

# REPORT

## Capacity Needs Assessment of ACMAD



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## Acronyms

ACMAD	African Centre of Meteorological Applications for Development
ACPC	African Climate Policy Centre
AfDB	African Development Bank
AMCOMET	African Ministerial Conference on Meteorology
ASECNA	Agency for Aerial Navigation Safety in Africa and Madagascar
AU	African Union
BAMS	Bulletin of the American Meteorological Society
BoG	Board of Governors
CLIMAT	Monthly Climatology
ClimDev	Climate for Development in Africa
CPC	Climate Prediction Centre
DCPC	Data Collection and Production Centre
DDG	Deputy Director General
DG	Director General
DFID	UK Department of International Development
DM	Disaster Management
DRR	Disaster Risk Reduction
ECOWAS	Economic Community of West African States
ECA	Economic Commission for Africa
ECMWF	European Centre for Medium range Weather Forecasting
EMWIN	Emergency Manager's Weather Information Network
ENSO	El-Niño Southern Oscillation
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FAO	United Nations Food and Agriculture Organization
GCM	General Circulation Model
GFCS	Global Framework for Climate Services
GMDSS	Global Marine Distress and Safety System
GPCs	Global Producing Centres
GTS	Global Telecommunication System
HPCD	High Performance Communication Department
ICPAC	IGAD Climate Prediction and Applications Centre
IDMC	Internal Displacement Monitoring Centre
IFRC	Federation of Red Cross and Red Crescent Committees
IGAD	Intergovernmental Authority on Development
IRI	International Research Institute for Climate and Society
ISACIP	Institutional Support to African Climate Institutions Project
ISCS	International Satellite Communications System

LRF	Long-Range Forecast
LC-SVSLRF	Lead Centres Standard Verification Scheme for LRF
MESA	Monitoring for Environment and Security in Africa
NAP	National Adaptation Programs
NFCS	National Framework for Climate Services
NOAA	National Oceanographic and Atmospheric Administration
NMHSs	National Meteorological and Hydrological Services
NRC	Norwegian Refugee Council
PRESAO	Regional Climate Outlook Forum for West Africa, Chad and Cameroon
PRESAC	Regional Climate Outlook Forum for Central Africa
PRS	Poverty Reduction Strategy
RANET	Radio and Internet for the Communication of Hydro-Meteorological and Climate-Related Information
RCC	Regional Climate Centre
RCOF	Regional Climate Outlook Forums
REC	Regional Economic Communities
SACOM	Scientific Advisory Committee
SADIS	Satellite Distribution System
SYNOP	Surface Synoptic Observations
TEMP	Upper-level Pressure, Temperature, Humidity and Wind
UKMet	United Kingdom Meteorological Office
UNECA	United Nations Economic Commission for Africa
UNDP	United Nations Development Programme
WCC	World Climate Conference
WMO	World Meteorological Organization
WISER	Weather and climate Information SERvices for Africa
WWP	Weather Watch and Prediction

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## Executive Summary

This capacity needs assessment of the African Centre of Meteorological Applications for Development (ACMAD) was conducted under the framework partnership of the African Ministerial Conference on Meteorology (AMCOMET), the United Kingdom Department for International Development (DFID) – Weather and climate Information SERvices (WISER)<sup>1</sup> programme, and the World Meteorological Organization (WMO)/ the Global Framework for Climate Services (GFCS) to support identification of ACMAD's major challenges in order to provide entry points for technical support and services intervention to improve the ability of the centre to deliver relevant climate services to the African National Meteorological and Hydrological Services (NMHSs) and the humanitarian sector in the continent.

ACMAD as an institution has faced human and financial constraints in a number of areas, and that has undermined its capability in the provision and delivery of climate services mandated to the Centre. Hence, the requirement of this study is to assess key human and technical skills as well as infrastructural, institutional and governance, fiscal and legal, communication and outreach capacity needs in order to help ACMAD improve its development, delivery, and uptake of key weather and climate products and services. The assessment is also designed to provide recommendations on how to adequately address the key gaps identified, including priority areas of intervention.

Until recently, climate variability and change was viewed largely as an environmental concern, of little importance to long-term development objectives, particularly in Sub-Saharan Africa, a region with low capacity to adapt to the future impacts of climate change. Factoring climate information and services into investments and planning decisions is therefore an important component of climate-resilient development.

To achieve climate-resilient development goals, WMO designated Regional Climate Centres (RCCs), are being tasked to generate and deliver more regionally-focused high-resolution climate data and products as well as training and capacity building. Following a successful demonstration phase, which started in 2012 and the WMO Commission for Basic Systems recommendation in 2014, the WMO Congress at its 17<sup>th</sup> session in 2015 endorsed the designation of ACMAD as a Pan-African Multifunctional Regional Climate Centre (RCC). RCCs have been identified as the

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<sup>1</sup> WISER is the Weather and climate Information SERvices, a programme aims to deliver a step-change in the use and provision of weather and climate information to support poverty reduction and promote socio-economic development in Africa.

essential instrument for the provision of climate services at regional level under the Climate Service Information System of GFCS.

The capacity needs assessment was therefore specifically designed to identify ACMAD's RCC human and infrastructure capacity needs in order to inform ACMAD key partners on areas the Centre needs support for the implementation of the GFCS in Africa, including its priority areas (agriculture, food security, water resources, disaster risk reduction, health and energy).

