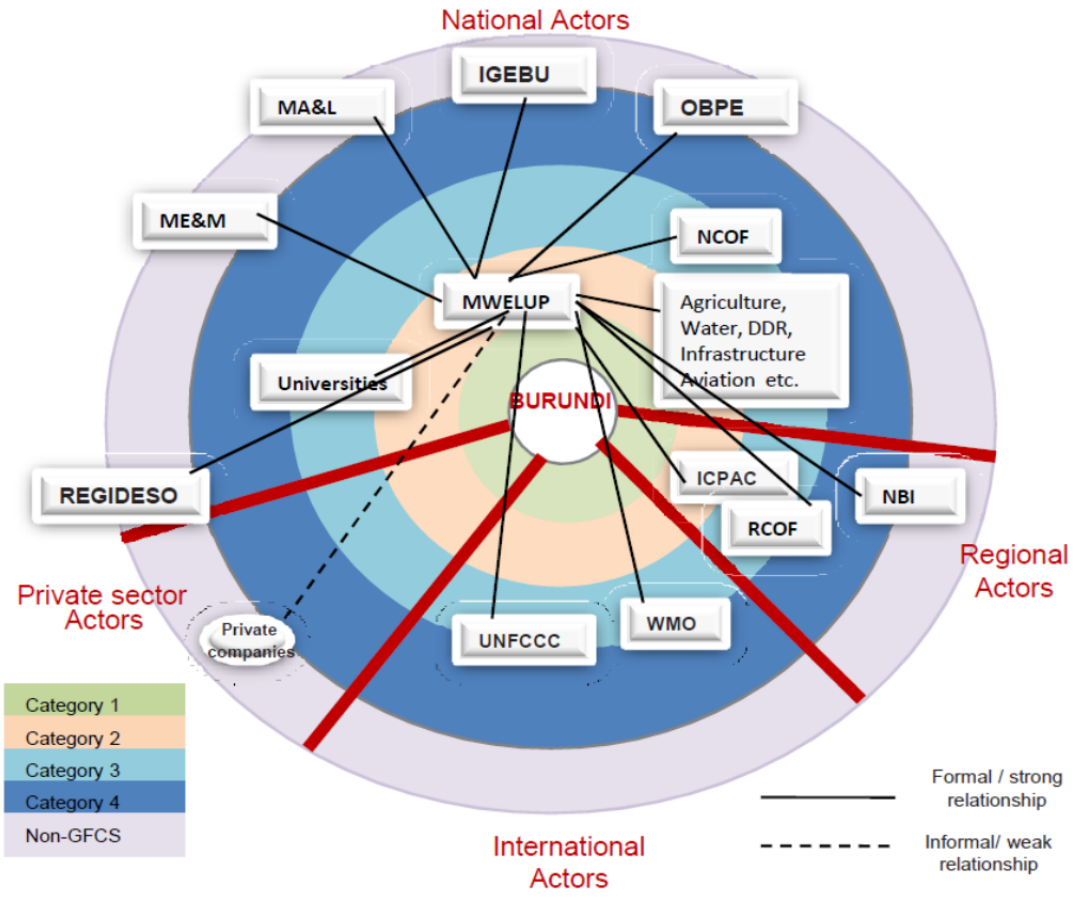

Figure 3: Climate Services Actors' landscape of Burundi

Table 19: Burundi Stakeholders in actors' landscape

DRR	Disaster Risk Reduction
GHACOF	Greater Horn of African Climate Outlook Forums
ICPAC	IGAD Climate Prediction and Application Center
IGEBU	Institut Géographique du Burundi
ME&M	Ministry of Energy and Mines
MA&L	Ministry of Agriculture and Livestock
MWELUP	Ministry of Water Environment, Land & Urban Planning-Burundi
NCOF	National Climate Outlook Forum
OBPE	Office Burundais pour la Protection de l'Environnement
RCOF	Regional Climate Outlook Forum
NBI	Nile Basin Initiative
REGIDESO	Régie de Distribution d'Eau et d'Electricité du Congo Belge et du Rwanda-Urundi
UNFCC	United Nations Framework Convention on Climate Change
WMO	World Meteorology Organisation

i) Analysis: It is extremely difficult to exclusively categorise the NHMS-MWELUP into any specific category according to the table above but most appropriately, it would be in Category 2. The NHMS is beyond category 1 since it meets the basic function and services of category 1 but to a limited extent not yet into category 3. There is clearly a deficit towards reaching category 4. This can be seen in the SCOT analysis of the services and products provided below. Nonetheless, there are multi-engagements under formal arrangements like MOUs or contracts with numerous agencies at national level and also directly with government sectors like agriculture, water, disaster risk reduction and universities. These other engagements allow it to access services and products from all the other categories for example WMO and RCOFs-ICPAC. It should also be noted that there is limited engagements with the private sector.

ii) SCOT (products) Analysis of climate service in Burundi of the general use of climate services' products and gaps in products at the Burundi NHMS.

Strength

a) The NMHS has historical datasets from both atmospheric and terrestrial parameters which are stored and made available for both internal use and external use
b) The NMHS of Burundi does perform basic assessments and analysis (diagnostics) of spatial and temporal factors and processes including the use and derivation of products from satellite data for monitoring activities for both internal and external purposes.
c) The NMHS of Burundi does analyse spatial patterns and observes climate patterns, their anomalies for climatic zoning and apply advanced climate statistics and graphical products for internal observation purposes only
d) The Burundi NMHS has developed and provided specialized climate analysis, prediction and monitoring products, tailored to the needs of specific users in general, but for only internal use.
e) The Burundi NMHS develops and provides prediction products for internal use only and this is at seasonal and decadal scales but not monthly.
f) The NMHS further issues and disseminates these products into specific advisories for user community and this is done as climate summaries, bulletins, reports, drought/flood maps and special statements for severe weather which is all done internal purposes only.
g) The NMHS does the assessment of current climate conditions in terms of averages, variance, thresholds, percentiles in weekly, 10-days, seasonal and annual time scales.

Challenges

a) It should also be noted that Burundi NMHS does not perform homogeneity tests and adjustments of time series on data.
b) The NMHS is limited in other areas like analysis of highly sophisticated climatologically statistics and complex characteristics, incl. indices for specific users like for building design codes.
c) The Burundi NMHS does not develop and provide prediction products at monthly scales and has limited access to and use of monthly to seasonal and longer climate predictions, provided by RCCs, Regional Climate Outlook Forum (RCOFs), and Global Production Centres (GPCs.).

d) The Burundi NMHS does not participate in and contribute to RCOF and therefore limiting the sharing/exchanging information, products, services to other countries in the region, even during the periods of significant climate anomalies.
e) The NMHS is also limited in performing reanalysis and adding value from national perspective to these products received form RCOFs, RCCs and GPCs.
f) The Burundi NMHS doesn't provide global and regional scale data resources as input into modelling, research and applications.
g) NMHS is limited in the provision of high density, small scale specialized data resources used for studies of small scale processes and urban environment.

Opportunity

a) The Burundi NMHS participates in the review and assessment of past climate patterns on the state of climate for their country as provided by WMO reports. This is done for the purposes of analysis, interpretation and reanalysis of climate statements or products for the general public or for specific users which is then used for both internal and external purposes.
b) The NMHS also does the development and/or interpretation of climate change scenarios for both internal and external purposes.
c) The Burundi NMHS does make analysis and provision of products relevant to El Nino and La Nina updates. This also includes Global Seasonal Climate Updates (GSCU) that contains information on climate extremes and variations driving phenomena but mainly for internal use purposes.

Threats

a) These products do not have Information related to the degree of uncertainties or skill level but does analysis on climate extremes recorded in maps, graphs and images.
b) Burundi NMHS does not provide ENSO, SST and intra-seasonal variability products.
c) The Burundi NMHS does not perform dynamical and/or statistical downscaling of Global Climate Models (GCM) and/or Regional Climate Models (RCM).

5.1.2 Climate services Inventory and actors landscape in DR. Congo

According to the GFCS categorisation CDSIP (2012), herein is the current state of national Climate Service. It shows a network of climate service providers, their functions and their interrelationships with the NHMS.

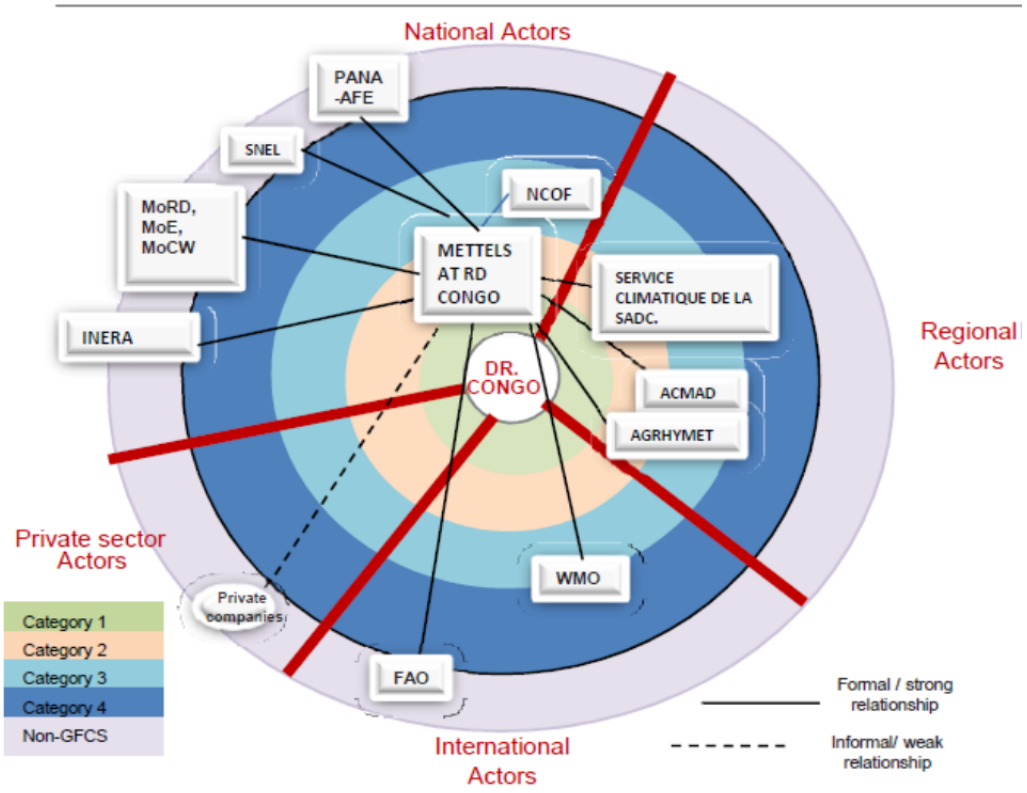

Figure 4: Climate Services Actors' landscape of DR. Congo

Table 20 DR. Congo Stakeholder abbreviations in the actors' landscape

ACMAD	African Centre of Meteorological Application for Development
AGRHYMET	Centre Regional de Formation et d'Application en Agrométéorologie et Hydrologie Opérationnelle
FAO	Food Agriculture Organisations
INERA	Institut National pour l'Etude et la Recherche Agronomiques
NCOF	National Climate Outlook Forum
MoE	Ministry of Environment
MoCW	Ministry of Civil Works
PANA-AFE	Programme d'Action National d'Adaptation au changement climatique en R.D du Congo.
MoRD	Ministry of Rural Development
SNEL	Société nationale d'électricité
WMO	World Meteorology Organisation

i) Analysis: Similar to the above situation, it is extremely difficult to exclusively categorise the METTELS AT RD Congo into any specific category according to the table above but most appropriately, it would be in Category 2. The NHMS is beyond category 1 since it

meets the basic function and services of category 1 but to a limited extent not yet into category 3. There is clearly a deficit towards reaching category 4. This can be seen in the SCOT analysis of the services and products provided below. Nonetheless, there are multi-engagements under formal arrangements like MOUs or contracts with numerous agencies at national level and also directly with government institutions like PANA-AFE, SNEL ANDINERA. These other engagements allow it to access services and products from all the other categories for example WMO and RCOFs-ACMAD AND SERVICE CLIMATIQUE DE LA SADC. It should also be noted that there is limited engagements with the private sector.

ii) SCOT (products) Analysis of climate service in DR. Congo of the general use of climate services' products and gaps in products at the DR. Congo NHMS.

Strengths

a) The NMHS of DR. Congo collects and stores historical datasets from terrestrial measurements and observations which is then made available for both internal use and external use.
b) The NMHS of DR. Congo performs advanced climate statistics, analysis of climate extremes and provides graphical products which are then used for both internal and external purposes.
c) The NMHS also provides ENSO, SST and intra-seasonal variability products provided by RCCs, Regional Climate Outlook Forum (RCOFs), and Global Production Centres (GPCs.).
d) Specific advisories products are issued and disseminated by the DR. Congo NMHS for community use which are for both internal and external purposes and also these products have degree of uncertainties to the users.
e) The NMHS of DR. Congo develops and provides prediction products at monthly and decadal scales for both internal and external use.

Challenges:

a) The NMHS has limited access to and use of monthly, seasonal and longer climate predictions provided by RCCs, Regional Climate Outlook Forum (RCOFs), and Global Production Centres (GPCs.)
b) It has been indicated that the NMHS does not collect nor store ocean data and also gridded/ interpolated data is lacking.
c) The NMHS of DR. Congo does not perform homogeneity tests or adjustments of time series on the available data sets not does it do analysis for spatial patterns, anomalies and climatic zoning.
d) The NMHS does not derive products from satellite data for monitoring activities nor does it perform basic assessments and analysis (diagnostics) of spatial and temporal factors.
e) The NMHS does not also develop nor provide specialized climate analysis, prediction and monitoring products.
f) It does not make analysis and provision of products relevant to El Nino, La Nina and Global Seasonal Climate Updates that should contain information on climate extremes and variations driving phenomena.
g) The NMHS from DR. Congo is also limited in the provision of high density, small scale specialized data resources used for studies of small scale processes and urban environment.

Opportunity

a) The NMHS of DR. Congo does not develop nor provide prediction products at seasonal scales for both internal and external use.
b) DR. Congo's NMHS does do climate projections for the purposes of analysis, interpretation and reanalysis of climate statements and products for the general public and for specific users for both internal and external purposes.
c) The NMHS also does the development and/or interpretation of climate change scenarios and also performs dynamical and/or statistical downscaling of GCM and/or RCMs.
d) The NMHS of DR. Congo does provide global and regional scale data resources as input into modelling, research and applications but mostly for external use.

Threats

a) The NMHS also has limited access to and use of monthly, seasonal and longer climate predictions provided by Regional Climate Centres, (RCCs), Regional Climate Outlook Forum (RCOFs), and Global Production Centres (GPCs.)
b) The NMHS from DR Congo is limited in performing reanalysis and adding value from national perspective to these products received form RCOFs, RCCs and GPCs.
c) The NMHS does not participate in the review and assessment of past climate patterns on the state of climate for DR. Congo as provided by WMO reports nor does it share and exchange information, products, services to other countries in the region, during the periods of significant climate anomalies.

5.1.3 Actor's landscape and SCOT analysis of Ethiopia NMHS

The current state of national climate services showing a network of climate service providers, elaborated functions and interrelationships. This was done according to the GFCS categorisation and Capacity Works actors' landscape.

i) Analysis: Similar to the above situation, it is extremely difficult to exclusively categorise the NMA into any specific category according to the table above but most appropriately, it would be in Category 2. The NHMS is beyond category 1 since it meets the basic function and services of category 1 but to a limited extent not yet into category 3. There is clearly a deficit towards reaching category 4. This can be seen in the SCOT analysis of the services and products provided below. Nonetheless, there are multi-engagements under formal arrangements like MOUs or contracts with numerous agencies at national level and also directly with government institutions like Ministry of Water, Irrigation and Electricity (MWIE), NDRC and sectors like aviation, agriculture, universities, insurance, environment etc. These other engagements allow it to access services and products from all the other categories for example WMO and RCOFs-ACMAD AND ICPAC. It should also be noted that there is limited engagements with the private sector.