The objectives of the capacity needs assessment were achieved through:

- A desktop review of recent reports performed, regarding needs and gaps related to ACMAD's work processes, user requirements, services/products produced, human, technical and infrastructural capacity needs.
- A one-on-one Skype/telephone call meetings and emails with ACMAD's top management in order to clarify the scope, objectives, methodology and expectations regarding the output of the assessment.
- Administration of survey questionnaire on the governance, climate information and product needs, strength and challenges of the centre.

**The key findings of the assessment can be summarized as follow:**

The insufficiency of technical staff is a major gap at ACMAD RCC. Currently, one permanent position is dedicated to its activities while at least five to fifteen positions are needed for the project lifetime. A minimum of six RCC support staff consisting of two staffs for long range forecasting, one for Climate monitoring, one for IT including the RCC web portal, one for data management and one for training would be required to support minimum optimal operation activities at ACMAD RCC.

Under the ACMAD-MESA project, climate services for Disaster Risk Reduction (DRR) in Africa was developed and delivered by ACMAD RCC. However, there still is a need for the development and delivery of climate services for the other GFCS areas such as agriculture and food security, water resources, health and energy.

ACMAD's experience in the delivery of climate services for DRR underlined the following lessons:



- There is a need to increase our knowledge and understanding of user's needs and requirements in order to tailored climate service;
- One expert is required to provide tailored climate information, advisories and warnings to Disaster Risks Management Agencies;
- One expert is also needed for planning and organizing user interface fora, help desks and other interactions.

Optimal delivery of RCC mandatory functions products and provision of climate services for disaster risk management will require a team of 12 operational staff members and a team leader. In addition to that, each GFCS priority sector will require a dedicated staff member for tailoring the climate information to meet the user's needs.

- Funding available in ACMAD to support the fundamental functions of a RCC activities in Africa is lowest for a continent. This is because many African countries fail to pay their contributions to ACMAD. Therefore, the international partner's support has a particularly important role to play in the improvement, maintenance and development of climate information and its interface with sustainable development in Africa.

The proposed financial mechanism to improve sustainability according to ACMAD consist of:

- (1) Donors to provide three to five years grants to ACMAD RCC for effective climate services in Africa;
- (2) Provision of climate services funded by a combination of grants and loans for an additional three to five years period whereby users are encouraged to support the payment of these loans from the benefits generated through the use of climate services;
- (3) Climate services funded from payments by users as a percent of their benefits derived from application of climate services in their specific sectors of operations.

- The implementation of ACMAD RCC functions and delivery of climate services for DRR in Africa is mainly funded by the ISACIP and MESA projects respectively. It is noted, however, that these projects were funded for a fixed period of time. A major challenge for ACMAD, therefore, is the mobilization of required funds to continue the provision of climate products and services developed during the implementation phases of these projects. An estimated budget of US\$ one million

per year would be required to **regularly operate the African RCC** and provide **Climate Services for Disaster Risk Reduction in Africa**.

- ACMAD's information and telecommunication system is constrained by unsecure power supply, a weak internet bandwidth, a limited processing facilities and capabilities and inadequate computer software. As a regional Centre, ACMAD is not yet a Data Collection and Production Centre (DCPC) of the WMO Information System (WIS).
- It is shown that the integration of climate services into development activities in Africa is hindered by the lack of research that translate climate information into policy and practice. While the ACMAD RCC produces useful climate information and services, there still is a shortage of intermediaries who can help connect science with decision-making in specific sectors, such as agriculture and food security, water resources, energy, health, and disaster risk management.
- There is a gap in capacity to develop the necessary climate information and services that are commensurate with the particular needs of development stakeholders, and at the scale of action required to meet the development challenge.
- Many climate services products available at ACMAD RCC are severely underutilized. This is attributed mainly to the lack of awareness about the existence of climate information, the lack of capacity and understanding to use the climate information, and a poor understanding of how to deal with forecast uncertainties. There are gaps in understanding and trusting the seasonal forecast and incorporating it in development planning processes.
- There is little collaboration with users, specifically in the health, water resources and energy sectors, while success stories have been demonstrated with the Disaster Risk reduction community under the ACMAD-MESA project. An improvement of seasonal forecast lead time was noted (Regional Climate Outlook Forums (RCOF) products now available in late April instead of late May or June in West Africa during the first decade of RCOF operations) but additional efforts are required to demonstrate related benefits in user communities. There is a need for information on onset of rainy season, dry spell frequency, rainfall cessation. Demonstration projects on weekly to biweekly outlooks based on global centres

products and experts judgement have been undertaken with no resources available after the projects to sustain operations.

- Data processing and data policy gaps are major limitations to the provision of climate services by ACMAD. Raisons for difficulties in obtaining climate data from the National Meteorological and Hydrological Services (NMHSs) in Africa vary, including for some countries, it is “against policy to disseminate data freely”, for reasons that include a strong push by governments for institutional cost recovery, limited resources for operational activities. There is a need to adopt a data access policy that will considered African climate data as a public good and non-excludable.

### Key recommendations

- To improve its ability to deliver relevant climate services to NMHSs and the humanitarian sector in the continent, ACMAD should be helped with human capacity on climate monitoring, Long Range Forecasting, climate service development, climate science, training of experts on the job, computer system administration, database management systems development, web administration and maintenance.
- To ensure sustainability of capacities development, an institutional re-organization is needed to create permanent or long term positions for climate monitoring, long range forecasting, climate research, data services, and training.
- ACMAD in collaboration with WMO/AMCOMET should set up a Trust Fund within the framework of Climate Services which will receive donors’ funds targeting common policy structure (i.e., adaptation to climate change, climate resilience, impact of extreme events, and disaster risk reduction) that are available for Africa. It is also recommended to initiate a high-level dialogue with AU Commission, Regional Economic Commissions (RECs), WMO and the African Development Bank (AfDB) to enlist their support of ACMAD RCC by transforming the perception of policy/decision maker’s financial support to climate services, and prioritizing climate service provision as essential to resilient society.
- To ensure that the Member States regularly pay their contributions to ACMAD, an institutional arrangement should be made to allow countries’ contributions to be paid through an intergovernmental organization such as the AU, UNECA or through each of the sub-regional economic communities such as ECOWAS, EAC,

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Supported by:

Fund Manager:

Delivery Partners:



United Nations  
Economic Commission for Africa



SADC, IGAD and the Arab Maghreb Union as does the AGRHYMET centre and the ASECNA training schools whose operations are financed by the contributions of member States through the parent intergovernmental organizations, namely CILSS and ASECNA respectively.

**To strengthen climate information services delivery and help to keep the continent on track for further economic growth and development**

- ACMAD should seek to leverage the various climate financing mechanisms in place to enhance access to e-infrastructure consisting of High Performance Computing, data analytic tools, observing networks and networks of institutions.
- There is a crucial need at this moment for ACMAD RCC to acquire desktop computers, laptops and high-performance computing system for data management, climate simulations, and analysis. At least ten (10) new desktops and three (3) laptop computers are currently needed.
- ACMAD should be supported to acquire equipment for access to data and IT expert to set up and operate the WMO/WIS/DCPC, ACMAD-MESA project developed and implemented a communication strategy. It is proposed to update this strategy for use by ACMAD to address its communication challenges with NMHSs, regional institutions, developing RCCs in Africa, Designated RCCs worldwide and final beneficiaries in the GFCS sectors.
- There is a need to create an Outreach and Communication Unit that would provide intensive outreach services to member countries NMHSs and other stakeholders.

***For effective climate services in Africa***

- There is a need for ACMAD to be able to collect and analyse environmental and socio-economic data to generate impacts, risks, vulnerability information and provide science based options for resilient policies, plans and practices in GFCS sectors. There is also the need to understand and monitor regional to local climate change which are key priorities to upgrade our current knowledge and satisfy the demand of all policy makers, planners and practitioners.
- ACMAD and partners should support capacity development of NMHSs on resources management, telecommunication systems, observation technology and infrastructure, access to high speed Internet, computing and web technologies.

### **To improve the use of climate information and services across Africa**

- ACMAD and partners should train trainers at NMHSs, including the user communities to successfully tailor and incorporate climate information products into routine decision-making. A better climate service for decision making must ensure that NMHSs and local climate services be able to respond to local users demand, often by providing locally relevant information.
- Multi-sectoral climate outlook forums, user organized workshops, dialogue and regular exchanges with climate communities on forecast reliability, accuracy, and incorporation of climate forecasts into development policies, plan and practices, and climate change adaptation should be initiated.

# 1.Introduction

## 1.1 Background

Widespread occurrences of severe drought during the 70s and 80s have underscored the vulnerability of African countries. Drought is a serious natural disaster and has been associated with many socioeconomic tragedies. For example, the 1983-1984 Sahelian droughts have caused large-scale water and food deficits, hunger, famine, death and exodus of people and animals, with rural households, whose livelihood is heavily dependent on traditional rainfed agriculture, being the most affected.

Recognising that natural disasters are a normal feature of Africa's climate and that its recurrence is inevitable, the Conference of Ministers of the United Nations Economic Commission for Africa (UNECA) and the World Meteorological Organization (WMO), in 1987, created the African Centre of Meteorological Applications for Development (ACMAD), a weather and climate centre based in Niamey (Niger), with mandate for continental coverage.

ACMAD's main mission is to provide reliable weather and climate information and to promote sustainable development in Africa -- within the context of national strategies for poverty eradication in productive sectors that include agriculture, water resources, health, public safety and renewable energy. The centre is also tasked to carry out capacity development for its Member State's National Meteorological and Hydrological Services (NMHSs) in weather prediction, climate monitoring, research and transfer of technology. However, few decades into its operation, it is felt that ACMAD's climate products and contributions are marginal, if any, with regards to development planning ...despite the consensus among scientists and policy makers that the future economic development across the African continent and the welfare of its inhabitant's will increasingly depend on the extent to which climate services are delivered and used (e.g., Vaughan and Dessai 2014). Consequently, vulnerability to dislocation, hunger and famine, diseases are still the most critical problems facing the inhabitants of Africa.

Climate variability is one factor among many that limits development in Africa, and subsequently, requires full consideration in development planning. Therefore, climate institutions (i.e., ACMAD, the sub-Regional Climate Centres and NMHSs) should have the capacity to fully implement their mandate. Unfortunately, these institutions



are still weak in terms of financial and human resources, infrastructure and technical expertise required to provide adequate climate services. In some cases, these institutions lack the political recognition they need to deliver critical climate information for the protection of lives and livelihoods. In order to overcome these challenges, the Conference of Ministers responsible for meteorology in Africa in collaboration with WMO, established the African Ministerial Conference on Meteorology (AMCOMET) as a high policy mechanism for the development of weather and climate services and their applications in Africa. Through its Implementation and Resource Mobilization Plan, AMCOMET will participate in strengthening ACMAD on the implementation of the Global Framework for Climate Services (GFCS) in Africa.