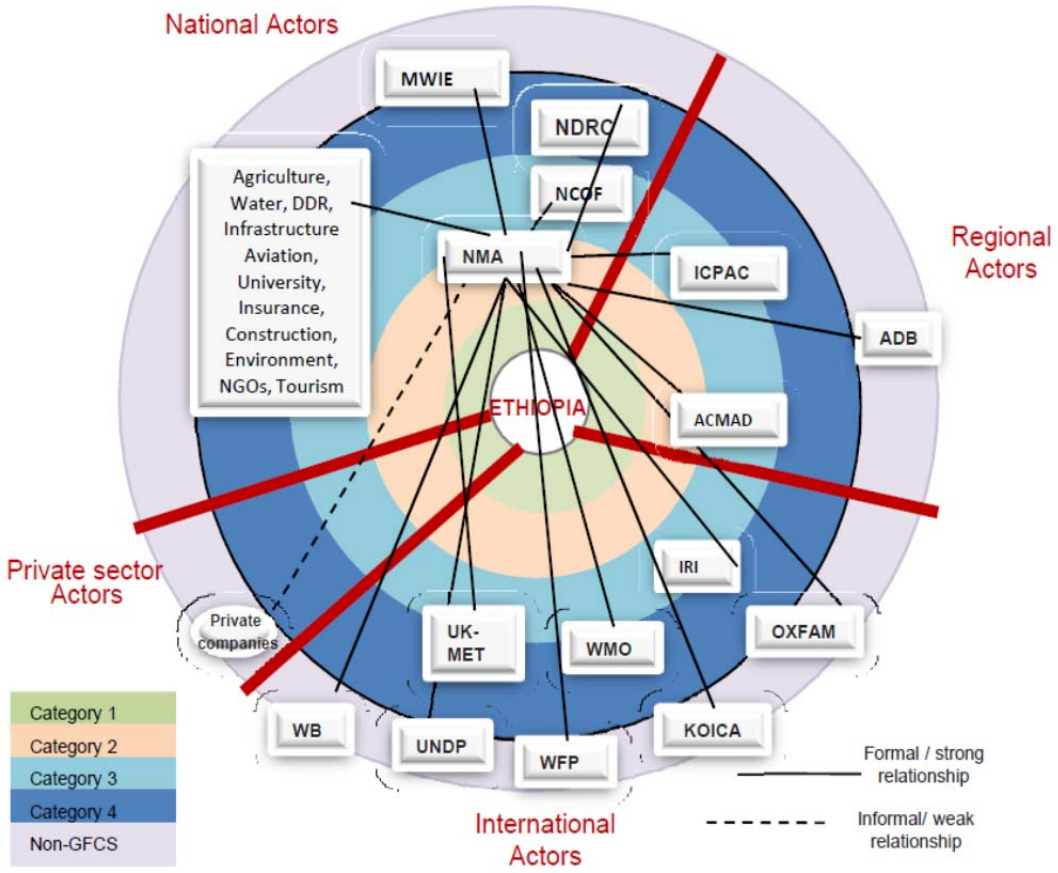

Figure 5: Climate Services Actors' landscape of Ethiopia

Table 21: Ethiopia NHMS Stakeholders abbreviations from the Actors' landscape

ACMAD	African Centre of Meteorological Application for Development
ADB	African Development Bank
DRR	Disaster Risk Reduction
ENDRM	Ethiopia National Disaster Risk Management Commission
EPP	Ethiopian Electric Power
ICPAC	IGAD Climate Prediction and Application Center
IRI	International Research Institute for Climate and Society
KOICA	Korea International Cooperation Agency
MWIE	Ministry of Water, Irrigation and Electricity
NCOF	National Climate Outlook Forum
NDRC	National Disaster Risk Management Center
NMA	National Meteorological Authority-Ethiopia
UK-MET	United Kingdom Meteorology

UNDP	United National Development Program
WB	World Bank
WFP	World Food Program, African Development Bank (ADB),
WMO	World Meteorology Organisation

ii) SCOT (products) Analysis of climate service in Ethiopia of the general use of climate services' products and gaps in products at the Ethiopia NHMS.

Strengths

a) Both terrestrial and atmospheric measurements and observations are collected and stored by Ethiopia-NMA as historical datasets and are also made available for both internal use and external use.
b) Basic statistics on climate extremes are also available for sector-specific products related and compiled for aviation and air transport both internal and for external use.
c) The NMHS of Ethiopia does analyse spatial patterns, their anomalies including climatic zoning for both internal and external purposes.
d) Ethiopia-NMA applies advanced climate statistics and graphical products for analysis of maps and graphs for both internal and external purposes.
e) The NMA does development and provision of specialized climate analysis, prediction and monitoring products, tailored to the needs of specific users are done for internal purposes only.
f) The NMA does climate diagnostics for sector-specific products for flood management and provided on a daily basis and by a select committee. This also includes developing and providing prediction products for internal and external use.
g) The NMA provides Information derived from the products that give climate predictions for use in reservoir management and hydrological forecast. The services offered is a report of the prediction and presented for user-interaction ion meetings and websites.
h) The NMHS of Ethiopia provides climate-related hazards and impacts with information on from extreme flow to the NDRC, infrastructure owners, flood management, dam operation during flood and drought through reports and meeting.
i) The NMHS analyses climate extremes into maps, graphs and images which can be provided as monthly to seasonal outlooks and also offers specific advisories for user community in climate summaries, bulletins, reports, drought/flood maps for both internal and external purposes.

Challenges

a) Ethiopia-NMA needs is capacity, manpower, modelling and software to be improved in developing sector-specific products and climate projections for example for aviation and air transport and construction.
b) Model data and ocean data are neither collected nor stored by the NMA meanwhile no homogeneity tests and adjustments of time series are performed.

Opportunity

a) The NMA does basic assessments and analysis especially diagnostics of spatial and temporal processes of observed climate patterns for internal purposes.
b) The NMHS receives predictions provided by RCCs, Regional Climate Outlook Forum (RCOFs) and Global Production Centres (GPCs.) and also performs reanalysis and adding value from

national perspective to these products received which are made available for internal use only.

c) The NMHS of Ethiopia does the development and interpretation of climate change scenarios and also performs dynamical and statistical downscaling of GCM and RCM.
d) The NMA reviews and assess past climate patterns on the state of climate in Ethiopia as provided by WMO internal purposes only
e) The NMA shares and exchanges information with other countries in the region especially during the periods of significant climate anomalies for general public or specific users for both internal and external purposes.
f) The NMHS of Ethiopia does analysis and provision of products relevant to climate extremes and variations for internal purposes only.
g) The specific services were not given but the means of user-interaction is through meeting and upon request. The needs include improvement of hydrological network, manpower and capacity for hydrological management.
h) NMA gives climates monitoring products to sector-specific entities like the department of Hydrology, design enterprises, for reservoir management and design of infrastructure and this creates basis for expansion into private sector.

Threats

a) The NMA does not provide global neither regional scale data resources as input into modelling, research and applications nor does it provide high density, small scale specialized data resources used for studies of small scale processes and urban environment.

The NMA does not provide decadal scales or information in relation to the degree of uncertainties or skill level in some of its products.

5.1.4 Actor's landscape and SCOT analysis of Kenya NMHS

The current state of national climate services showing a network of climate service providers, elaborated functions and interrelationships. This was done according to the GFCS categorisation and Capacity Works actors' landscape.

i) Analysis: Similar to the other NHMS, it is extremely difficult to exclusively categorise the KMD into any specific category according to the table above but most appropriately, it would be in Category 2. The NHMS is beyond category 1 since it meets the basic function and services of category 1 but not yet fully into category 3. There is clearly a deficit towards reaching category 4. This can be seen in the SCOT analysis of the services and products provided below. Nonetheless, there are multi-engagements under formal arrangements like MOUs or contracts with numerous agencies at national level and also directly with government institutions like MWI, National Disaster Operations Center, NGOs and sectors like aviation, Tourism, agriculture, insurance, environment etc. These other engagements allow it to access services and products from all the other categories for example WMO, EUMETSAT and ICPAC. It should also be noted that there is limited engagements with the private sector.

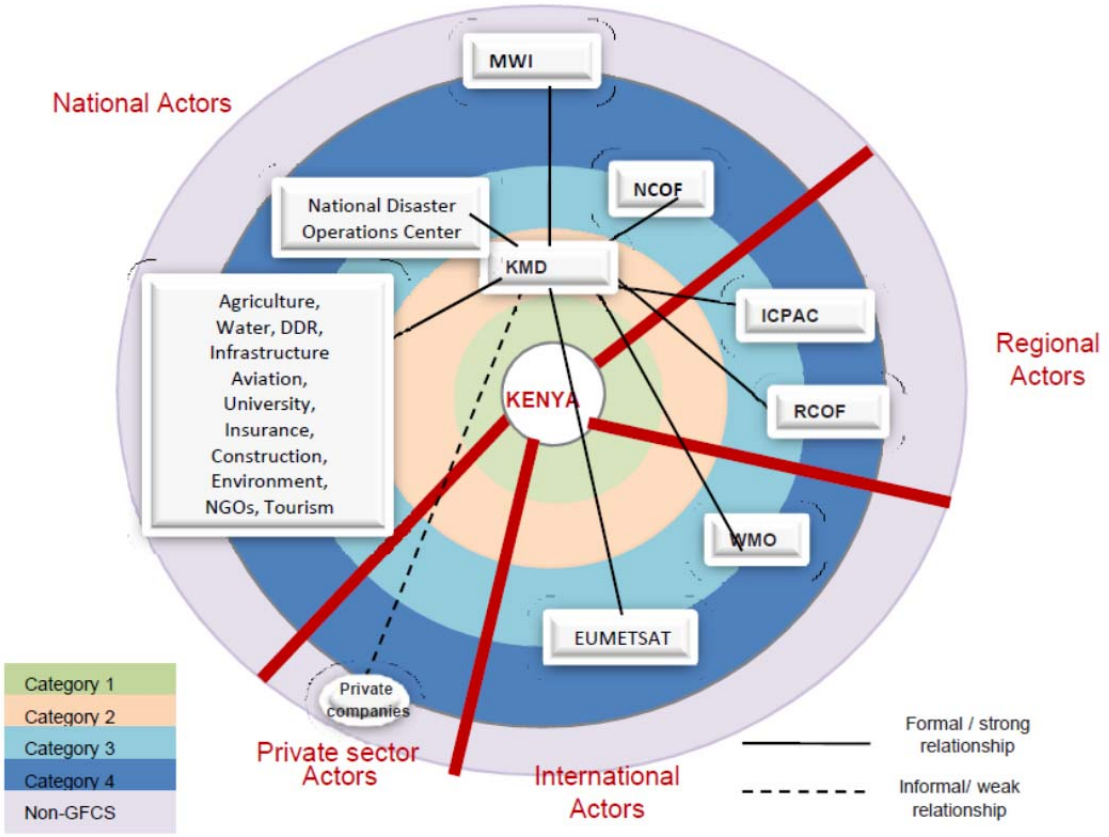

Figure 6: Climate Services Actors' landscape of Kenya

Table 22 Kenya NMHS stakeholders' abbreviations in the actors' landscape

DRR	Disaster Risk Reduction
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
ICPAC	IGAD Climate Prediction and Application Center
KMD	Kenya Meteorological Services Department
MWI	Ministry of Water and Irrigation
NCOF	National Climate Outlook Forum
RCOF	Regional Climate Outlook Forum
WMO	World Meteorology Organisation

ii) SCOT (products) Analysis of climate service in Kenya of the general use of climate services' products and gaps in products at the Kenya NHMS.

Strengths

a) Kenya Meteorological Department (KMD) does store historical datasets from terrestrial, ocean and atmospheric measurements and observations made available but only for internal use.

b) KMD has basic statistics on climate extremes, performs homogeneity tests and adjustments of time series with the date only made available for internal use.
c) The NMHS-Kenya analyses spatial patterns, anomalies and climatic zoning into advanced climate statistics and graphical products for both internal and external purposes.
d) KMD has Information on climate diagnostics and provide sector-specific targeting users from design and construction industry. This is done via manuals.
e) KMD issues prediction products and specific advisories for user communities given through climate summaries, bulletins, reports, drought/flood maps and special statements for severe weather but for internal purposes only.
f) KMD does the development and interpretation of climate change scenarios and also performs dynamical and statistical downscaling of GCMs and also the analysis and interpretation of climate statements for general public and other specific users.
g) KMD does provide both high density, small scale specialized data resources used for studies of small scale processes and urban environments; also used are global and regional scale data resources as input into modelling, research and applications but mostly for external use only.
h) KMD derives, relates and compiles Information for sector-specific products for catchment area which can be used for daily flood watch and update. The services offered are processed data per hour while the means of user-interaction is through community Radio.

Challenge

a) KMD notices some key challenges of scarcity of recording gauge network, inadequate monitoring network, lead time in climate predictions and model skills.
b) KMD does not do sophisticated climatology statistics which may include indices for specific users and complex characteristics for building design codes.

Opportunity

a) KMD is involved in the development and provision of specialized climate analysis, prediction and monitoring products tailored to the needs of specific user and monitoring activities for internal purposes only.
b) KMD analyses climate extremes and current climate conditions which are then developed into maps, graphs and images and given to specific users. The provided information contains degree of uncertainties in its products and onset and cessation of rainfall for say agriculture and food security. This user-interaction is through participatory scenario planning.
c) The Kenya NMHS offers climate monitoring products for sector-specific areas and monitoring is by volunteer observers who record and transmit data.
d) The NMHS also does make analysis and provision of products relevant to climate extremes and variations driving phenomena but for internal purposes only.

Threats

KMD does not perform reanalysis of data and also lead time and model skills threaten the quality of long-term predictions which in turn threatens food security.

5.1.5 Actor's landscape and SCOT analysis of Rwanda NMHS

The current state of national climate services showing a network of climate service providers, elaborated functions and interrelationships. This was done according to the GFCS categorisation and Capacity Works actors' landscape.

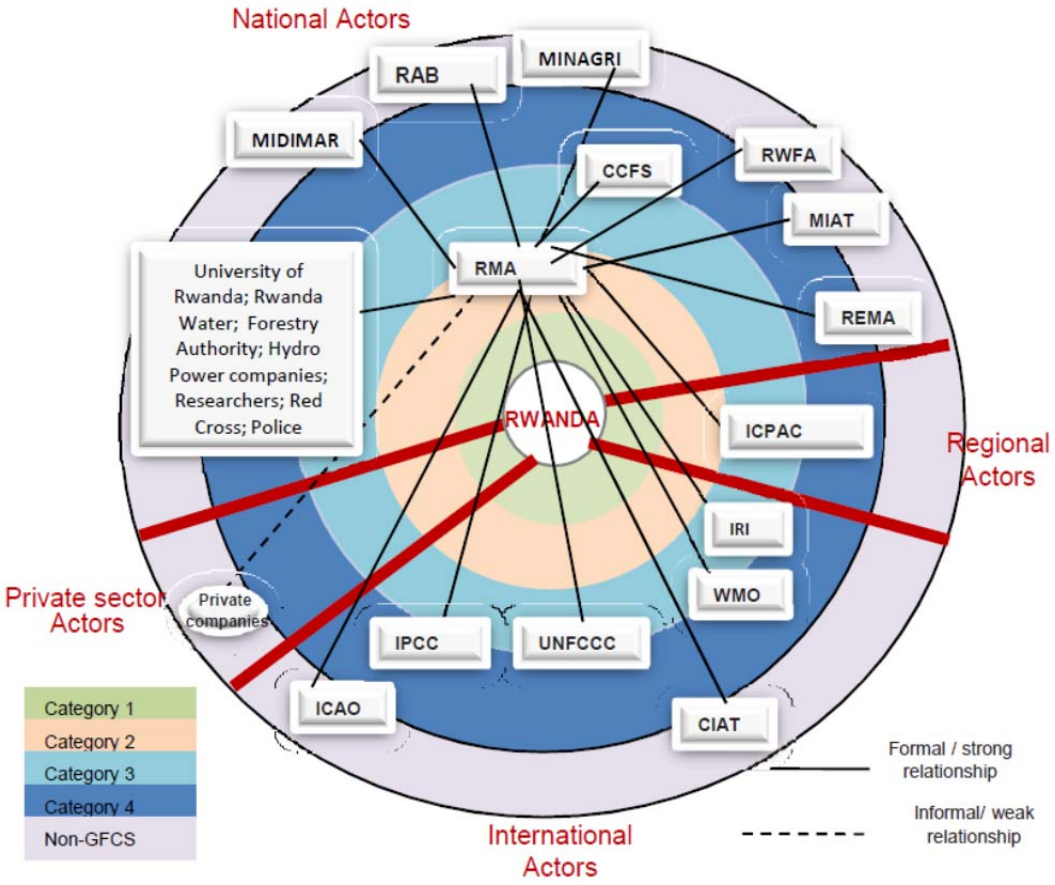

Figure 7: Climate Services Actors' landscape of Rwanda

CIAT	International Center for Tropical Agriculture
ICAO	International Civil Aviation Organization
ICPAC	IGAD Climate Prediction and Application Center
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute for Climate and Society
MINAGRI	Ministry of Agriculture and Animal Resources.
MIAT	Ministry of Infrastructure and Air Transport
MIDIMAR	Ministry of Disaster Management and Refugee Affairs
RMA	Rwanda Meteorological Agency
RAB	Rwanda Agriculture Board
REMA	Rwanda Environment Management Authority
RWFA	Rwanda Water and Forestry Authority
UNFCC	United Nations Framework Convention on Climate Change
WFP	World Food Program, African Development Bank (ADB),

WMO	World Meteorology Organisation

i) Analysis: Similar to the other NHMS, it is extremely difficult to exclusively categorise the RMA into any specific category according to the table above but most appropriately, it would be in Category 2. The NHMS is beyond category 1 since it meets the basic function and services of category 1 but not yet fully into category 3. There is clearly a deficit towards reaching category 4. This can be seen in the SCOT analysis of the services and products provided below. Nonetheless, there are multi-engagements under formal arrangements like MOUs or contracts with numerous agencies at national level and also directly with government institutions like MINAGRI, RAB, MDR, and sectors like Police, Red cross, aviation, tourism, agriculture, environment etc. These other engagements allow it to access services and products from all the other categories for example CIAT, WMO, IPCC, UNFCCC and ICPAC at regional level. It should also be noted that there is limited engagements with the private sector.

ii) SCOT (products) Analysis of climate service in Rwanda of the general use of climate services' products and gaps in products at the Ethiopia NHMS.