The GFCS (<http://www.wmo.int/gfcs>) was created under the leadership of WMO during the third World Climate Conference (WCC-3) in 2009. It is an international framework to facilitate the development and incorporation of science based climate information and prediction into planning, policy and practice. Its purpose is to enable society to better manage the risks and opportunities arising from climate variability and change, especially for those communities at risk and most vulnerable to climatic hazards. The implementation of GFCS will support and promote effective collaboration with global, regional and national stakeholders. At the global level, GFCS provides through a number of Global Producing Centres (GPCs) for Long-range Forecasts (LRF), climate prediction products and maintains standards. The regional focus is on promoting capacity development beyond single nations through Regional Climate Centres (RCCs), while the national level focuses on tailoring information products to meet user demands in support of climate-smart solutions. Through this approach, countries in need will have access to the latest products, methodologies and tools they can adapt to generate tailored climate services. Capacity development will underpin all the activities of the GFCS, given, particularly debilitating limitations in Africa.

ACMAD has recently been qualified as a pan-African multifunctional WMO RCC. This suggests that the centre will have to develop new products and play significant roles in the production and delivery of climate services. The goal of ACMAD RCC is to help fulfil the need for more regionally focused climate services especially in tailoring the available climate product to match users' needs. Appropriate strategies are required to develop and implement downscaling of such products for applications in (the five GFCS priority areas) agriculture and food security, water, health, energy and disaster risk reduction. But the level of technical expertise needed to support modelling at

ACMAD and hence the level of activity, is very low. International collaboration and support are vital to African RCCs in order for them to bridge the gap between the scale at which the data exist and provision of climate data required by the climate impact assessors.

Recognising this need to support African climate centres to produce useful climate information and strengthen the application of weather and climate services for social and economic development across Africa, the UK Department of International Development (DFID) has formulated the Weather and climate Information SERVICES (WISER) programme. The WISER programme aims to deliver a step-change in the use and provision of weather and climate information to support poverty reduction and promote socio-economic development. Its pan-African component will focus on improving governance and the enabling environment for weather and climate services. DFID will achieve this by supporting African Climate Policy Centre (ACPC) through AMCOMET and WMO to ACMAD with the primary focus of advancing co-development and uptake of the needs-based user-led weather and climate services. This will strengthen the enabling environment, including donors' coordination, protocol for sharing data, running the climate research for development (CR4D) initiative and a fellowship programme.

It is therefore vital to undertake a capacity needs assessment (CNA) of ACMAD to assess its status and capacity needs to effectively fulfil its initial and current mandates. The study will provide recommendations on key human and technical skills, as well as infrastructural and institutional support, needed for ACMAD to improve its ability to deliver relevant climate services to NMHSs and the humanitarian sector in Africa.

## 1.2 Objectives of the assessment

Building operational climate services that can assist decision makers to reduce vulnerability and adapt to climate impacts in GFCS priority areas are the major challenges facing the pan-African RCC. These challenges are hindering the provision and delivery of climate services to the NMHSs, and further prevent the use of these services by the African societies who needed to improve risks management and opportunities arising from climate variability and change, especially those that are most vulnerable to climate-related hazards.



The joint AMCOMET and DFID/WISER programme capacity needs assessment of ACMAD is therefore planned to identify key human and technical skills, infrastructure and institutional needs, governance and the development of fiscal and legal framework, communication and outreach support needed in order for ACMAD RCC to improve its ability to deliver relevant climate services. The assessment is also designed to provide recommendations on how to adequately address the key gaps identified, including a proposed priority of issues to be addressed, and to provide a baseline for continuous monitoring and evaluation of progress against relevant indicators. It is also aim to create a solid foundation for short and long-term planning, implementation and sustainable results.

### 1.3 Deliverables

The final capacity needs assessment report will contain the following:

- Provide an analysis of the current state and status, and project the future development of the institution, focusing on how the RCC will improve delivery of services to key users and sectors;
- Identify the capacity building needs for effective functioning of the RCC;
- Assist in addressing governance issues of the RCC in the shortest time possible by setting goals and benchmarks, explaining objectives and to present a plan in order to realize the goals and objectives of ACMAD RCC. The plans should include how the RCC will monitor and evaluate their improvements in institutional performance and service delivery over time;
- Provide an opportunity to collect pertinent information and data to support decision making processes and to identify strengths and weaknesses within the organization and within its working environment;
- Provide concrete recommendations and specific actions for the development of the RCC over the next 5-10 years, along with a realistic investment plan for the sustainable delivery of services (linking available funds and resources with the level of services).

## 1.4 Methodology

The methodology is designed according to the capacity needs assessment guidelines of the United Nations Development Programme (UNDP, 2008), which is to enable rapid collection and review of existing key capacities needed to reach desired objectives. This approach consists of collecting data through desktop review, interviews and questionnaires, and follow up discussions. Key findings of this assessment will be drawn under 3 structured components, including:

- A desktop review of recent reports and findings, regarding needs and gaps related to ACMAD's work processes, user requirements, services/products produced, human, technical and infrastructural capacity needs. This will include the recent report of joint WMO/GFCS and the Norwegian Refugee Council (NRC) Expert Deployment/NORCAP human capacity needs assessment of ACMAD for effective climate services frameworks in the Sahel. In addition, it will include the report on the review of the current status of ACMAD and proposals for its future governance framework and strategies required for the establishment of AGRHYMET as an RCC for the Economic Community of West African States (ECOWAS) countries.
- A one-on-one telephone call meetings and emails with ACMAD's top management in order to clarify the scope, objectives, methodology and expectations regarding the output of the assessment. The meeting will result in preliminary analysis of the main human, and infrastructural capacity challenges of ACMAD.
- Administration of survey questionnaire on the governance, climate information and product needs, strength and challenges of the centre.

## 2. Current Status of ACMAD

### 2.1 History

In April 1987 the Conference of Ministers of the United Nations (UN) Economic Commission for Africa (ECA) on behalf of the member States and the World Meteorological Organization (WMO), through Decision 540 (XX) established the African Centre of Meteorological Applications for Development (ACMAD), a weather and climate centre based in Niamey, Niger. The aim of the centre is to strengthen Africa's resilience to extreme weather events by improving the understanding of atmospheric and climatic processes over the continent. To achieve this goal, ACMAD must collect, analyse and disseminate meteorological and hydrological information, provide a meteorological watch and early warning system over 53 African countries and promote the training of African scientists and technicians in the application of meteorology for development. However, although ACMAD provides its services to the entire continent of Africa, only 27 out of the 53 ECA Member States have endorsed ACMAD status (Table 1) suggesting the need for additional efforts for many other African countries to effectively participate in promoting ACMAD's activities.

In addition to its mission, ACMAD has recently been qualified as a pan-African multifunctional WMO RCC. WMO RCCs are centres of excellence emanating from the implementation of the GFCS. They serve as a backbone for a given region NMHSs climate activities by creating regional climate products, including regional long-range forecasts, and strengthen their capacity to meet national climate information needs. RCC responsibilities are regional in nature and do not duplicate or replace services produced by NMHSs.

### 2.2 Vision and Mission

The vision of ACMAD is to become the African Centre of Excellence in making Weather, Climate and Environment resources for Sustainable Development. Its

mission is the provision of weather and climate information for the promotion of sustainable development in Africa (notably within the context of national strategies for poverty eradication), in the fields of agriculture, water resources, health, public safety and renewable energy. This is carried out through capacity-building of National Meteorological Services (NMSs) of its Member States, in weather prediction, climate monitoring (extreme events), and transfer of technology (telecommunications, computing and rural communication) and in research.

**Table 1:** List of Member States who have ratified the ACMAD's status (left panel) and those who have not yet ratified the status (right panel).

Countries Endorsed ACMAD status	Date of Endorsement	Countries not Endorsed
1. Angola	<b>Not specified</b>	1. Botswana
2. Algeria	September 18, 1991	2. Cabo Verde
3. Benin	1992	3. Central African Republic
4. Burkina Faso	June 7, 1989	4. Chad
5. Burundi	June 14, 1989	5. Comoros
6. Cameroon	December 18, 1989	6. Djibouti
7. Congo	November 9, 1989	7. Eritrea
8. Cote d'Ivoire	June 1994	8. Gambia
9. Egypt	November 22, 1990	9. Ghana
10. Ethiopia	March 10, 1990	10. Guinea Bissau
11. Gabon	<b>Not specified</b>	11. Equatorial Guinea
12. Guinea	June 20, 1988	12. Lesotho
13. Kenya	April 29, 1991	13. Liberia
14. Libya	<b>Not specified</b>	14. Libya
15. Madagascar	June 18, 1990	15. Mauritania
16. Malawi	June 29, 1990	16. Mozambique
17. Mali	June 6, 1991	17. Namibia
18. Mauritius	March 27, 1989	18. Sao Tome & Principe
19. Morocco	June 4, 1990	19. Sierra Leone
20. Niger	February 22, 1988	20. Somalia
21. Nigeria	March 18, 1988	21. South Africa
22. Rwanda	<b>Not specified</b>	22. Swaziland
23. Senegal	July 6, 1989	23. Tanzania

24. Seychelles	November 8, 1989	24. Uganda
25. Sudan	<b>Not specified</b>	25. Zambia
26. Togo	May 29, 1989	26. Zimbabwe
27. Tunisia	April 7, 1989	

Source: ACMAD archive

## 2.3 Mandate

ACMAD's mandate is as follows:

- Promote and develop the applications of meteorological data and information so as to enhance the economic and social development of the member states, assist in the investigation and mitigation of the effects of weather phenomena, improve the knowledge of the anomalies of the weather and climate resources of the member states and foster the proper conservation of the natural resources of the member states;
- Assist the member states to achieve self-sufficiency in food production, water resources management and utilization of new and renewable sources of energy;
- Act as an African centre of reference in meteorology and its applications to development, and as a resource centre to stimulate applied scientific research especially in tropical meteorology and rain-producing systems and to enrich existing training and development programs;
- Strengthen national weather services to enable them to take full advantage of development opportunities offered by the Centre in support of the respective national economies in order to ensure the total development of the whole meteorological system of the African region in a harmonious manner; and
- Develop those aspects of meteorology which are not catered for by national and sub-regional centres, particularly in the areas of acquiring and adapting agro-meteorological techniques successfully applied elsewhere in support of self-sufficiency in food production and energy; and to address the many pressing issues of drought, tropical cyclones and other climate or weather-related disasters.