Strength

a) The Rwanda Meteorological Agency (RMA) stores terrestrial historical datasets and gridded/ interpolated data; which is available for both internal use and for external use.
b) RMA does basic statistics on climate extremes and perform homogeneity tests and adjustments of time series for data and this is done for mainly internal use.
c) The Rwanda NMHS performs and provides Information on sector-specific products that may be used for flood analysis, hydrological analysis, infrastructure and research with the users engaged through MoUs.
d) The RMA uses and derives products from satellite data for monitoring activities; perform basic assessments and diagnostics analysis of spatial and temporal processes for internal purposes.
e) The NMHS does intra-seasonal variability analysis, observes climate patterns, anomalies and climatic zoning which may include the analysis of spatial patterns and application in advanced climate statistics tailored to the needs of specific users.
f) Climate change projections by the RMA provide product characteristics that describe the seasonal variability and scenarios which is then used by modellers, water resources and planning. The user-interaction is by MoUs and free access.
g) The NMHS does provide global and regional scale data as inputs into modelling, research and applications external use. It also does make analysis and provision of products relevant to El Nino and La Nina updates and other climate extremes and variations driving phenomena but internal purposes only.

Challenge

a) It should be noted that RMA is limited in the provision of high density, small scale specialized data resources used for studies of small scale processes and urban environment.
b) RMA has noticeable challenges of inconsistency of data, lack of satellite data and model data, gaps in modelling capability and interpretation, data gaps and tool (Software, equipments), limited early warning systems and malfunction of monitoring equipment.

c) The Rwanda NMHS does not offer sophisticated climatology statistics for example indices for specific users complex work like building design codes etc.
d) RMA does not receive monthly to seasonal and even longer climate predictions from Global Production Centres.

Opportunity

a) RMA uses and derives products from satellite data for monitoring activities and performs basic assessments and diagnostics analysis of spatial and temporal factors but internal use only.
b) RMA received monthly to seasonal and even longer climate predictions from RCCs, Regional Climate Outlook Forum (RCOFs) for internal purposes.
c) The Rwanda NMHS provides sector-specific products to target users who receive information on flood analysis, hydrological analysis, infrastructure, research and agriculture. The services daily production of information and this is shared through MoUs.
d) RMA develops and provides long-term prediction products at decadal, monthly and seasonal scales with information on degree of uncertainties and disseminated as specific advisories products for community use and done for internal purposes only.
e) The Rwanda NMHS does perform reanalysis and adding value from national perspective to products received form RCOFs, RCCs and GPCs which also means the review and assessment of past climate patterns on the state of climate in Rwanda.
f) RMA developments and interprets climate change scenarios and also performs dynamical and/or statistical downscaling of GCM and RCMs for general public and other specific users and this is internal purposes only.

Threats

a) The NMHS of Rwanda does not do analysis on climate extremes nor does it provide assessments of current climate conditions in certain favourable units for the users.
b) The NMHS does not share and exchange information, products, services to other countries in the region especially during the periods of significant climate anomalies.

5.1.6 Actor's landscape and GFCS categorisation of South Sudan NMHS

The current state of national climate services showing a network of climate service providers, elaborated functions and interrelationships put into the Capacity Works actors' landscape. It is not possible to categorise the SSMD into any specific category according to the GFCS categorisation provided by the table above because they did not complete the questionnaire hence not enough information was available to appropriately categorize it but nonetheless information from the products matrix suggests that there are multi-engagements under formal arrangements like MOUs or contracts with numerous agencies at national level and also directly with government institutions like water resources and hydrology while also with radio stations at national level. These other engagements allow it to access services and products from all the other categories for example WMO and ICPAC. It should also be noted that there is limited engagements with the private sector.

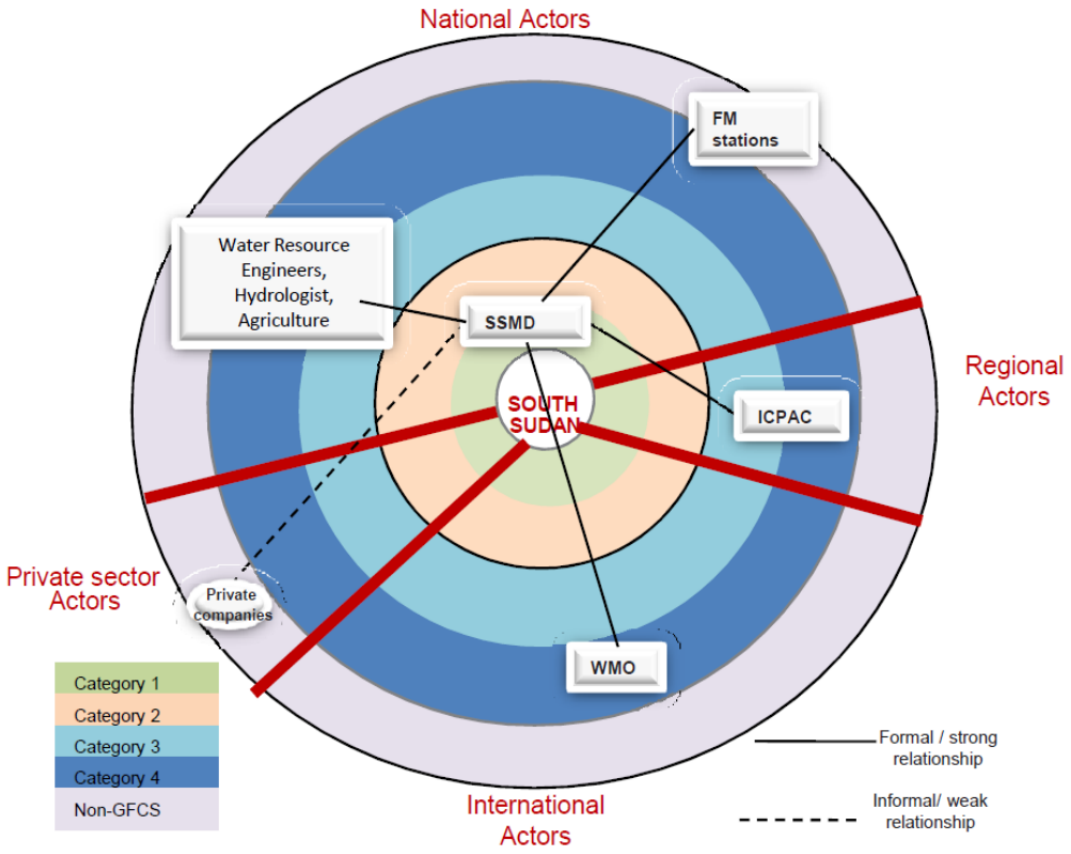

Figure 8: Climate Services Actors' landscape of South Sudan

Table 23: South Sudan NMHS key stakeholders' abbreviations in the actors' landscape

SSMD	South Sudan Meteorological Department
ICPAC	IGAD Climate Prediction and Application Center
WMO	World Meteorology Organisation

i) SCOT Analysis of climate service (products) in South Sudan. The South Sudan NMHS did not complete the questionnaire but attempted parts of the product matrix and it is from this submission that an attempt has been made to provide the SCOT analysis but not adequate enough to provide a list of gaps in the NMHS products nor a conclusive general use of climate services' products (SCOT Analysis).

Strength

a) The South Sudan Meteorological Department (SSMD) provides climate data sets which used by water resource engineers and hydrologists for the development of sector-specific products.
b) The SSMD does co-production of some of its products and services with collaboration with ICPAC.

Challenges

a) The noticeable gap is that of few and poor networks distribution.

Opportunity

a) The SSMD has regular interacts with its users and this is mainly through MOUs, regular meetings and interpretation. Also in use are printed hard copies and FM radios to relay information to users.

Threats

a) The SSMD has hinted that low personnel numbers and poor institution capacity is limiting the production of services for South Sudan.

5.1.7 Actor's landscape and SCOT analysis of the Sudan NMHS

The current state of national climate services showing a network of climate service providers, elaborated functions and interrelationships. This was done according to the GFCS categorisation and Capacity Works actors' landscape.

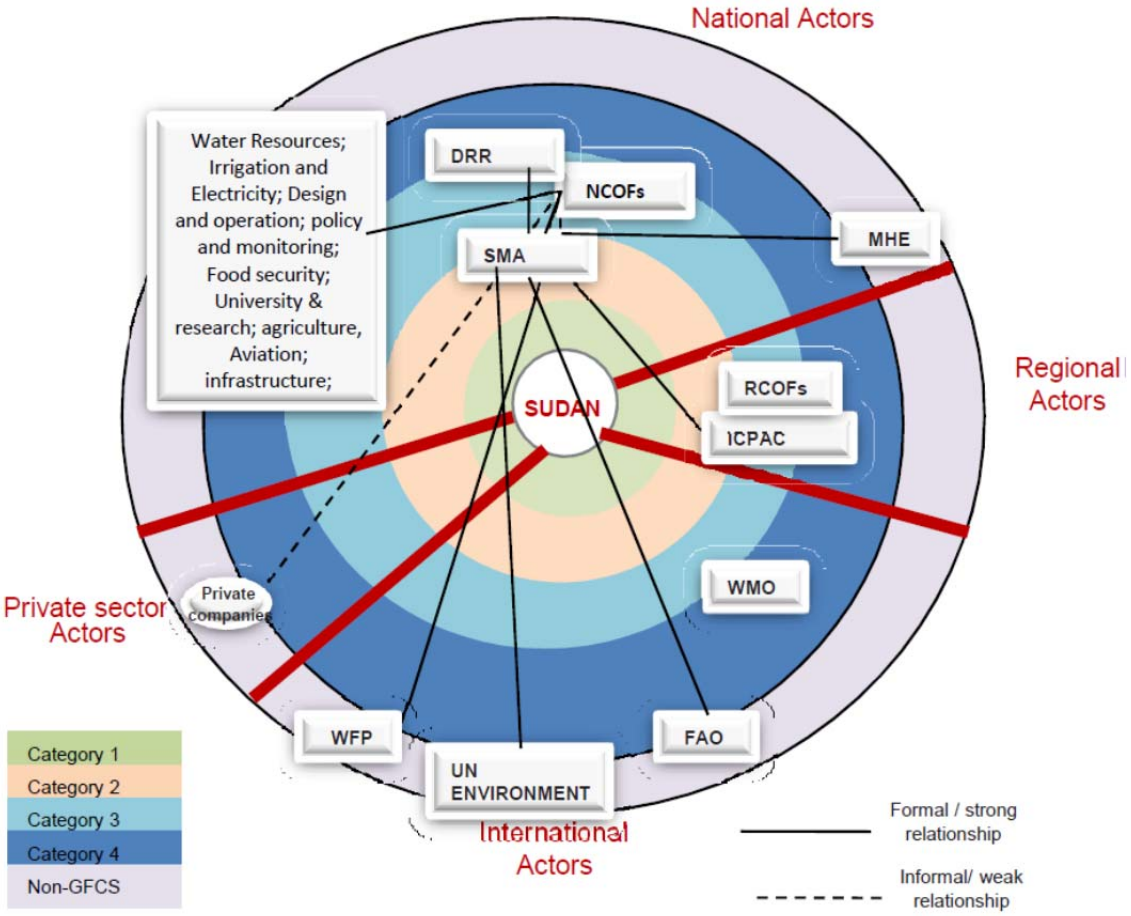

Figure 9: Climate Services Actors' landscape of the Sudan

Table 24 The Sudan NMHS key stakeholders' abbreviations in the actors' landscape

DRR	Disaster Risk Reduction
ICPAC	IGAD Climate Prediction and Application Center
FAO	Food Agricultural Organisation

MHE	Ministry of Higher Education
NCOF	National Climate Outlook Forum
SMA	Sudan Meteorological Authority
WFP	World Food Program,
WMO	World Meteorology Organisation

i) Analysis: Similar to the other NHMS, it is extremely difficult to exclusively categorise the SMA into any specific category according to the table above but most appropriately, it would be in Category 2. The NHMS is beyond category 1 since it meets the basic function and services of category 1 but not yet fully into category 3. There is clearly a deficit towards reaching category 4. This can be seen in the SCOT analysis of the services and products provided below. Nonetheless, there are multi-engagements under formal arrangements like MOUs or contracts with numerous agencies at national level and also directly with government institutions like MHE, DDR and sectors like water resources, irrigation, infrastructure, aviation, tourism, agriculture, environment etc. These other engagements allow it to access services and products from all the other categories for example WMO, UN-ENVIRONMENT, WFP and ICPAC at regional level. It should also be noted that there is limited engagements with the private sector.

ii) SCOT (products) Analysis of climate service in Sudan of the general use of climate services' products and gaps in products at the Sudan NHMS.

Strengthen

a) The Sudan Meteorological Authority (SMA) does have terrestrial, ocean and atmospheric measurements and observations which are stored and also historical datasets.
b) The SMA does perform homogeneity tests and adjustments of time series and has satellite data rescued data and metadata.
c) The SMA product provides information for sector-specific products which include forecasts, bulletins and warning; derived and compiled from studying trends and coefficient of variation with main users being ICPAC; Ministry of Agriculture, Policy & monitoring; 2-Water Resources, Irrigation and Electricity, Design and operation; 3-Disaster risk management bodies, policy and monitoring; 4- Food security sector (Governmental & NGOS).
d) The SMA does perform basic assessments and diagnostics analysis of spatial and temporal factors that involve observation of climate patterns.
e) SMA applies advanced climate statistics, uses and produces products derived from satellite data for monitoring activities or for analysis of spatial patterns anomalies including climatic zoning.
f) SMA develops and provides specialized climate analysis, prediction and monitoring of products tailored to the needs of specific users which may include sophisticated climatology statistics like indices used in building design codes.

Challenges

a) SMA has some noticeable challenges and these include weak observation network, poor capacity building, gaps in modelling skills and need for improvement in capabilities.

b) Analysis of climate-related hazards and impacts are very limited hence not much information is available on the product characteristics, users and their interaction and services types.

Opportunity

a) Sudan Meteorological Authority has specialized divisions or units that users in Irrigation and flood monitoring proving them with climate diagnostic products, time Series, statistical analysis &indices for better management of resources.
b) In Sudan, the NMHS does develop and provide prediction products and degree of uncertainties on products that are in the form of specific advisories for community use.
c) SMA performs reanalysis, dynamical and/or statistical downscaling of Global Climate Models (GCM) and/Regional Climate Models to improve on its internal products.
d) The SMA develops and interprets climate change scenarios for general public and other specific users showing them periods of significant climate anomalies and review of past climate patterns as provided by WMO reports which may be used for modelling, research and applications.
e) SMA makes analysis and provision of products that are relevant to El Nino and La Nina updates giving information on climate extremes and variations driving phenomena.

Threats

a) It is not clear if SMA does climate monitoring and long-term climate predictions to better understand monthly, seasonal and decadal climate variations and also sector-specific products, users, means of interaction etc.

5.1.8 Actor's landscape and SCOT analysis of Uganda NMHS

The current state of national climate services showing a network of climate service providers, elaborated functions and interrelationships. This was done according to the GFCS categorisation and Capacity Works actors' landscape.

i) Analysis: Similar to the other NHMS, it is extremely difficult to exclusively categorise UNMA into any specific category according to the table above but most appropriately, it would be in Category 2. The NHMS is beyond category 1 since it meets the basic function and services of category 1 but not yet fully into category 3. There is clearly a deficit towards reaching category 4. This can be seen in the SCOT analysis of the services and products provided below. Nonetheless, there are multi-engagements under formal arrangements like MOUs or contracts with numerous agencies at national level and also directly with government institutions like DWRM, Media Center, NARO, NARO, and sectors like water resources, aviation, tourism, energy, infrastructure, agriculture and environment etc. These other engagements allow it to access services and products from all the other categories for example UNDP, GIZ, FAO, WMO and ICPAC at regional level. It should also be noted that there is limited engagements with the private sector.