## 3. Programmes, Products and Services

### 3.1 Status of ACMAD Products and Services

ACMAD activities focus mainly on climate information and prediction, weather watch and forecasting, and applications in support to sustainable development of Africa (notably within the context of national strategies for poverty eradication), in the fields of agriculture, water resources, health, public safety and renewable energy. Hence, ACMAD's work is implemented by two core scientific programmes; (i) climate and environment and (ii) Weather Watch and Prediction, in addition to one major technical support department, namely the telecommunication and computing department. The climate and environment programme also host the WMO RCC for the provision and delivery of climate products and services including long-range forecast (LRF), climate monitoring products, data services, and training activities to the NMHSs and the sub-regional centres of the continent's economic communities, including ECOWAS RCC, ICPAC, Drought Monitoring Centre, North African RCC-Network and Central African RCC.

### 3.2 Technical Department and Key Products

#### 3.2.1 Climate and Environment Department

ACMAD climate and environment department products are derived from analysis of climate data, statistical models developed at the centre and dynamical model outputs from the global producing centres (GPCs). The focus is mainly on climate monitoring, long range forecasting, data services and training. The department collaborates with other RCCs including the RCC network for Europe over the Mediterranean region under a joint RA I/RA VI framework, and provide expertise for the preparation of the demonstration phase at developing RCCs in Northern, Eastern, Central, Western and Southern Africa. The climate and environment department organizes and leads the consensus pre-season regional climate outlook fora for West, Central, North Africa, the Gulf of Guinea, and South West Indian Ocean in conjunction with the major climate centres world-wide in order to derive a single consensus forecast for each region. The African RCC products are accessible online at <http://www.acmad.net/rcc>, and the status of these products is as follow:

- **Operational activities for climate monitoring**

The overview of the climate monitoring products are depicted in Table 2. This includes, a 10-day and monthly climate monitoring bulletin, seasonal rainfall monitoring, and the production of the African section of WMO/American Meteorological Society (BAMS) annual state of climate report.

**Table 2:** Operational climate monitoring products at the pan-African multi-functional regional climate centre (ACMAD).

Activities	Products
1. Climate Diagnostics and Assessment	<ul style="list-style-type: none"> <li>• Annual state of African climate report (ACMAD)</li> <li>• Annual state of global climate (WMO/BAMS), Africa section report</li> <li>• Monthly climate diagnostic bulletin</li> <li>• 10-day climate diagnostic bulletin</li> <li>• Precipitation, temperatures, anomalies climate indices maps, time series graphs with trends</li> </ul>
2. Establishment of Climate References	<ul style="list-style-type: none"> <li>• Precipitation and temperature reference climatologies for 1931-1960, 1961-1990, 1971-2000, 1981-2010</li> <li>• Climate assessment and datasets climatologies for precipitation, temperature, significant anomalies and indices based on station data</li> </ul>
3. Implementation of Regional Climate Watch	<ul style="list-style-type: none"> <li>• Climate information and advisories focus on significant anomalies and extremes</li> </ul>

Source: <http://acmad.net/rcc/climatemonitoring.php>

- **Operational activities for long range forecasting**

The current status of the operational activities for LRF at the pan-African RCC is summarized in Table 3. The African RCC collects ensembles and multi-model ensemble products from over 6 GPCs for LRF, interpret and assess them for the provision of climate information relevant to RCC users, and provide feedbacks to participating GPCs. Activities such as the comparison of monthly and seasonal LRF



products from over 6 GPCs for the generation of regionally targeted products are routinely performed. The centre offers rainfall, wind velocity and relative humidity predictions at 850 hPa, as well as temperature predictions at 300 hPa for West, Central, and the Horn of Africa.

Regional or sub-regional scale consensus pre-season outlook statements for West and Central Africa (rainfall and monsoon onset) are also organised. However, it is noted that ACMAD does not have a high performance computer cluster to enhance its dynamical modelling capability in order to calibrate regional climate models (RCMs) needed for downscaling and producing dynamical seasonal climate prediction. Instead, the centre relies on the dynamical forecast products of the GPCs such as IRI, Meteo-France, UK Met Office, NOAA Climate Prediction Centre (CPC) and that of the statistical from the NMHSs of participating countries for its regional or sub-regional consensus pre-season outlook statements produce during the annual regional climate outlook forums (PRESAO and PRESAC).

**Table 3:** Operational long-range forecasting products at the pan-African multi-

Activities	Products
Interpretation and assessment of Global products and distribution of results to Global centres	Maps and Graphs of statistical and dynamical models performance
Generation of regional products including seasonal outlooks	Maps of tailored precipitation and temperature forecasts
Generation of consensus statement on regional forecasts	Consensus statements for the region and sub-regions
Verification products	Graphs and maps for verification of forecasts and outlooks
Development of a web portal	All products and datasets related to RCC functions

functional regional climate centre (ACMAD).