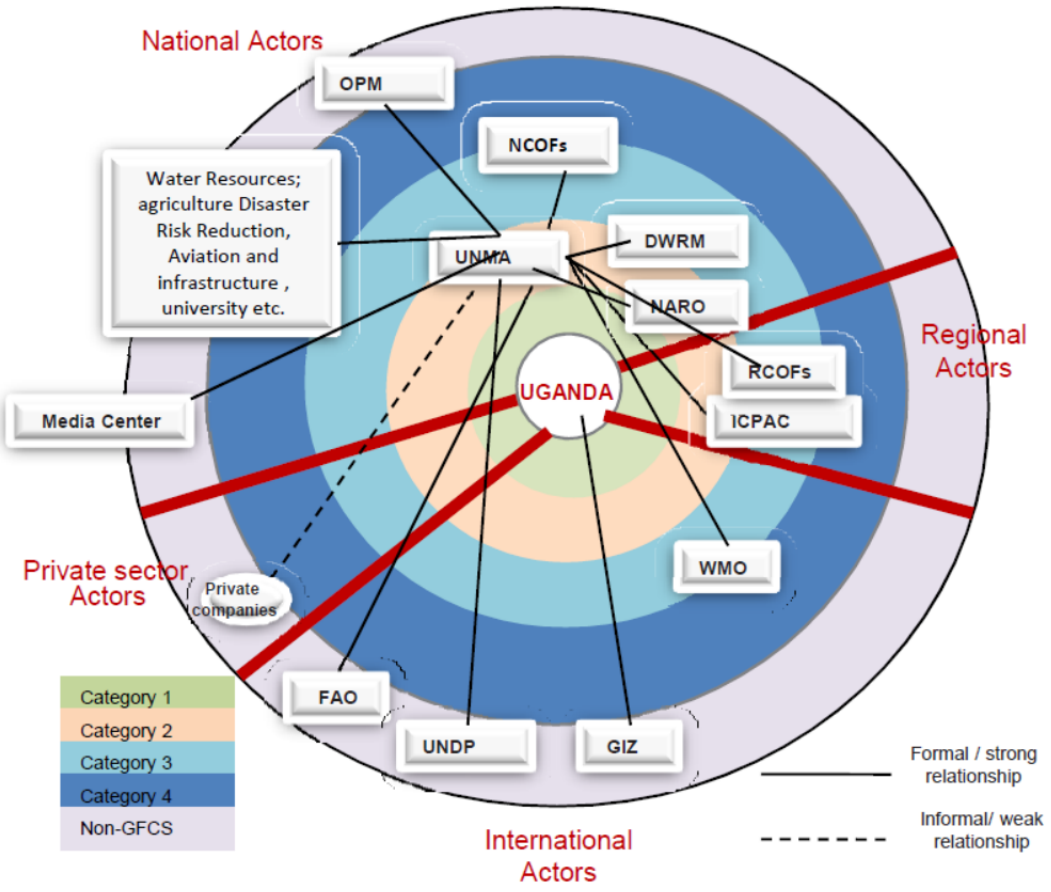

Figure 10: Climate Services Actors' landscape of Uganda

Table 25 Uganda-NMHS key stakeholders' abbreviations in the actors' landscape

DWRM	Directorate of Water Resources Management-Uganda
GHACOF	Greater Horn of African Climate Outlook Forums
GPCS	Global Production Centres
GIZ	German Development Cooperation
ICPAC	IGAD Climate Prediction and Application Center
NARO	National Agricultural Research Organisation-Uganda
OPM	Office of the Prime Minister
NCOF	National Climate Outlook Forum
UNDP	United National Development Program
UNFCC	United Nations Framework Convention on Climate Change
UNMA	Uganda National Meteorological Authority
FAO	Food Agriculture Organisations
WFP	World Food Program, African Development Bank (ADB),
WMO	World Meteorology Organisation

ii) SCOT (products) Analysis of climate service in Uganda of the general use of climate services' products and gaps in products at the Ethiopia NHMS.

Strength

a) The Uganda National Meteorological Authority (UNMA) stores and makes available both terrestrial and atmospheric historical datasets and also provides rescued metadata, model data and basic statistics, gridded/ interpolated data and satellite data.
b) UNMA also processes climate data sets together with Uganda National Meteorological Authority (UNMA) that is used to produce sector-specific are products which are used by related airport control systems, National water and Sewerage Corporation, Irrigation managers, road construction contractors, hydropower development & operating entities. The user-interaction is through MoU, written requests, stakeholder meetings, contractual obligations and sector review meetings.
c) UNMA does develop and provide prediction products into specific advisories for user communities as climate summaries, bulletins, reports, drought/flood maps and special statements for severe weather.
d) UNMA does provide the degree of uncertainties in its products which enables the users to understand the limitations of the product.
e) UNMA does develop and interpret climate change scenarios, performing dynamical and statistical downscaling of Global Climate Models (GCM) and Regional Climate Models for general public, modelling, research and other specific users especially during the periods of significant climate anomalies.

Challenges

a) UNMA does have some noticeable challenges and gaps in its service and this includes inadequate funding, obsolete equipments, limited skilled human resource and limited stations.
b) UNMA does not perform homogeneity tests and adjustments of time series when it comes to data.
c) UNMA does not apply advanced climate statistics to provide specialized climate analysis, prediction and monitoring products, tailored to the needs of specific users for example indices for building design codes.

Opportunity

a) UNMA does provide climate diagnostics derived products from satellite data for monitoring activities especially observing climate patterns, their anomalies and for climatic zoning.
b) UNMA does analysis on long-term predictions and climate extremes (El Nino and La Nina updates) into maps, graphs and images for the assessment of current climate conditions and intra-seasonal variability.
c) UNMA produced climate-related hazards and impacts on drought and flood events for the country.

Threats

a) UNMA is limited in fully utilising the available information on climate change projections where available product characteristics and sector-specific products on GCMs and RCMs are not used.

b) It should be noted that UNMA does not provide high density, small scale specialized data resources used for studies of small scale processes and urban environment.

5.1.9 Actor's landscape, Categorisation and SCOT analysis of Egypt and Tanzania NMHS

It was not possible categorizing NMHSs according to CDSIP (2012) because the above countries didn't complete the questionnaire during the study. Neither was it possible to provide the actors' landscape and SCOT analysis.

5.2 Identification of specific climate services gaps on the product level.

The table below shall show climate service gaps in product which is either unavailable, limited or not in use for the NMHS and integration results from user-interviews.

Table 26: climate service gaps in product at the NMHS

Country/ NMHS	Type of data, product or service	Unavailable Product type or parameters measured etc.
Burundi	Intra-seasonal variability products.	El Niño–Southern Oscillation (ENSO) and Sea Surface Temperature (SST)
	Climate predictions from RCC, RCOF and GPC	Monthly, seasonal, annual and decades forecasts and predictions
	Prediction products	Monthly forecasts
	Highly sophisticated climatologically statistics and complex characteristics,	Climate indices for specific users like for building design codes etc.
	Stored historical datasets	ocean data, gridded or interpolated data and model data
DR. Congo	Seasonal Climate Updates; climate extremes and variations driving phenomena	El Nino, La Nina updates, North Atlantic Oscillation (NAO) , pacific–North American Tele-connection pattern (PNA) and Indian Ocean Dipole (IOD)
	basic statistics on data sets	Atmospheric and ocean data; gridded/ interpolated data
	Monitoring and analysis diagnostics	satellite data- temperature, precipitation,
	Prediction products	seasonal outlooks
Ethiopia	Input from global and/or regional scale data for Modelling, research and applications or small scale processes and urban environment.	specialized data resources (unknown)
	highly sophisticated climatologically statistics for building design codes etc,	Temperature, precipitation, humidity, sunshine duration, frequency of occurrence and spatial mean.
	time series and basic statistics	Model data and ocean data
Kenya	climate-related hazards and impacts	sector-specific products, data etc.
	sophisticated climatology statistics	Indices for specific users, complex characteristics for building design codes, etc.

Rwanda	climate-related hazards and impacts,	Flash floods, drought, lightning, wind, and mudslide and hell storm. early warning systems
	sophisticated climatology statistics	indices for specific users such as building design codes ,
	Basic data sets	Satellite data, ocean data and model data.
Sudan/ SMA	climate change scenarios and interpretation	Products received form RCOFs, RCCs and GPCs. climate anomalies and also past climate patterns
	climate monitoring and long-term climate predictions	monthly/ seasonal/ decadal climate predictions
	climate-related hazards and impacts	Sector-specific products
Uganda/ UNMA	high density, small scale specialized data resources	Small scale processes and urban environment.
	climate-related hazards and impacts,	drought and flood events
	historical datasets and basic statistical data	Ocean data

5.3 Analysis and evaluation of climate services in the Nile Basin

This section shall offer a summary to the sectors of most interest to NMHS and also a climate services (SCOT) in the Nile Basin.

5.3.1 The sectors of most interest to NMHS in the Nile Basin.

From the table below, the majority of services offered by NMHS in the basin are still to the traditional sectors like environment, agriculture and water resources (green colour) with the service ranking tending towards 5 while the more commercial oriented sectors like construction, finance and insurance, tourism, recreation and sports, fisheries, commercial enterprises, etc. receive the least of climate services as can be seen with ranks closest to 1 and yet, these sectors form part of the big 6 sectors poised for commercial growth in African according to Leke, Jacobson and Lund (2016); actually only agriculture, which relates to the field of food and agri-processing is a priority to the NHMS.

Table 27 A ranking of the sectors most serviced by the NHMS within the basin

Climate service Sectors	Burundi	Ethiopia	Kenya	Rwanda	Sudan	Uganda	Average rank
Government	5	5	5	5	5	5	5.00
Local authorities	5	4	5	5	5	3	4.50
Scientific	5	5	3	4	4	5	4.33
Commercial enterprises	1	2	2	3	3	3	2.33
Water resources	5	5	5	4	5	5	4.83
Agriculture	5	5	5	5	5	5	5.00
Fisheries	5	2	2	1	1	4	2.50
Forestry	4	3	3	2	3	5	3.33
Transport	5	4	4	2	3	4	3.67
Energy industry	5	5	3	3	3	5	4.00
Human Health	4	4	4	3	5	4	4.00
Tourism	3	3	3	3	1	3	2.67
Recreation, sport	3	3	2	1	1	2	2.00
Aviation	5	5	5	5	5	5	5.00
Environmental protection	4	5	3	3	1	4	3.33
Building/ construction	4	2	3	3	3	4	3.17
Finance and insurance	1	4	4	3	4	3	3.17
Emergency planning and response	5	5	5	4	5	4	4.67

*Data from DR. Congo, Egypt, South Sudan and Tanzania was not available

*Ranking by the NHMS of each sector for climate services, where ''1'' is the least important, ''5'' is the most important

5.3.2 Product types and services being used or required within the Nile basin

The summarized result of user needs from the 5 Nile basin countries of Burundi, DR. Congo, Kenya, Rwanda and Sudan is provided below (and also in the table below); this may not necessarily represent the whole basin but provide an indication on the trends in the basin with such as:

- The users from the countries of Burundi, Kenya, Rwanda and Sudan find climate (change) information and also climate laws, regulation and policy very relevant when compared to other laws, regulation or policy for the user's organization although not significantly relevant in DR. Congo. The main drivers for the use of climate information that is relevant to the users is that of internal motivation such as the organizations' vision and policy and to a less extend because of external motivation such as public relations, regulatory obligation and business interests.
- Climate information for decision-making processes at various organizational levels is very relevant because of strategic and Infrastructure planning yet to a lesser extent, it is seen as only relevant for maintenance and day-to-day operation management of existing infrastructure, education and awareness of staff and decision makers and development of risk management plans. With most of the users saying that their ability to formulate their needs on climate information products is good.
- The top reason given that applies as to why there is limited use of climate information products in the users' organization is that the product is not available when required, access to climate information is restricted and the information content is not understandable. While those reasons as to why there is limited use of climate information at organizational level is that the products is not freely available. While the reasons stated for insufficient technical and personnel capacity to help process and interpret climate-related information which strongly applies is that there are limitations in technical equipment and skills and know-how and training while funding is also seen as relevant. It is only users from Rwanda who stated that they had sufficient capacity to process and interpret climate-related information.

Table 28: A summary of product types and services being used or desired/ required (but not) used or available within the Nile basin

This **product type** is being **used** directly for **decision-making**	This **product type** is **desired /required** but not (yet) being used/available
• Climate change impact data/model outputs (e.g. on ecosystems, water availability, etc.) • Climate data (e.g. raw or processed, gridded data, station data, etc. for specific parameters and regions). *For example: Historical Meteorological and hydrological data which is given for monthly and yearly data sets for specific observing stations and printed out in hard copies for stations of interest.* • Climate forecasts/outlooks for specific parameters/events at various time scales (e.g. week, month, year, etc.) • Climate statistic products (e.g. information about means and extremes for individual parameters for a specific region and period in form of maps, graphs, etc.). *For example: Historical Meteorological and hydrological data which could be trends of historical highs and lows as well as averages and submitted in tabular format as well as in form of graphs and maps.* • Hydrological data / statistics and events (e.g. discharge, floods, low-flows, etc.). *For example: Historical Hydrological data (stream flow levels converted to flows) where rating curves for specific streams in a catchment are presented in terms of graphs and if possible, formulas.* • Training, workshops, lectures and information material on climate issues, e.g. climate change	• Analysis and interpretation of climate statements or products for specific users/sectors (e.g. analysis of consequences of past/prevalent climatic conditions for specific sectors) • Climate change impact data/model outputs (e.g. on ecosystems, water availability, etc.) • Climate change projections (e.g. model output data/maps for specific parameters, events, etc.) • Climate change vulnerability/risk information (e.g. maps for specific sector/region) • Climate vulnerability/risk information in general or for specific sectors (e.g. data/info on exposures and sensitivities). • Data / statistics on hazardous climate events / extreme events (e.g. impact maps, magnitude-frequency analysis, etc.) *For example: Historical Hydrological Data in the form of PMP, PMF, return periods of rainfall, drought for a catchment in the form of Graphs, maps and curves in hard copy.* • Data/statistics on climate impacts on terrestrial systems (e.g. impacts on ecosystems (vegetation etc.), geo-morphological impacts (soil erosion, landslides, etc.)) • Information on regional climate conditions (e.g. review and analysis in form of bulletins, synthesis reports, statements, etc.) • Information/data on climate impacts/consequences for specific sectors (e.g. info on expected crop yields, losses, costs, damage, disruptions or fatalities for agriculture, transport, health, energy, etc.) • Others Estimation of sediment flow for current situation and also sediment flow occasioned by climate change. For example: Sediment transport in form of amount of sediment generated in a catchment and transported in the streams. The form of data required is blended data which is preferred and currently, this is presented as formulas based on land use. • Tailored climate data/statistics (e.g. indices) for specific purpose (e.g. 'sector of concern'). *For example: Historical Hydrological data in the form of depth-area –*

and its impacts (*e.g. qualitative info/education material to raise awareness ; general or sector-specific*)	*duration curves of precipitation for given return periods that are presented in terms of graphs* • Tools which support decision-making, strategy development and financial planning
This **service** is being **used** to enhance **decision-making**	This **service** is **desired/ required** but not (yet) being used/ available.
Advice or decision-support tools to integrate climate information in decision-making	• Explanation of content/meaning of climate information is required (e.g. how to read the graphs?) • Guidelines for selecting relevant climate information and assess its relevance • None. Available climate-related products and formats can be processed/utilized • Support for optional queries is desired • Technical training, tools or support for data processing and product application • Training, tools or support to assess the value/significance of the climate information for the own context (e.g. interpretation of information on probability and uncertainty.

5.3.3 A SCOT analysis of climate services in the Nile Basin

This is an analysis and summary of the general provision and use of climate service within the Nile basin giving the SCOT from both the providers and users.

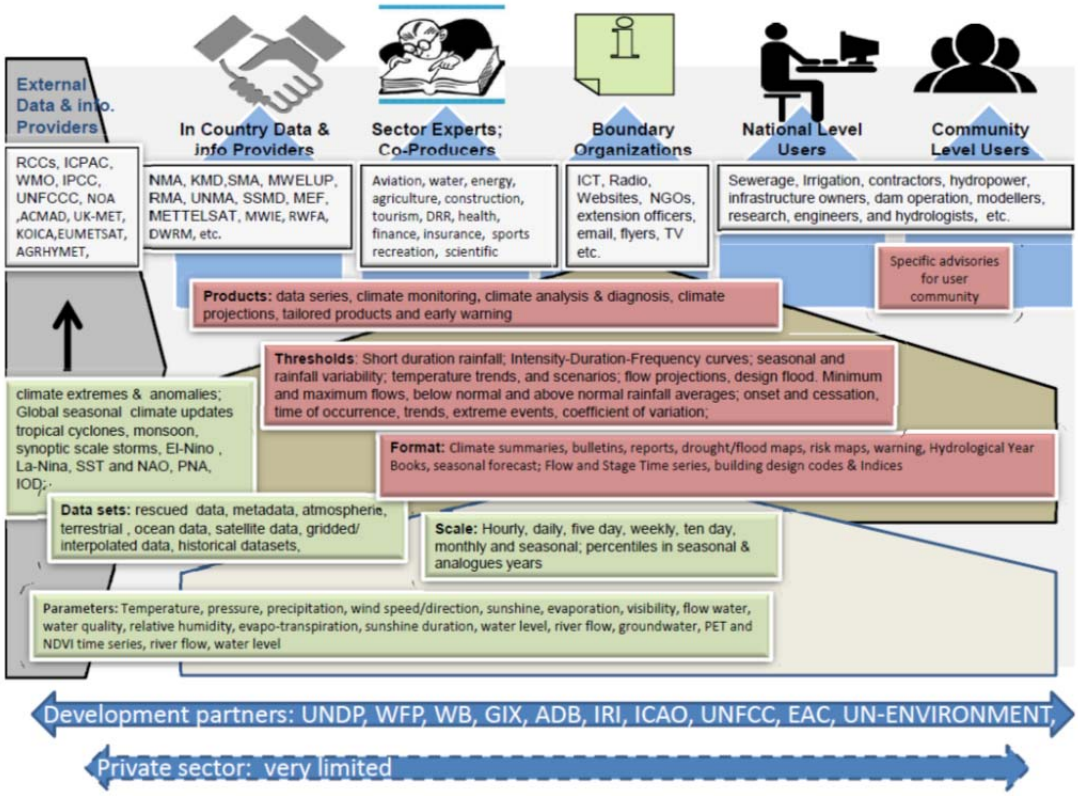

Figure 11 Summary of NMHS, climate services and products in the Nile Basin

<u>Strength</u>

a) The information derived is that all the Nile Basin countries adhere to climate monitoring principles and have access to observational data from neighbouring countries which may include atmospheric and terrestrial measurements and to limited extent, ocean measurements are only done in few countries for example in Kenya.
b) Some of these countries have long-term strategies of managing the network by taking note of station change, relocation, automation and protection (except Ethiopia and DR. Congo).
c) Most of the NHMS have good exchange of data with neighbouring, regional and international countries and organisations like World Meteorology Organisation (WMO), Regional Climate Centres (RCC) mainly for backup of data and IGAD Climate Prediction and Application Center (ICPAC) for regional modelling.
d) Internally, the NHMS have mechanisms to create, archive and document climate data sets into appropriate length and time units; and also having the data stored in databases although most of the NHMS indicated that the databases are inadequate but with improvements planned. The indicated databases undergo regular quality tests, homogeneity tests (except Uganda and Burundi) and data rescue if required.
e) The NMHS have strategies for ensuring security, integrity, retention and technological migration for data archival processes and systems. Most of the NMHS indicate the use of

various channels to market, seek visibility and disseminate their products and service; some of their information is still given as raw data but there is a trend towards producing reports, bulletins, maps, graphs, warnings alerts etc. The medium of use are mainly through emails, handouts, recorded media, webpage, correspondence letter, flash disk and workshops. The information is also mainstreamed into sector policies although they recognize that the way the messages are conveyed may lead to misunderstanding and interpretation. With some of the NHMS stating that they offer the degree of uncertainty in the products and information shared with the public.

f) The NHMS have policies on human resources development (except Burundi) and also do involve themselves in regional and international training programs to enhance capacities, most of which are organised around training courses, conferences, e-learning and fellowships. They also extend trainings to communities although these trainings may not be adequate to meet current requirements.

g) Most of the NHMS do perform basic assessments and analysis especially the diagnostics of spatial and temporal factors and processes (except DR. Congo) while others have the ability to derive products from satellite data for monitoring activities. The NHMS apply advanced climate statistics and are also involved in observing climate patterns for example tropical cyclones, monsoon, and synoptic scale storms but within the general observation of spatial patterns of temperature, precipitation, relative humidity, evapo-transpiration, sunshine duration etc and their anomalies for climatic zoning. All the NHMS develop and provide climate analysis, prediction and monitoring products tailored to the needs of specific users in general (except DR. Congo)

h) The NHMS develop and provide prediction products at decadal, monthly and seasonal scale with degrees of uncertainties but recognise the need to provide skills in the provision of uncertainties especially for forecasts and prediction Information. The NHMS also engage in the analysis of climate extremes into maps, graphs, and images which may include the assessment of current climate conditions in terms of averages, variance, thresholds, percentiles in weekly, 10-days, monthly, seasonal and annual time scale. User communities are issued specific advisories, climate summaries, bulletins, reports, and other special statements for severe weather on drought and flood. The NHMS participate in the review and assessment of past climate patterns as provided by WMO; although most of the NHMS does not perform dynamical and/or statistical downscaling of Global Climate Models (GCM), Regional Climate Models (RCM) or climate change scenarios into reports for their countries.

i) The user groups that participated were very diverse and of many sectors which include agriculture, energy, mines, water, etc. These are seen to help with design and construction of dams and roads, flood protection, irrigation etc,

<u>Challenges</u>

a) The major challenges limiting the provision of climate services and products as stated by the National Hydrology and Meteorology Services (NHMS) include mainly: inadequate station numbers and distribution/ coverage especially over water bodies; Inadequate staffing levels and limited capacity especially when it comes to maintenance and ability to manufacture spare parts; poor financial and technical resources especially towards replacing spares; weak means of communication and transmission of data from observation stations while the automated ones suffer from interruptions due to power failure or network failure of hosting telecom companies.

b) Some of the notable challenges noted with data for the production of climate services include: the database not connected with regional meteorological centres; no local climate outlook at sub-national levels; inadequate skill and manpower for modelling; limited computing and server capacities; un-digitalised data; transmission of data, archiving of data and timely updating of databases is limited; and limited financial resources for servers and equipment.
c) Their main challenges with research and development is lack skilled manpower; research funding is limited; limited knowledge in skilled research; equipment is not available and they cannot cope with fast changing technologies.
d) The lack of specific user programs limits user understanding of climate information although seasonal climate outlook forums are regularly held to interact, enhance awareness and provide tailored products to users. Monitoring and evaluation to tract the quality of service including levels of satisfaction is done by some of the NHMS while others do identify and measure impacts of their services like disaster lose, crop yields (except in Uganda) and level of interest of products with users. Not all NHMS do investment planning and socio-economic analysis or cost-benefit analysis of their services.
e) Nearly all NHMS mention that financial resources, building space, staffing levels and remuneration are the main challenges in human resources development and hence limit improvements towards products and services. The NHMS recognise the need improving Human Resources (HR) capacities through specialised trainings in climate services, tailoring of climate information to specific sectors, communication and also the need for additional staff for data management, product development, climate services interaction with users, research and development, etc as key to improve climate services.
f) When it comes to highly sophisticated climatologically statistics and complex characteristics, nearly all the NHMS are limiting in providing indices for specific users like for building design codes.
g) Common reasons suggested for limited use of climate services by users is that there is no access or information on the availability of products, product quality is normally an issue of concern, no legal obligation for the use and limited capacity on how to use the information and products from providers.
h) The NHMS also noted that there is shortage of private sector players in the value chain of climate services apart from those who deal in the manufacture of equipment or support the dissemination of products. Some of the reasons cited is that the policy, regulatory and structural environment in most of the countries restrict participation of other entities which are not NHMS from involvement in climate services especially at the providers' side. In those cases where the private sector is involved, there are no cooperation agreements that allow for further engagement and collaboration.

<u>Opportunity</u>

a) A wide range of data is available within the region and this includes: gridded/ interpolated data (except Burundi/ Sudan), satellite data, reanalysis data and model data (except DR. Congo). In addition to this, the countries do have access to socio-economic and impact databases (except Rwanda, Kenya) although limited in some cases (for example in Uganda, Sudan and Burundi).
b) Most of the NHMS within the Nile basin have mandates to carryout research activities, some with fully pledged units (except DR. Congo and Rwanda). They also do share research responsibility with mainly University and agricultural organizations in their respective

countries, part of the research results are then used in operational practice. In some cases, the research is through specific user groups (except in Burundi). These collaborations are mainly through Memorandum of Understanding (MoUs) except in Rwanda and DR. Congo. Additionally, they are also involved in the development of new methods, tools and models (except Sudan and DR. Congo).

c) Highly noted is the collaboration with other national, regional and international organizations such as: WMO, ICPAC, African Centre of Meteorological Application for Development (ACMAD), United National Development Program (UNDP), World Food Program (WFP), World Bank (WB), African Development Bank (ADB), German Development Cooperation (GIZ), United Kingdom Meteorology (UK-MET), Korea International Cooperation Agency (KOICA), International Research Institute (IRI), OXFAM, National Oceanic and Atmospheric Administration (NOA), European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), International Civil Aviation Organization (ICAO), Intergovernmental Panel on Climate Change (IPCC), United Nations Framework Convention on Climate Change (UNFCC), East African Community (EAC), UN-ENVIRONMENT, Centre Regional de Formation et d'Application en Agrométéorologie et Hydrologie Opérationnelle (AGRHYMET), CLIMATIQUE DE LA SADC. Etc.

d) The NHMS have dedicated persons to interact with the public (except Rwanda) and in some cases, the users come with their needs while in others, the Public Relations Officers (PROs) hold regular meetings, are involved in studies, and complete questionnaires and surveys. This is done to ascertain needs, meet requests, get feedback, and provide guidance and interpretation of data & information. It should be noted that most have regular planned meetings with ministries, sectors and some NHMS have sector specific help desks (Except Uganda, Rwanda, Sudan and Kenya); meanwhile they all have an established mechanism of interacting with media especially during emergency situations.

e) The users recognise that no proper assessment of climate change vulnerabilities and impacts have been done on different sectors in their countries but have general consensus on some potential impacts that range from: increase in severe weather, dwindling ground water, increased droughts and floods, damage to infrastructure.

f) Users also sometimes delegate functions to cooperatives, engineers and consultants. The fair chance for CS to enter is at planning stage

<u>Threats</u>

- Although most of these NHMS share data with WMO, they have policies that restrict free and open data sharing (except Rwanda, Burundi and Uganda).
- The NHMS are operating within legal, policy and strategic oriented environments; with most of them being part of the National Adaptation Plan, National Disaster Risk Management Strategy and National and Sector policies and strategies in their countries. It has been stated that their funding varies from national budgets to donor funding and in some incidences, internally generated funds.
- In most cases, the institutional arrangements are such that the NHMS are separated between meteorological services and hydrological services which they recognize require the need for strengthening the cooperation and partnership amongst themselves. With exception of a few, most of the HHMS are still fully embedded in their government structures and not semi-autonomous like in Uganda's case. These NHMS also recognize the existence of other services providers doing work similar to their function but are not fully pledged climate services institutions and with fewer and unregulated services.

- The NHMS also acknowledged that gaps do exist especially with recognition and visibility of services including social-economic benefits of climate services within their governments although improvement of internal processes, structure and policies would improve the current state of climate services within their NHMS.
- There is an interaction between user and providers but this is on request and not so much supported by any formal agreements like MOUs or contracts.
- The demand is normally triggered by the users who mostly see climate services as simply a decision support tool and if one is not obliged, then such a product or service will not be used. Secondly, budget allocation also determines the use of climate services.

6. CONCLUSIONS & RECOMMENDATIONS

The conclusions and therefore recommendation shall be done in a structured manner of using the successful factors as provided for by Cooperation Management for Practitioners (GIZ's Capacity Works, 2015). This considers strategy, cooperation, steering structure, processes and lessons learnt and innovation as the key ingredients for the success of interventions in the development context.

Strategy

- Although climate services and/ or NMHS are duly recognised within national policy and strategy documents of the NBI countries, there is still limited interest and visibility of their services within their governments, social and also the public. This then creates limited value of their services hence a small budgetary allocation within the national budgets. It is recommended that these NMHS provide a strong basis for their continued service through proper social-economic and cost-benefit analysis of their service and the impact of their services on the economy hence providing a stronger case for better budget allocation and attract interest from private sector actors.
- The NMHS services does provide services and attend to numerous stakeholders, especially the more traditional ones like environment, forestry, disaster risk management and water resources; most of the NMHS do very little engagement and service to sectors with strong private sector and commercial enterprises for example: tourism, construction, finance and insurance, transport (apart from aviation), sports and recreation etc. It is recommended that products and services towards these listed sectors be increased in order to improve on internally generated revenue; afterall, nearly all NMHS did mention high dependency on their national budgets and donor funding to carry out their role.
- The users indicated that there are no laws which oblige them to consider and use climate services in their work especially those engaged in infrastructure planning and development. They indicate that climate services are primarily considered within the context of the environmental and social protection or generally on the principle to do no harm and hence not integrated into their work. The recommendation for NMHS would to start the process of getting legislation that requires users to embed climate services in the planning and design of their activities while in the meantime, invoke the precautionary principle on the need to safeguard the environment, health and safety at the workplace and also within the projects.

Cooperation

- Currently, the countries of Burundi, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania and Uganda, who form 80% of the NBI membership do participate and find value in the Greater Horn of African Climate Outlook Forums (GHACOF) which is a regional climate outlook forum (RECOF) organised by ICPAC. The value of participation is having the ability to contribute, receive capacity development and also seasonal climate outlook products. These regional products are then downscaled by these countries' NMHS to help improve their national products. The recommendation would be for the NBI to join and regularly participate at GHACOF so as to assist in improving the regional products but also receive these products on behalf of the other two countries of Egypt and DR. Congo who are not members of GHACOF. This also in recognition that most of these NMHS (especially meteorological agencies) did not mention any direct collaboration with NBI. A desk office or a current position should be revised to incorporate this support.

- Most of the NMHS recognise the emergence of private sector players within the hydrological meteorological space, these are not only beginning to own equipment but also produce and issue UNREGULATED hydro-meteorological information and products. It is recommended that in countries were the law does not exist begin the process to formulate laws that protect the activities of NMHS, while where the law exists, more awareness should created to inform these "new" entities about NMHS mandate and lastly, cooperation agreements like private-public relationships should be designed to accommodate these private sector entities.

Steering structure

- Nearly all the NMHS within the region do have a separate hydrological services and meteorological service not within the same institution. This has led to the appreciation from NMHS that better cooperation is need amongst them. It is herein recommended that better institutional cooperation (beyond MOUs) be designed between them for example cooperation agreements which take into consideration of exchange or embedment of staff across these institutions, sharing of equipment and training, etc. to improve on these relationship and similar functions.

Processes

- The NMHS all have limited staff or a trend towards a leaner number of employees and yet, the traditional practice of volunteer observers is fading away. It would be suggested that the NMHS embrace and bring back this practice in win-win situations like installations at schools, hospitals and public building where they could easily get more volunteers in exchange for better learning aids for example in schools.
- Most of the NMHS recognise misunderstanding and misinformation in the products and services they offer despite the fact that most of them do provide the degree of uncertainty in their information. This is further compounded by the fact that most of the NMHS do not have professionally trained communicators to support the issuance of their information. It is therefore recommended that dedicated media offices be established at the NMHS institution to better improve the public relations, better uptake of their products and also training of user communities on the available products. The NMHS should also go beyond traditional media and traditional learning tools and embrace the emergence of new media for example social media and use services like android apps, facebook, Instagram etc. alongside new training environments like webinars and e-learning if they are to reach a wider audience and the younger generation.

Lessons Learnt and Innovation

- It has been seen that most of the engagements of the providers, that is the NMHS with users is mostly informal and in some cases through non-binding agreements like MOUs which they recognise can be easily broken and also because most of the NMHS are still fully embedded in their government structures, it is suggested that these NMHS adopt better, more binding agreements and innovative instruments like private-public partnerships (PPP) and contracts to enable their commitments to users and vice-versa to be more respected.
- It should be noted that there is limited capacity at the NMHS along the entire value-chain of the service from installation and maintenance of equipment, collection and storage of data, processing data and product development, dissemination and use, and finally feedback and innovation. It is recommended that through the NBI, systems and processes can be arranged for the exchange of strengths and cooperative advantages or joint trainings amongst these

NMHS and this could start with NBI establishing a desk office at the secretariat in Entebbe or using projects like Climate Services for Infrastructure and the Hydro-Meteorology projects that brings together country institutions and allow for exchange of experience and transfer of knowledge and skills.

In summary,

1. The NMHS within the Nile basin cannot be exclusively grouped into any of the 4 categories of WMO's Global Framework for Climate Services (GFCS) scheme but it should be noted that most of the NMHS do meet the requirements of Category 1 (basic functions) and category 2 (essential services); meaning that they can perform the essential functions of: medium-range (synoptic scale) forecasts and warnings establish links with media and DRR communities; provide seasonal climate outlooks and climate monitoring; also provide hydrological data products for design and operation of water supply structures; water level and flow monitoring, short-term flow forecasts (low flows) and flood forecasting. But with engagements and collaborations with regional and international organisations, allow them to access services and products from categories 3 (full range) and 4 (advanced), for example WMO and regional climate outlook forums like GHACOF and thus being able to provide a much improved service.

2. Although most of the NMHS are fairly good at providing the more traditional services like data and to a limited extent daily forecasts to seasonal predictions, it is important that they improve on their value-addition and intermediary function or invite private sector participation in this domain in order to enhanced the whole value-chain of climate services. This is also true for most users since they also identify themselves more as end-users and would simply need the finished products sent to them while they stick to their core business rather than having to try to improve what is given to them by the NMHS. Secondly, that in the absence of laws, users and providers need to form user groups and jointly express they needs and demands so that resources and expertise are collectively mobilised to support the more adoption of climate services into highly sensitive sectors.

7. OUTLOOK

The outlook will offer an insight into the next probable steps from this report and this would include two aspects of: 1) a policy brief coming out of this report and 2) this report providing basic information to support the activity on climate risk assessment for infrastructure in the Nile basin.