Source: <http://acmad.net/rcc/longerange.php>

- **Operational data services, to support LRF and climate monitoring**



The operational data services should be the main arm that monitors climate and weather patterns in the region. As such, it must collect and provide crucial data relating to climatic trends and changes. The centre should provide efficient and responsive weather and climate services that meets member countries' obligations and contribute to Africa's socio-economic development. However, no concrete observational climate database exists at ACMAD even in the form of processed data like gridded observational data. Furthermore, the centre does not have any satellite observation nor environmental data archiving system. The rare observational climate data that exist at the ACMAD RCC centre are obtained using the Surface Synoptic Observations (SYNOP), the upper-level pressure, temperature, humidity and wind (TEMP), and the monthly climatology (CLIMAT) messages transmitted through the Global Telecommunication System (GTS). The centre however, provides African gridded precipitation and temperature datasets through the website of the International Research Institute for Climate and Society (IRI). These datasets resulted from analysis or assimilation of a collection of in situ, satellite and state-of-art model datasets.

### **3.2.2 Weather Watch and Prediction Department**

The Weather Watch and Prediction (WWP) Department assists the National Meteorological and Hydrological services in Africa to better serve the end-users and communities with the provision of short to medium range weather forecast. The WWP department has access to a variety of dynamical model outputs and satellite products using its telecommunication system made up with RETIM and MSG on EUMETCast, a EUMETSAT primary dissemination mechanism for the near real-time delivery of satellite data and products. The department has a central processing system, namely MESSIR COM and MESSIR Vision servers, links to the Regional Teleconnection Centres and EAMAC, and a SYNERGY workstation comprising one server and 3 PC clients installed by Météo France for AMMA programme. Current products generated by the WWP department according to ACMAD web site include:

- A continental scale daily weather forecast bulletin for the general public, and distributed in both French and English;
- A daily severe weather forecast bulletin with continent wide coverage and valid for 3 days;
- A 10-day rainfall monitoring bulletin, in which the previous 10-day rainfall events area summarised and the forecast is issued for the next 10 days;
- Flash flood risk bulletin for West Africa, valid for 3days;

- A weekly Niger basin rainfall forecast bulletin, valid for 7 days;
- An analysis and forecast of key elements characterizing the West African monsoon;
- A regional analysis and forecast of synoptic elements and atmosphere dynamics for Southern Africa region.

### 3.2.3 Telecommunication and Computing Departments

The Telecommunication and Computing department provides information technology assistance, data and information management tools and other support services. It is responsible for managing all matters related to data reception and exchange and maintenance of ACMAD infrastructure. As the other departments, the telecommunication department also lacks human capacity. The current staffing of this department is made up of one personnel, the manager, which is the only one dealing with all the department's activities.

### 3.2.4 Capacity-Building

ACMAD undertakes capacity building programmes in climate prediction, data management, and weather prediction in the form of On-the-Job-Training, workshops and seminars. For example, the climate and environment department organises workshops/trainings to enhance interaction with regional and national users to improve climate literacy, and expand the community of people who can tailor science information for specific applications. The centre also organises capacity building workshops in seasonal climate prediction and applications. The on-job-training at the WWP is dedicated to develop methodologies for the interpretation and use of numerical weather prediction (NWP) products and verification strategies.

## 3.3 Programmes

This section examines the projects entrusted to ACMAD by development partners.

### 3.3.1 MESA project

ACMAD is the continental implementation centre on Monitoring of Environment for Security in Africa (MESA) project Continental Climate Services for Disaster Risks Reduction (DRR). MESA seeks to increase the capacity in information management, decision-making and planning of African continental, regional and national institutions mandated for environment, climate, and food security. It is initiated to provide increasingly powerful tools supporting better communication and policy decisions with

regards to key environment and security issues. Funded by the European Union with an implementation timeframe from 2013-2017, it is characterized by two major activities:

- 1) *Climate Change Assessment Service* -- the objective of this service is to provide planning managers and decision makers with relevant climate information and projections to enable them formulate appropriate policies and strategies on climate change adaptation to build climate resilient societies and economies on the African continent.

Expected output products include regional climate model outputs, climate indices maps, climate trend and variability diagrams and African climate outlook reports. These services can found at ACMAD's web portal <http://www.acmad-au.org/products-services/climate-change-assessment/>

- 2) *Drought Service and Seasonal Climate Forecast* -- designed for preparedness and to support strategic planning ahead of a season through assessing seasonal and intra-seasonal variability and to forecast the probability of drought events.

The expected products delivery include: drought information system established as a dynamic and accessible decision support tool that provides users the ability to determine the potential impacts of drought and the decision support tools needed to better prepare for and mitigate the effects of the drought. This service is accessible at <http://www.acmad-au.org/products-services/drought-services-seasonal-climate-forecast/>

### 3.3.2 ISACIP Project

The Institutional Support to African Climate Institutions Project (ISACIP) is an African Development Bank (AfDB) funded project designed to strengthen the capacities of African regional climate centres to develop and disseminate climate information in support of economic development in the continent. Although coordinated by ACMAD, the primary beneficiaries are ACMAD, AGRHYMET, ICPAC and DMC. ISACIP main activities include:

- improve access to observation networks;
- operationalization of climate information systems;
- improve expertise for downscaling global climate data and scenarios;
- develop and implement climate information dissemination strategies;

- enhancement of the capacity of scientists;
- climate impacts assessments;
- technical and professional training;
- Capacity strengthening.

**Table 4:** Status of delivery of WMO regional climate centre mandatory services at the pan-African regional climate centre in ACMAD, Niamey (Niger).