7.1 Policy brief on climate services in the Nile basin.

i) Would opening up climate services in the Nile basin to commercialization and privatisation improve the provision and use of products and services? The basis for this argument is derived from the challenges highlighted in this report that the current institutional set up of National Meteorology& Hydrology Services (NMHS) within the Nile basin cannot ably meet current and future user needs. First, most of the NHMS within the region are still government entities with their funding coming primarily from the national budget and to a limited extent donors and also from internally generated revenue. Second, most of the current services are provided to traditional sectors and limited to fast growing commercial sectors like tourism, construction & infrastructure, sports & recreation, finance and insurance etc. Third, there is limited involvement of private companies in the climate services industry. The policy brief will invoke the need for action due to the recognition that:

- The demand for climate services will continue to rise due to current and future climate (change) trends and impacts.
- Prompt action is needed to improve the current level and overall, the policy, regulatory and institutional environment of climate services within the Nile Basin region.
- In the short term, improvements to the current workings of NHMS; but for the medium to long term, a complete reform of NHMS from government owned to semi-autonomous or commercial entities. Secondly, open up to partnership with the private sector especially in the value addition space for customized products for specific end-users of climate services.

ii) Or can the Nile Basin Initiative can play a catalysts role in enhancing the use of climate service in the basin. This second option to the policy brief offers the opportunity for the NBI to play a leading role in participating at the GHACOF and support the value-addition process, at least in those sectors with specific interest to its work like for water infrastructure development. Secondly, mobilize resources to improve on the station network and coverage within the region especially water bodies and trans-boundary basins and thirdly, initiate and drive a process towards free and open data sharing within the region. All the above are seen as contributing to the growth of NMHS and climate services industry within the region.

7.2 Climate risk assessment for the infrastructure in the Nile basin

There was first Nile basin initiative forum on climate services for infrastructure which was held in Entebbe from 5-8th February 2018. At the forum, it was agreed that a climate risk assessment of selected infrastructure within the basin should be done and part of commissioning this assignment is that results from this report should provide part of the information to be used to support this assessment. This would include a climate risk assessments to start May 2018 with 5 work packages planned. These work packages shall involve 3 PIEVC trainings over 2 years on the two optional case studies of Tekeste Highest arch dam in the Sudan and the RUSUMO dam

project that covers Burundi, Rwanda and Tanzania. The assessment shall be facilitated by the EngineersCanada who would apply the PIEVC methodology; but this would be adapted and contextualized within the confines of regional needs. All countries shall participant in the trainings and experience from other regions will be brought into the project. There shall also visits to different sites at a time for example for 1 week training with 20-30 participants or carry out parallel/ concurrent sessions and compare lessons learnt to take to the next training stage and a Trainer of Trainers approach shall be adopted for easy transfer to skills and knowledge to wider groupings.

8. REFERENCES

BELSPO (2014): Survey Climate Services Users (http://www.belspo.be/survey/climate/).

Bessembinder, J. et al. (2012): Guidance to support the identification and assessment of users' requirements. (http://www.climate-services.org/wp-content/uploads/2015/05/jpi2012_assessment_of_users_requirements.pdf).

Climate Change Information Fact Sheet EGYPT (2015), USAID FACT SHEET https://www.climatelinks.org/sites/default/files/asset/document/Egypt%20Climate%20Info%20Fact%20Sheet_FINAL.pdf

Climate Change Information Fact Sheet Ethiopia (2015), USAID FACT SHEET: https://www.climatelinks.org/sites/default/files/asset/document/Ethiopia%20Climate%20Info%20Fact%20Sheet_FINAL.pdf

Climate Change Adaptation in Kenya (2012), USAID FACT SHEET: https://www.climatelinks.org/sites/default/files/asset/document/kenya_adaptation_fact_sheet_jan2012.pdf
Climate Change Adaptation in Rwanda (2012), USAID FACT SHEET: https://www.climatelinks.org/sites/default/files/asset/document/rwanda_adaptation_fact_sheet_jan2012.pdf

Climate Change Risk Profile South Sudan (2016), USAID FACT Sheet; https://www.climatelinks.org/sites/default/files/asset/document/2016%20CRM%20Fact%20Sheet%20-%20South%20Sudan_0.pdf

Climate Change Risk Profile Sudan (2016), USAID Factsheet https://www.climatelinks.org/sites/default/files/asset/document/2016%20CRM%20Fact%20Sheet-%20Sudan.pdf

Cooperation Management for Practitioners, (GIZ Capacity Works, 2015), Springer-Gabler ISBN 978-3-658-07904-8

Conway, D., Hanson, C., Doherty, R., and Persechino, R.: GCM simulations of the Indian Ocean dipole influence on East African rainfall: present and future, Geophys. Res. Lett., 34, L03705, doi: 10.1029/2006GL027597, 2007.

CDSIP- (2012), Categorization of NMHSs, Annex4https://www.wmo.int/pages/prog/dra/documents/CDSIP-Annex5.doc

CSC (2013): Climate Change Scenarios for the Congo Basin. [Haensler A., Jacob D., Kabat P., Ludwig F. (eds.)]. Climate Service Centre Report No. 11, Hamburg, Germany, ISSN: 2192-4058.

Daly, M. et al. (2016): Establishing a baseline for monitoring and evaluating user satisfaction with climate services in Tanzania. CICERO Rapport 2016:02, Oslo, Norway. (https://brage.bibsys.no/xmlui/handle/11250/2382516).

European Union (2015): A European research and innovation Roadmap for Climate Services. Luxembourg. (https://publications.europa.eu/en/publication-detail/-/publication/73d73b26-4a3c-4c55-bd50-54fd22752a39/language-en).

Harris, I., Jones, P. D., Osborn, T. J., and Lister, D. H.: Updated high-resolution grids of monthly climatic observations – the CRU TS3.10 Dataset, Int. J. Climatol., 34, 623–642,doi:10.1002/joc.3711, 2014.

IRI (2012): Climate Services for Climate-Smart Development – a preliminary guide for investment. Technical Report for USAID, Washington, US. (https://www.climatelinks.org/sites/default/files/asset/document/Climate.Services.for_.Climate.Smart_.Development.Guide_.for_.Investment-final.pdf).

Liersch,Rivas et al (2014) : Climate Change Projectionsfor Burundi; 2014, Bureau de la GIZ à Bujumbura/ Eschborn GIZ; "Adaptationau changement climatique pour la protection des ressources en eau et sol au Burundi"(ACCES).

Leke, A., Jacobson, P., and Lund, S.: The 6 Sectors of Africa's Economy Are Poised for Growth, Harvard Business Review (HBR) Webinar 2016, https://hbr.org/2016/09/these-6-sectors-of-africas-economy-are-poised-for-growth.

M. B. Butts et al.: A regional approach to climate adaptation in the Nile Basin; Proc. IAHS, 374, 3–7, 2016. proc-iahs.net/374/3/2016/doi:10.5194/piahs-374-3-2016; © Author(s) 2016. CC Attribution 3.0 License.

NBI Report (2016): Thematic Report-Phase 1, NBI Strategic Water Resources Analysis 2016. – Unpublished.

PCC 2007, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007 M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds); Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Tanzania Climate Vulnerability Profile (2013), USAID Factsheet; https://www.climatelinks.org/sites/default/files/asset/document/tanzania_climate_vulnerability_profile_jan2013.pdf

Uganda Climate Vulnerability Profile (2013), USAID Factsheet;https://www.climatelinks.org/sites/default/files/asset/document/uganda_climate_vulnerability_profile_jan2013.pdf

WMO (2014a): Implementation Plan of the Global Framework for Climate Services. Geneva, Switzerland. (http://gfcs.wmo.int/implementation-plan).

WMO (2014b): Annex to the Implementation Plan of the Global Framework for Climate Services – Capacity Development. Geneva, Switzerland. (http://gfcs.wmo.int/CD).

WMO (2014c): Annex to the Implementation Plan of the Global Framework for Climate Services – Climate Services Information System Component. Geneva, Switzerland. (http://gfcs.wmo.int/CSIS).

WMO (2014d): Annex to the Implementation Plan of the Global Framework for Climate Services – User Interface Platform Component. Geneva, Switzerland. (http://gfcs.wmo.int/UIP).

WMO website publication, Value Chain linking Knowledge to action,: http://www.wmo.int/gfcs/sites/default/files/value%20chain%20image.jpg

WWC-3 (2009): Conference Statement – summary of the expert segment. Geneva, Switzerland. (http://gfcs.wmo.int/wwc_3).

9. ANNEX

9.1 Climate related information used for decision making and product development process

Table 29: The type of climate-related information the two Ministries in Burundi use for decision-making

Product code	Product type	This product type is being used directly for decision-making (incl. internal post-processing)	This product type is being used as input for follow-up products / services	This product type is desired/ required but not (yet) being used/available	This product type is provided by our organization
E.3.1	Climate data (*e.g. raw or processed, gridded data, station data, etc. for specific parameters and regions*)	☐	☐	☒	☐
E.3.2	Climate statistic products (*e.g. information about means and extremes for individual parameters for a specific region and period in form of maps, graphs, etc.*)	☐	☐	☒	☐
E.3.3	Tailored climate data/statistics (e.g. indices) for specific purpose (*e.g. 'sector of concern'*)	☐	☐	☒	☐
E.3.4	Data / statistics on hazardous climate events / extreme events (*e.g. impact maps, magnitude-frequency analysis, etc.*)	☐	☐	☒	☐
E.3.5	Information on regional climate conditions (*e.g. review and analysis in form of bulletins, synthesis reports, statements, etc.*)	☐	☐	☒	☐
E.3.6	Analysis and interpretation of climate statements or products for specific users/sectors (*e.g. analysis of consequences of past/prevalent climatic conditions for specific sectors*)	☐	☐	☒	☐
E.3.7	Hydrological data / statistics and events (*e.g. discharge, floods, low-flows, etc.*)	☐	☐	☒	☐
E.3.8	Data/statistics on climate impacts on terrestrial systems (e.g. *impacts on ecosystems (vegetation etc.), geo-morphological impacts (soil erosion, landslides, etc.))*	☒	☐	☐	☐
E.3.9	Information/data on climate impacts/consequences for specific	☒	☐	☐	☐

	sectors (*e.g. info on expected crop yields, losses, costs, damage, disruptions or fatalities for agriculture, transport, health, energy, etc.*)				
E.3.10	Climate vulnerability/risk information in general or for specific sectors (*e.g. data/info on exposures and sensitivities*)	☐	☐	☒	☐
E.3.11	Climate forecasts/outlooks for specific parameters/events at various time scales (*e.g. week, month, year, etc.*)	☐	☐	☒	☐
E.3.12	Climate change projections (*e.g. model output data/maps for specific parameters, events, etc.*)	☐	☐	☒	☐
E.3.13	Climate change impact data/model outputs (*e.g. on ecosystems, water availability, etc.*)	☐	☐	☒	☐
E.3.14	Climate change vulnerability/risk information (*e.g. maps for specific sector/region*)	☐	☐	☒	☐
E.3.15	Training, workshops, lectures and information material on climate issues, e.g. climate change and its impacts (*e.g. qualitative info/education material to raise awareness ; general or sector-specific*)	☐	☐	☒	☐
E.3.16	Tools which support decision-making, strategy development and financial planning	☐	☐	☒	☐

Table 30: The additional services the two Burundi Ministries uses to make climate information usable for decision-making processes

		This service is being used to enhance decision-making	This service is desired/ required but not (yet) being used/ available.	This service is provided by our organization
E.1.1.	Guidelines for selecting relevant climate information and assess its relevance	☐	☒	☐
E.1.2.	Explanation of content/meaning of climate information is required (*e.g. how to read the graphs?*)	☐	☒	☐
E.1.3.	Technical training, tools or support for data processing and product application	☐	☒	☐
E.1.4.	Training, tools or support to assess the value/significance of the climate information for the own context (*e.g. interpretation of information on probability and uncertainty*)	☐	☒	☐
E.1.5.	Advice or decision-support tools to integrate climate information in decision-making	☐	☒	☐
E.1.6.	Support for optional queries is desired	☐	☒	☐
E.1.7.	None. Available climate-related products and formats can be processed/ utilized	☐	☐	☐

Table 31: Information on the product development, performance and provider-user interaction in Burundi

	Questions	Product (#; e.g. Ax1.1)
Ax2.1	Who is your climate service provider for the product? And what is the relationship with this provider? (e.g. regular meetings, MoU, contracts, etc.)?	*Please select from list (1):* Public authorities *Please state the name: OBPE Please explain the relationship*: Regular meetings&weather forecast and broadcastings
Ax2.2	How did you know about the product and its potential value?	*Please explain: From report on land degradation and crop losses caused by weather externalities*
Ax2.3	Through which channel do you receive this product?	*Please select from list (2): Radio TV broadcastings*
Ax2.4	Is the product specifically designed for your sector/purpose?	YES ☐ NO ☒ DON'T KNOW ☐

Ax2.5a	How would you rate the general quality and usability of the products and services you currently use? (e.g. skill, presentation, format, medium, timing, frequency of delivery, access, etc.) *Please rank 1-5*	*Please rank 1-5* *[1=no usability; 5=very good usability]* *4*
Ax2.5b	If less than 5: what are the major shortcomings of this product?	*Please select from list (3):* The product is not available when required *Please explain: There is need to get the product as tool for predictability to take decision on the right time*
Ax2.6a	Have your needs been reflected in the product development process?	*Please rank 1-5 [1=not at all; 5=yes totally]* *1*
Ax2.6b	If yes, how have they been reflected?	*Please explain:*
Ax2.7	Is there any guidance/support/training/advice provided to you to enhance application/usability of the product?	YES ☐ NO ☒ DON'T KNOW ☐
Ax2.8	Did you have the opportunity to give feedback on the usability/satisfaction of this product?	YES ☐ NO ☒ DON'T KNOW ☐
Ax2.9	For which purpose/ decision/ follow-up product do you use this product?	*Please select from list (4):* Strategic planning & Infrastructure planning and implementation *Please give details: We plan and implement referring to the available Information /date on climate impacts*
Ax2.10	In which of the following decision making tools you have used climate information:	Multi-criteria analysis ☐; Cost-benefit analysis ☒; Others ☐ specify: None ☐; I don't know ☐

Table 32: The type of climate-related information the users in DR. Congo use for decision-making

Product code	Product type	This product type is being useddirectly fordecision-making(incl.internal post-processing)	This product type is being used as input for follow-up products / services	This product type is desired/required but not (yet) being used/available	This product type is provided by our organization
E.3.1	Climate data (*e.g. raw or processed, gridded data, station data, etc. for specific parameters and regions*)	☐	☒	☐	☐
E.3.2	Climate statistic products (*e.g. information about means and extremes for individual parameters for a specific region and period in form of maps, graphs, etc.*)	☒	☐	☐	☐
E.3.3	Tailored climate data/statistics (e.g. indices) for specific purpose (*e.g. 'sector of concern'*)	☐	☐	☐	☒
E.3.4	Data / statistics on hazardous climate events / extreme events (*e.g. impact maps, magnitude-frequency analysis, etc.*)	☐	☐	☒	☐
E.3.5	Information on regional climate conditions (*e.g. review and analysis in form of bulletins, synthesis reports, statements, etc.*)	☐	☒	☐	☐
E.3.6	Analysis and interpretation of climate statements or products for specific users/sectors (*e.g. analysis of consequences of past/prevalent climatic conditions for specific sectors*)	☐	☒	☐	☐
E.3.7	Hydrological data / statistics and events (*e.g. discharge, floods, low-flows, etc.*)	☒	☐	☐	☐
E.3.8	Data/statistics on climate impacts on terrestrial systems (*e.g. impacts on ecosystems (vegetation etc.), geomorphological impacts (soil erosion, landslides, etc.))*	☐	☒	☐	☐
E.3.9	Information/data on climate impacts/consequences for specific sectors (*e.g. info on expected crop yields, losses, costs, damage, disruptions or fatalities for agriculture, transport, health, energy, etc.*)	☐	☐	☒	☐
E.3.10	Climate vulnerability/risk information in general or for specific	☐	☐	☒	☐

	sectors (*e.g. data/info on exposures and sensitivities*)				
E.3.11	Climate forecasts/outlooks for specific parameters/events at various time scales (*e.g. week, month, year, etc.*)	☐	☐	☐	☒
E.3.12	Climate change projections (*e.g. model output data/maps for specific parameters, events, etc.*)	☐	☐	☐	☒
E.3.13	Climate change impact data/model outputs (*e.g. on ecosystems, water availability, etc.*)	☐	☐	☒	☐
E.3.14	Climate change vulnerability/risk information (*e.g. maps for specific sector/region*)	☐	☐	☒	☐
E.3.15	Training, workshops, lectures and information material on climate issues, e.g. climate change and its impacts (*e.g. qualitative info/education material to raise awareness ; general or sector-specific*)	☐	☐	☒	☐
E.3.16	Tools which support decision-making, strategy development and financial planning	☐	☐	☒	☐

Table 33: The additional services the Climate Service Users in DR. Congo use to make climate information usable for decision-making processes

		This service is being usedto enhancedecision-making	This service is desired/required but not (yet) being used/ available.	This service is provided by our organization
E.1.1	Guidelines forselecting relevant climate informationand assess its relevance	☐	☒	☐
E.1.2	Explanation of content/meaning of climate information is required (*e.g. how to read the graphs?*)	☐	☐	☒
E.1.3	Technical training, tools or support for data processing and product application	☐	☒	☐
E.1.4	Training, tools or supportto assess the value/significance of the climate information for the own context (*e.g. interpretation of information on probability and uncertainty*)	☐	☒	☐
E.1.5	Advice or decision-support tools to integrate climate information in decision-making	☒	☐	☐
E.1.6	Support for optional queries is desired	☐	☒	☐
E.1.7	None. Available climate-related products and formats can be processed/utilized	☐	☒	☐

Table 34: Information on the product development, performance, and provider-user interaction in DR. Congo

	Questions	Product (#; e.g. Ax1.1)
Ax2.1	Who is your climate service provider for the product? And what is the relationship with this provider? (E.g. regular meetings, MoU, contracts, etc.)?	*Please select from list (1):1a ; 1c; 1e;* *Please state the name: MoU* *Please explain the relationship*:
Ax2.2	How did you know about the product and its potential value?	*Please explain:*
Ax2.3	Through which channel do you receive this product?	*Please select from list (2):2a*
Ax2.4	Is the product specifically designed for your sector/purpose?	YES ☐ NO ☒ DON'T KNOW ☐
Ax2.5a	How would you rate the general quality and usability of the products and services you	*Please rank 1-5* *[1=no usability; 5=very good usability]*

	currently use? (e.g. skill, presentation, format, medium, timing, frequency of delivery, access, etc.) *Please rank 1-5*	*4*
Ax2.5b	If less than 5: what are the major shortcomings of this product?	*Please select from list (3):3a; 3h* *Please explain:*
Ax2.6a	Have your needs been reflected in the product development process?	*Please rank 1-5 [1=not at all; 5=yes totally]* *Non*
Ax2.6b	If yes, how have they been reflected?	*Please explain:*
Ax2.7	Is there any guidance/support/training/advice provided to you to enhance application/usability of the product?	YES ☐ NO ☒ DON'T KNOW ☐
Ax2.8	Did you have the opportunity to give feedback on the usability/satisfaction of this product?	YES ☐ NO ☐ DON'T KNOW ☐
Ax2.9	For which purpose/ decision/ follow-up product do you use this product?	*Please select from list (4):* *Please give details:*
Ax2.10	In which of the following decision making tools you have used climate information:	Multi-criteria analysis ☐; Cost-benefit analysis ☐; Others ☐ specify: None ☐; I don't know ☐

Table 35: The type of climate-related information the Kenya National Water Conservation uses for decision-making

Product code	Product type	This product type is being used directly for decision-making (incl. internal post-processing)	This product type is being used as input for follow-up products / services	This product type is desired/required but not (yet) being used/available	This product type is provided by our organization
E.3.1	Climate data (e.g. raw or processed, gridded data, station data, etc. for specific parameters and regions)	☒	☐	☐	☐
E.3.2	Climate statistic products (e.g. information about means and extremes for individual parameters for a specific region and period in form of maps, graphs, etc.)	☒	☐	☐	☐
E.3.3	Tailored climate data/statistics (e.g. indices) for specific purpose (e.g. 'sector of concern')	☒	☐	☐	☐
E.3.4	Data / statistics on hazardous climate events / extreme events (e.g. impact maps, magnitude-frequency analysis, etc.)	☒	☐	☐	☐
E.3.5	Information on regional climate conditions (e.g. review and analysis in form of bulletins, synthesis reports, statements, etc.)	☐	☒	☐	☐
E.3.6	Analysis and interpretation of climate statements or products for specific users/sectors (e.g. analysis of consequences of past/prevalent climatic conditions for specific sectors)	☐	☐	☐	☐
E.3.7	Hydrological data / statistics and events (e.g. discharge, floods, low-flows, etc.)	☒	☐	☐	☐
E.3.8	Data/statistics on climate impacts on terrestrial systems (e.g. impacts on ecosystems (vegetation etc.), geomorphological impacts (soil erosion, landslides, etc.))	☐	☐	☒	☐
E.3.9	Information/data on climate impacts/consequences for specific sectors (e.g. info on expected crop yields, losses, costs, damage, disruptions or fatalities for agriculture, transport, health, energy, etc.)	☐	☐	☒	☐
E.3.10	Climate vulnerability/risk information in general or for specific	☐	☐	☒	☐

	sectors (e.g. data/info on exposures and sensitivities)				
E.3.11	Climate forecasts/outlooks for specific parameters/events at various time scales (e.g. week, month, year, etc.)	☐	☐	☒	☐
E.3.12	Climate change projections (e.g. model output data/maps for specific parameters, events, etc.)	☐	☐	☒	☐
E.3.13	Climate change impact data/model outputs (e.g. on ecosystems, water availability, etc.)	☐	☐	☒	☐
E.3.14	Climate change vulnerability/risk information (e.g. maps for specific sector/region)	☐	☐	☒	☐
E.3.15	Training, workshops, lectures and information material on climate issues, e.g. climate change and its impacts (e.g. qualitative info/education material to raise awareness ; general or sector-specific)	☐	☐	☒	☐
E.3.16	Tools which support decision-making, strategy development and financial planning	☐	☐	☒	☐
E.3.17	Others: Estimation of sediment flow for current situation and also sediment flow occasioned by climate change.	☒	☐	☒	☐

Table 36: The additional services the National Water Conservation of Kenya uses to make climate information usable for decision-making processes

		This service is being **used** to enhance **decision-making**	This service is **desired/required** but not (yet) being used/ available.	This service is **provided** by our organization
E.1.1	Guidelines for selecting relevant climate information and assess its relevance	☐	☒	☐
E.1.2	Explanation of content/meaning of climate information is required (*e.g. how to read the graphs?*)	☐	☒	☐
E.1.3	Technical training, tools or support for data processing and product application	☐	☒	☐
E.1.4	Training, tools or supportto assess the value/significance of the climate information for the own context (*e.g. interpretation of information on probability and uncertainty*)	☐	☒	☐
E.1.5	Advice or decision-support tools to integrate climate information in decision-making	☐	☒	☐
E.1.6	Support for optional queries is desired	☐	☒	☐
E.1.7	None. Available climate-related products and formats can be processed/utilized	☐	☐	☐

Table 37: Information on the product development, performance, and provider-user interaction in Kenya

	Questions	Product (#; e.g. Ax1.1)
Ax2.1	Who is your climate service provider for the product? And what is the relationship with this provider? (e.g. regular meetings, MoU,	*Please select from list (1):**1a, 1c;** Please state the name:**(a) Kenya Meteorlogical Department (b)National***

	contracts, etc.)?	***Water Resource Authourity.*** *Please explain the relationship*: *On a need basis, no contracts.*
Ax2.2	How did you know about the product and its potential value?	*Please explain: Common knowldege, classroom.*
Ax2.3	Through which channel do you receive this product?	*Please select from list (2):a*
Ax2.4	Is the product specifically designed for your sector/purpose?	YES ☐ NO ☒ DON'T KNOW ☐
Ax2.5a	How would you rate the general quality and usability of the products and services you currently use? (e.g. skill, presentation, format, medium, timing, frequency of delivery, access, etc.). *Please rank 1-5*	*Please rank 1-5 [1=no usability; 5=very good usability]* *3*
Ax2.5b	If less than 5: what are the major shortcomings of this product?	*Please select from list (3):c, h. Please explain: You have to pay for the product and it's not up to date.*
Ax2.6a	Have your needs been reflected in the product development process?	*Please rank 1-5 [1=not at all; 5=yes totally]* *3*
Ax2.6b	If yes, how have they been reflected?	*Please explain:Sometimes, the data does not cover the point of interest eg nearest staion could be 500km away,*
Ax2.7	Is there any guidance/support/training/advice provided to you to enhance application/usability of the product?	YES ☐ NO ☒ DON'T KNOW ☐
Ax2.8	Did you have the opportunity to give feedback on the usability/satisfaction of this product?	YES ☐ NO ☒ DON'T KNOW ☐
Ax2.9	For which purpose/ decision/ follow-up product do you use this product?	*Please select from list (4):b, c , d. Please give details: Desgin of dams and flood control works.*
Ax2.10	In which of the following decision making tools you have used climate information:	Multi-criteria analysis ☒; Cost-benefit analysis ☐; Others ☐ specify: ; None ☐; I don't know ☐

Product (#;Ax1.2)		
Ax2.1	Who is your climate service provider for the product? And what is the relationship with this provider? (e.g. regular meetings, MoU, contracts, etc.)?	*Please select from list (1):**a, c;** Please state the name:**Kenya Met. and Water Resources Authority.** Please explain the relationship: Need basis.*
Ax2.2	How did you know about the product and its potential value?	*Please explain: School, bulletins.*
Ax2.3	Through which channel do you receive this product?	*Please select from list (2):a*
Ax2.4	Is the product specifically designed for your sector/purpose?	YES ☐ NO ☒; DON'T KNOW ☐
Ax2.5a	How would you rate the general quality and usability of the products and services you currently use? (e.g. skill, presentation, format, medium, timing, frequency of delivery, access, etc.). *Please rank 1-5*	*Please rank 1-5 [1=no usability; 5=very good usability]* *3*
Ax2.5b	If less than 5: what are the major shortcomings of this product?	*Please select from list (3):e,f; Please explain: The spatial aspect of the product is not always what is of interest to us.*
Ax2.6a	Have your needs been reflected in the product development process?	*Please rank 1-5 [1=not at all; 5=yes totally]1*
Ax2.6b	If yes, how have they been reflected?	*Please explain:*
Ax2.7	Is there any guidance/support/training/advice provided to you to enhance application/usability of the product?	YES ☐ NO ☒; DON'T KNOW ☐
Ax2.8	Did you have the opportunity to give feedback on the usability/satisfaction of this product?	YES ☐ NO ☒; DON'T KNOW ☐
Ax2.9	For which purpose/ decision/ follow-up product do you use this product?	*Please select from list (4):b, d; Please give details: Design and operation and maintenance of water supply*
Ax2.10	In which of the following decision making tools you have used climate information:	Multi-criteria analysis ☒; Cost-benefit analysis ☐; Others ☐ specify: ; None ☐; I don't know ☐

Product (#; e.g. Ax1.3)		
Ax2.1	Who is your climate service provider for the product? And what is the relationship with this provider? (E.g. regular meetings, MoU, contracts, etc.)?	*Please select from list (1):***c, d;** *Please state the name:* ***Water Reeources authority, JICA and Consultants*** *Please explain the relationship: Contracts, need basis*
Ax2.2	How did you know about the product and its potential value?	*Please explain: Bulletins, lectures*
Ax2.3	Through which channel do you receive this product?	*Please select from list (2):a*
Ax2.4	Is the product specifically designed for your sector/purpose?	YES ☒ NO ☐; DON'T KNOW ☐
Ax2.5a	How would you rate the general quality and usability of the products and services you currently use? (e.g. skill, presentation, format, medium, timing, frequency of delivery, access, etc.) *Please rank 1-5*	*Please rank 1-5; [1=no usability; 5=very good usability] 4*
Ax2.5b	If less than 5: what are the major shortcomings of this product?	*Please select from list (3):C, H, J; Please explain: Temporal scenarios not flexible, missing for some regions*
Ax2.6a	Have your needs been reflected in the product development process?	*Please rank 1-5 [1=not at all; 5=yes totally]* *5*
Ax2.6b	If yes, how have they been reflected?	*Please explain: Standard procedures*
Ax2.7	Is there any guidance/support/training/advice provided to you to enhance application/usability of the product?	YES ☐ NO ☒; DON'T KNOW ☐
Ax2.8	Did you have the opportunity to give feedback on the usability/satisfaction of this product?	YES ☐ NO ☒; DON'T KNOW ☐
Ax2.9	For which purpose/ decision/ follow-up product do you use this product?	*Please select from list (4):b, c, d; Please give details: DEssign, operation and maintenance*

Ax2.10	In which of the following decision making tools you have used climate information:	Multi-criteria analysis ☒; Cost-benefit analysis ☐; Others ☐specify: ; None ☐; I don't know ☐
Product (#;Ax1.4)		
Ax2.1	Who is your climate service provider for the product? And what is the relationship with this provider? (e.g. regular meetings, MoU, contracts, etc.)?	*Please select from list (1):**d,g;** Please state the name:**JICA, Engineering consultants;** Please explain the relationship*: *Need basis, contracts*
Ax2.2	How did you know about the product and its potential value?	*Please explain: Books;*
Ax2.3	Through which channel do you receive this product?	*Please select from list (2):a*
Ax2.4	Is the product specifically designed for your sector/purpose?	YES ☒NO ☐; DON'T KNOW ☐
Ax2.5a	How would you rate the general quality and usability of the products and services you currently use? (e.g. skill, presentation, format, medium, timing, frequency of delivery, access, etc.) *Please rank 1-5*	*Please rank 1-5 ; [1=no usability; 5=very good usability]5*
Ax2.5b	If less than 5: what are the major shortcomings of this product?	*Please select from list (3): ; Please explain:*
Ax2.6a	Have your needs been reflected in the product development process?	*Please rank 1-5 [1=not at all; 5=yes totally]; 5*
Ax2.6b	If yes, how have they been reflected?	*Please explain:PArameters need have been taken into consideration. Standard methods.*
Ax2.7	Is there any guidance/support/training/advice provided to you to enhance application/usability of the product?	YES ☐NO ☒; DON'T KNOW ☐
Ax2.8	Did you have the opportunity to give feedback on the usability/satisfaction of this product?	YES ☐NO ☒; DON'T KNOW ☐
Ax2.9	For which purpose/ decision/ follow-up product do you use this product?	*Please select from list (4):b, c, d, f; Please give details: Planning, design,*

		emergencies.
Ax2.10	In which of the following decision making tools you have used climate information:	Multi-criteria analysis ☒; Cost-benefit analysis ☐; Others ☐specify: ; None ☐; I don't know ☐
Product (#; e.g. Ax1.5)		
Ax2.1	Who is your climate service provider for the product? And what is the relationship with this provider? (e.g. regular meetings, MoU, contracts, etc.)?	*Please select from list (1):**C;** Please state the name:**Water Resources Authority;** Please explain the relationship*: *Need basis*
Ax2.2	How did you know about the product and its potential value?	*Please explain: LEctures*
Ax2.3	Through which channel do you receive this product?	*Please select from list (2):a*
Ax2.4	Is the product specifically designed for your sector/purpose?	YES ☒NO ☐; DON'T KNOW ☐
Ax2.5a	How would you rate the general quality and usability of the products and services you currently use? (e.g. skill, presentation, format, medium, timing, frequency of delivery, access, etc.) *Please rank 1-5*	*Please rank 1-5 [1=no usability; 5=very good usability]; 5*
Ax2.5b	If less than 5: what are the major shortcomings of this product?	*Please select from list (3):C; Please explain: Not available for all sites*
Ax2.6a	Have your needs been reflected in the product development process?	*Please rank 1-5 [1=not at all; 5=yes totally]; 5*
Ax2.6b	If yes, how have they been reflected?	*Please explain:Standard*
Ax2.7	Is there any guidance/support/training/advice provided to you to enhance application/usability of the product?	YES ☒NO ☐; DON'T KNOW ☐
Ax2.8	Did you have the opportunity to give feedback on the usability/satisfaction of this product?	YES ☐NO ☒; DON'T KNOW ☐
Ax2.9	For which purpose/ decision/ follow-up product do you use this product?	*Please select from list (4):b,c,d; Please give details: Design and flood forecasts*

Ax2.10	In which of the following decision making tools you have used climate information:	Multi-criteria analysis ☒; Cost-benefit analysis ☐; Others ☐specify: ; None ☐; I don't know ☐
Product (#;Ax1.6)		
Ax2.1	Who is your climate service provider for the product? And what is the relationship with this provider? (e.g. regular meetings, MoU, contracts, etc.)?	*Please select from list (1):**C;** Please state the name:**Water Resources Authority*** *Please explain the relationship: Publication*
Ax2.2	How did you know about the product and its potential value?	*Please explain: Bulletin*
Ax2.3	Through which channel do you receive this product?	*Please select from list (2):G*
Ax2.4	Is the product specifically designed for your sector/purpose?	YES ☐NO ☒; DON'T KNOW ☐
Ax2.5a	How would you rate the general quality and usability of the products and services you currently use? (e.g. skill, presentation, format, medium, timing, frequency of delivery, access, etc.) *Please rank 1-5*	*Please rank 1-5 ; [1=no usability; 5=very good usability]; 2*
Ax2.5b	If less than 5: what are the major shortcomings of this product?	*Please select from list (3):D,E; Please explain: WRA just gives figures for sediment estimate for a catgchment. This needs to be accurately developed while considering Land use, soils and rainfall patterns.*
Ax2.6a	Have your needs been reflected in the product development process?	*Please rank 1-5 [1=not at all; 5=yes totally]; 1*
Ax2.6b	If yes, how have they been reflected?	*Please explain:*
Ax2.7	Is there any guidance/support/training/advice provided to you to enhance application/usability of the product?	YES ☐NO ☒; DON'T KNOW ☐
Ax2.8	Did you have the opportunity to give feedback	YES ☐NO ☒; DON'T KNOW ☐

	on the usability/satisfaction of this product?	
Ax2.9	For which purpose/ decision/ follow-up product do you use this product?	*Please select from list (4):b, c; Please give details: Estimating service life and also for maintenance*
Ax2.10	In which of the following decision making tools you have used climate information:	Multi-criteria analysis ☐; Cost-benefit analysis ☐; Others ☒specify: Site location and erosioncontrol works site selction; None ☐; I don't know ☐

Table 38: The type of climate-related information the Rwanda Agriculture Boarduses for decision-making

Product code	Product type	This product type is being **used** directly for **decision-making** (incl.internal post-processing)	This product type is being **used as input** for follow-up products / services	This product type is **desired/ required** but not (yet) being used/available	This product type is **provided** by our organization
E.3.1	Climate data (*e.g. raw or processed, gridded data, station data, etc. for specific parameters and regions*)	☒	☐	☐	☐
E.3.2	Climate statistic products (*e.g. information about means and extremes for individual parameters for a specific region and period in form of maps, graphs, etc.*)	☐	☐	☐	☒
E.3.3	Tailored climate data/statistics (e.g. indices) for specific purpose (*e.g. 'sector of concern'*)	☐	☐	☐	☒
E.3.4	Data / statistics on hazardous climate events/extreme events (*e.g. impact maps, magnitude-frequency analysis, etc.*)	☐	☐	☐	☒
E.3.5	Information on regional climate conditions (*e.g. review and analysis in form of bulletins, synthesis reports, statements, etc.*)	☒	☐	☐	☐
E.3.6	Analysis and interpretation of climate statements or products for specific users/sectors (*e.g. analysis of consequences of past/prevalent climatic conditions for specific sectors*)	☒	☐	☐	☐
E.3.7	Hydrological data / statistics and events (*e.g. discharge, floods, low-flows, etc.*)	☒	☐	☐	☐

E.3.8	Data/statistics on climate impacts on terrestrial systems (*e.g. impacts on ecosystems (vegetation etc.), geomorphological impacts (soil erosion, landslides, etc.))*	☒	☐	☐	☐
E.3.9	Information/data on climate impacts/consequences for specific sectors (*e.g. info on expected crop yields, losses, costs, damage, disruptions or fatalities for agriculture, transport, health, energy, etc.*)	☐	☐	☐	☒
E.3.10	Climate vulnerability/risk information in general or for specific sectors (*e.g. data/info on exposures and sensitivities*)	☒	☐	☐	☐
E.3.11	Climate forecasts/outlooks for specific parameters/events at various time scales (*e.g. week, month, year, etc.*)	☒	☐	☐	☐
E.3.12	Climate change projections (*e.g. model output data/maps for specific parameters, events, etc.*)	☒	☐	☐	☐
E.3.13	Climate change impact data/model outputs (*e.g. on ecosystems, water availability, etc.*)	☒	☐	☐	☐
E.3.14	Climate change vulnerability/risk information (*e.g. maps for specific sector/region*)	☐	☐	☐	☒
E.3.15	Training, workshops, lectures and information material on climate issues, e.g. climate change and its impacts (*e.g. qualitative info/education material to raise awareness ; general or sector-specific*)	☒	☐	☐	☐
E.3.16	Tools which support decision-making, strategy development and financial planning	☐	☐	☒	☐

Table 39: The additional services the Rwanda Agriculture Board uses to make climate information usable for decision-making processes

		This service is being **used** to enhance **decision-making**	This service is **desired/ required** but not (yet) being used/ available.	This service is **provided** by our organization
E.1.1.	Guidelines for selecting relevant climate information and assess its relevance	☐	☐	☒
E.1.2.	Explanation of content/meaning of climate information is required (*e.g. how to read the graphs?*)	☐	☐	☒
E.1.3.	Technical training, tools or support for data processing and product application	☐	☐	☒
E.1.4.	Training, tools or support to assess the value/significance of the climate information for the own context (*e.g. interpretation of information on probability and uncertainty*)	☐	☐	☒
E.1.5.	Advice or decision-support tools to integrate climate information in decision-making	☐	☐	☒
E.1.6.	Support for optional queries is desired	☐	☐	☐
E.1.7.	None. Available climate-related products and formats can be processed/ utilized	☐	☐	☐

Table 40: Information on the product development, performance, and provider-user interaction in Rwanda by Rwanda Agriculture Board

	Questions	Product (#; e.g. Ax1.1)

Ax2.1	Who is your climate service provider for the product? And what is the relationship with this provider? (E.g. regular meetings, MoU, contracts, etc.)?	*Please select from list (1):* National Meteorological Service*; Please state the name:Meteo Rwanda. Please explain the relationship*: *Institutional*
Ax2.2	How did you know about the product and its potential value?	*Please explain:*
Ax2.3	Through which channel do you receive this product?	*Please select from list (2):* Received via e-mail, Copied from a web page
Ax2.4	Is the product specifically designed for your sector/purpose?	YES ☒ NO ☐ ; DON'T KNOW ☐
Ax2.5a	How would you rate the general quality and usability of the products and services you currently use? (E.g. skill, presentation, format, medium, timing, frequency of delivery, access, etc.). *Please rank 1-5*	*Please rank 1-5 [1=no usability; 5=very good usability]* *5*
Ax2.5b	If less than 5: what are the major shortcomings of this product?	*Please select from list (3):* *Please explain:*
Ax2.6a	Have your needs been reflected in the product development process?	*Please rank 1-5 [1=not at all; 5=yes totally]; 5*
Ax2.6b	If yes, how have they been reflected?	*Please explain:*
Ax2.7	Is there any guidance/support/training/advice provided to you to enhance application/usability of the product?	YES ☒ NO ☐ ; DON'T KNOW ☐
Ax2.8	Did you have the opportunity to give feedback on the usability/satisfaction of this product?	YES ☒ NO ☐ ; DON'T KNOW ☐
Ax2.9	For which purpose/ decision/ follow-up product do you use this product?	*Please select from list (4): Strategic planning, infrastructure planning and implementation, maintenance and organizational planning of existing infrastructure; Please give details:*
Ax2.10	In which of the following decision making tools you have used climate information:	Multi-criteria analysis ☒ ; Cost-benefit analysis ☐ ; Others ☐ specify: ; None ☐; I don't know ☐

Table 41: The type of climate-related information the Sudan User uses for decision-making

Product code	Product type	This product type is being **used** directly for **decision-making**(incl. internal post-processing)	This product type is being **used as input** for follow-up products / services	This product type is **desired/required** but not (yet) being used/available	This product type is **provided** by our organization
E.3.1	Climate data (*e.g. raw or processed, gridded data, station data, etc. for specific parameters and regions*)	☒	☐	☐	☐
E.3.2	Climate statistic products (*e.g. information about means and extremes for individual parameters for a specific region and period in form of maps, graphs, etc.*)	☒	☐	☐	☐
E.3.3	Tailored climate data/statistics (e.g. indices) for specific purpose (*e.g. 'sector of concern'*)	☐	☐	☒	☐
E.3.4	Data / statistics on hazardous climate events / extreme events (*e.g. impact maps, magnitude-frequency analysis, etc.*)	☒	☐	☐	☐
E.3.5	Information on regional climate conditions (*e.g. review and analysis in form of bulletins, synthesis reports, statements, etc.*)	☐	☐	☒	☐
E.3.6	Analysis and interpretation of climate statements or products for specific users/sectors (*e.g. analysis of consequences of past/prevalent climatic conditions for specific sectors*)	☐	☐	☒	☐
E.3.7	Hydrological data / statistics and events (*e.g. discharge, floods,*	☐	☐	☐	☒

	low-flows, etc.)				
E.3.8	Data/statistics on climate impacts on terrestrial systems (*e.g. impacts on ecosystems (vegetation etc.), geomorphological impacts (soil erosion, landslides, etc.))*	☐	☐	☒	☐
E.3.9	Information/data on climate impacts/consequences for specific sectors (*e.g. info on expected crop yields, losses, costs, damage, disruptions or fatalities for agriculture, transport, health, energy, etc.*)	☐	☐	☒	☐
E.3.10	Climate vulnerability/risk information in general or for specific sectors (*e.g. data/info on exposures and sensitivities*)	☐	☐	☒	☐
E.3.11	Climate forecasts/outlooks for specific parameters/events at various time scales (*e.g. week, month, year, etc.*)	☒	☐	☐	☐
E.3.12	Climate change projections (*e.g. model output data/maps for specific parameters, events, etc.*)	☒	☐	☐	☐
E.3.13	Climate change impact data/model outputs (*e.g. on ecosystems, water availability, etc.*)	☐	☒	☐	☐
E.3.14	Climate change vulnerability/risk information (*e.g. maps for specific sector/region*)	☐	☐	☒	☐
E.3.15	Training, workshops, lectures and information material on climate issues, e.g. climate change and its impacts (*e.g. qualitative info/education material to raise awareness ; general or sector-specific*)	☐	☐	☒	☐

E.3.16	Tools which support decision-making, strategy development and financial planning	☐	☐	☒	☐

Table 42: The additional services the Sudan User uses to make climate information usable for decision-making processes

		This service is being **used** to enhance **decision-making**	This service is **desired/required** but not (yet) being used/ available.	This service is **provided** by our organization
E.1.1.	Guidelines for selecting relevant climate information and assess its relevance	☐	☒	☐
E.1.2.	Explanation of content/meaning of climate information is required (*e.g. how to read the graphs?*)	☐	☒	☐
E.1.3.	Technical training, tools or support for data processing and product application	☐	☒	☐
E.1.4.	Training, tools or support to assess the value/significance of the climate information for the own context (*e.g. interpretation of information on probability and uncertainty*)	☐	☒	☐
E.1.5.	Advice or decision-support tools to integrate climate information in decision-making	☐	☒	☐
E.1.6.	Support for optional queries is desired	☐	☒	☐
E.1.7.	None. Available climate-related products and formats can be processed/utilized	☐	☐	☐

Table 43: The additional services the Sudan User uses to make climate information usable for decision-making processes

	Questions	Product (#; e.g. Ax1.1)
Ax2.1	Who is your climate service provider for the product? And what is the relationship with	*Please select from list (1):* ***;*** *Please state the name:* ***;*** *Please explain the*

	this provider? (E.g. regular meetings, MoU, contracts, etc.)?	*relationship*:
Ax2.2	How did you know about the product and its potential value?	*Please explain:*
Ax2.3	Through which channel do you receive this product?	*Please select from list(2):*
Ax2.4	Is the product specifically designed for your sector/purpose?	YES ☐ NO ☐; DON'T KNOW ☐
Ax2.5a	How would you rate the general quality and usability of the products and services you currently use? (e.g. skill, presentation, format, medium, timing, frequency of delivery, access, etc.). *Please rank 1-5*	*Please rank 1-5 ; [1=no usability; 5=very good usability];*
Ax2.5b	If less than 5: what are the major shortcomings of this product?	*Please select from list (3): ; Please explain:*
Ax2.6a	Have your needs been reflected in the product development process?	*Please rank 1-5 [1=not at all; 5=yes totally];*
Ax2.6b	If yes, how have they been reflected?	*Please explain:*
Ax2.7	Is there any guidance/support/training/advice provided to you to enhance application/usability of the product?	YES ☐ NO ☐; DON'T KNOW ☐
Ax2.8	Did you have the opportunity to give feedback on the usability/satisfaction of this product?	YES ☐ NO ☐; DON'T KNOW ☐
Ax2.9	For which purpose/ decision/ follow-up product do you use this product?	*Please select from list(4):* *Please give details:*
Ax2.10	In which of the following decision making tools you have used climate information:	Multi-criteria analysis ☐; Cost-benefit analysis ☐; Others ☐ specify: None ☐; I don't know ☐

Table 44: Information on the product development, performance, and provider-user interaction in Sudan by MWRIE

Ax2: Information on the product development, performance, and provider-user interaction

USER: Ministry of Water Resources, Irrigation and Electricity (MWRIE)

a) PARAMETERS: Rainfall and Rainfall Estimation

(Flood Early warning, reservoir management and WRDSS)

PROVIDER: Sudan Meteorological Authority (SMA)

PROVIDER: Open Source(TRMM, CMORPH, RFE)

- Rainfall and Rainfall Estimation data over Nile Basin (in real-time) is not available from the provider (Met Authority)
- *From our experience on relying on the open Source data , that the information may not be available in the near real time and examined delay and sometimes missing segment*.
- As proposed by World bank in the VC meeting May 2017 "Enhancing Water Resources Management in Sudan:
  Rainfall and Flood Forecasting", Our organization is to use National Center for Atmospheric Research (NCAR) merged products for the decision making as input to the hydrological models.
- In their products they used ECMWF 24-Hour ensemble forecast (50 ensemble members) and a simple average Rainfall from TRMM, CMORPH and CPC (Climate Prediction center).

b) PARAMETERS: Local Rainfall, Temperature, air pressure, humidity, Wind Speed, wind direction, radiation and Evaporation

(used for design of dams and associated agricultural projects)

PROVIDER: Sudan Meteorological Authority (SMA)

- Sudan Meteorological Authority and Ministry of Water Resources, Irrigation and Electricity are two Governmental bodies linked institutionally
- Climate Data for Design of infrastructures (dams and associated Agricultural projects is available to users in daily, monthly and annual basis but only in hard copies)
- High cost hindering the hydrological studies and research

Table 45: Ranking and relevance of climate Services information to users in the Nile basin

	Evaluation Criteria for the use of climate information	Burundi /Ministry of Energy and Mines	Burundi /Ministry of Agriculture and Livestock	Burundi combined	DR. Congo	Kenya	Rwanda	Sudan	Basin score
a	Relevance of climate laws, regulation and policy (1-not relevant at all, 2-not specifically relevant, 3-little relevant, 4-relevant, 5 very relevant)	5	5	5	2	4	5		4
b	Main drivers for using climate information (1-not relevant at all, 2-not specifically relevant, 3-little relevant, 4-relevant, 5 very relevant)								
	internal motivation (vision, policy)	5	2	4	3	4	5	4	4
	External motivation (PR , image)	2	1	2	3	1	4	3	3
	Regulatory obligation (laws, decrees)	4	1	3	2	4	4	1	3
	Business interests (economic value, competition)	3	5	4	3	1	5	1	3
c	Role of CC information compared to others in decision making criteria (1-not relevant at all, 2-not specifically relevant, 3-little relevant, 4-relevant, 5 very relevant)	5	5	5	2	4	5	4	4
d	Relevance of climate information in decision making process at organization level (1-not relevant at all, 2-not specifically relevant, 3-little relevant, 4-relevant, 5 very relevant)								
	strategic planning (policies, investments)	5	4	5	5	5	5	3	5
	Infrastructure planning	5	5	5	4	5	5	4	5
	maintenance of existing infrastructure	3	5	4	3	5	5	1	4
	day-to-day operation management of existing infrastructure	4	5	5	3	5	4	4	4
	education and awareness of staff and decision makers	5	4	5	4	4	3	4	4
	development of risk management plans	4	3	4	5	5	4	2	4
e	Limitations on the use of climate information/product specific reasons (1 doesn't apply, 2-hadly applies, 3-applies little, 4-applies; 5-applies very much)								
	the product is not available when required	5	2	4	3	4	3	5	4

	the product is of limited quality	4	1	3	2	3	4	2	3
	access to climate information is restricted/limited,	5	4	5	4	4	4	5	4
	the information content is not understandable,	1	2	2	4	4	4	4	4
	the product is not relevant for our context,	1	1	1	3	4	1	3	2
	the product is not usable for our purpose,	2	1	2	1	5	1	4	3
	The existence of the product is not known.	3	1	2	3	4	3	1	3
f	Limitations on the use of climate information/organization specific reasons (1 doesn't apply, 2-hadly applies, 3-applies little, 4-applies; 5-applies very much)								
	there is no legal obligation to use climate information,	2	1	2	1	1	1	1	1
	the products is not freely available,	2	4	3	4	5	1	2	3
	there are no capacities available to deal with climate information,	4	5	5	1	1	1	1	2
	There is no need for climate information,	1	1	1	3	1	1	1	1
	the cost-benefit value of the use of climate information is not profitable,	2	1	2	5	1	1	1	2
	the relevance of climate information for decision-making is negligible,	4	1	3	3	1	1	1	2
	the added value of the product for our purpose is not evident.	2	3	3	3	2	1	3	2
g	Capacities that require improvement (technical & personnel) (1 doesn't apply, 2-hadly applies, 3-applies little, 4-applies; 5-applies very much)								
	Technical equipment and skills	5	5	5	5	5		5	5
	Know-how and training	4	5	5	4	5		5	5
	number of staff	2	1	2	2	5		2	3
	funding	5	1	3	4	4		5	4
h	Assessment of own capacity to formulate needs for climate information products (1-very poor, 2-poor, 3-intermediate, 4-good, 5,-very good)	2	4	3	4	4	5	3	4