Function	Products	Status	Observations
<b>Operational Activities for Long-Range Forecast (LRF)</b>			
Interpret & assess relevant LRF from GPCs, distribute information to RCC Users, and provide feedback to GPCs	Assessment of reliability and outcomes of GPCs or Centres on LRF-Multi-Model Ensemble products and reasoning (making use of LC-SVSLRF for the region of interest, in the form of texts, tables, figures...	Implemented	Maps and graphs of GPCs statistical and dynamical model performances exist, NO text attached for interpretation of the maps nor how to make use of them.
Generate regional and sub-regional tailored products, relevant to RCC User needs, including seasonal outlooks etc.	Probabilities for terciles (or appropriate quantile) Element: 2-m mean temperature, total precipitation Update frequency: 10 days to one month	Implemented	Seasonal outlook indicating probabilities with forecast consistency information is posted
Generate consensus statement on regional or sub-regional forecasts	Consensus statement on regional or sub-regional forecast. 2-m mean temp, total precipitation update at least once per year	Implemented	Consensus statements posted for rainfall
Perform verification of RCC quantitative LRF products, including the exchange of basic forecasts and hindcast data	Verification datasets (e.g. SVS LRF scores, Brier Skill Score; ROC; Hit Rate Skill Score) 2-m mean temperature, total precipitation	Non Implemented	In place of the verification dataset, users are offered a seasonal 2 m temperature and precipitation forecast maps

Provide online access to RCC products/services to Users	Online data/information portal	Implemented	RCC website in place
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Operational Activities for Climate Monitoring			
Perform climate diagnostics including analysis of climate variability and extremes, at regional and sub-regional scales	Climate diagnostics bulletin including tables, maps, related products Mean, Max and Min temperatures, total precipitation. GCOS essential climate variables 10-day and monthly	Implemented	10-day and monthly bulletins provided But not frequently updated
Establish an historical reference climatology for the region and/or sub-regions	Database climatological means for various reference periods (e.g. 1931-60; 1951-80; 1961-90; 1971-2000) Mean, Max and Min temperatures, Total precipitation, etc. At least 30 years, preferably 10 years	Implemented	Monthly station climatology provided
Implement a Regional Climate Watch	climate advisories and information for RCC Users Update whenever required, based on the forecast of significant regional climate anomalies	Implemented	Products available with the support of the Monitoring of Environment for Security in Africa (MESA) project
Operational Data Services, to support operational LRF and climate monitoring			
Develop quality controlled regional climate datasets,	Regional, quality controlled climate datasets, gridded where	Partially implemented	African stations climate data were extracted from

gridded where applicable	applicable, following CCI guidance on QA/QC procedures - Mean, Max and Min Temperature, and Precipitation, at a minimum		GTS-SYNOP Metadata and gridded rainfall and temperature dataset provided by NOAA/NCDC and IRI
Provide climate database and archiving services, at the request of NMHSs	National databases with metadata, accessible to the NMHS in question (backup service, development site, etc.).	Partially implemented	No national databases archived No metadata for country databases
<b>Training in the use of operational RCC products and services</b>			
Provide information on methodologies and product specifications for mandatory RCC products, and provide guidance on their use	Manuals, guidance documents and information notes. Update frequency: when methods/ products are revised or introduced or discontinued	Partially implemented	Manuals or guidance on data management posted No manual on the use of climate indices and RCC products
Coordinate training for RCC users in interpretation and use of mandatory RCC products	Survey and analysis of regional training needs, and proposals for training activities.	Partially implemented	Capacity Building workshops provided On-the-job training provided

### 3.4 Major Gaps

ACMAD RCC provides its products and services through a web portal as the GFCS implementation plan recommended. Inspection of the products posted on this webpage was conducted to determine the extent to which the RCC mandatory functions are implemented. Table 4 summarises the implementation status of the



RCC functions. The Table demonstrated that quite a number of activities related to the mandatory functions are being implemented while few overlooked.

### 3.4.1 Human capacity gaps

ACMAD statutes provide 1 permanent staff for each of its technical department, the Chief of the Department and all other staff member are seconded experts from member countries. ACMAD organogram has not been changed even with its recognition as the Pan-African Multifunctioning RCC. Consequently, the centre lacks key personnel to sustain the activities of the RCC functions on a permanent basis.

Currently, there is only one staff, the Chief of Department at the **Climate and Environmental Department** where the RCC activities are being implemented. This demonstrate that ACMAD RCC lacks the minimum manpower to perform a continental RCC mandatory functions. There is no dedicated staffs for climate monitoring, Long Range Forecasting, data services, and training, for example and the centre uses the MESA project human resources for the operational activities of its RCC.

Central to the operational climate services is the **Information and Technology Department**. No activity could be possible at ACMAD RCC without the support of the Information and Telecommunication department. The Department also focus on data collection and management, database support and archiving, and more importantly the dissemination of ACMAD RCC products. ACMAD's information and technology department also has one permanent staff whose contract with the center has ended long ago, but still is in charge because of the non-recruitment of the new manager. The human capacity gaps for this department consist of (i) A System Administrator, responsible for the configuration, operation, and maintenance of systems hardware and software and related infrastructure. (ii) An Information Technology (IT) specialist for providing expertise related to software, hardware, databases, Web resources, and networks. (iii) A Computer Technician for hardware and software system installing, maintaining or repairing equipment, troubleshooting a variety of computer issues, setting up computer security measures, configuring network, and offering technical support on-site.

### 3.4.2 Gaps in ACMAD RCC Products and Services

Many operational applications of climate information require continual inputs on current climatological conditions in making day-to-day, week-to-week, or month-to-month decisions. It appears, however, that climate information and services that incorporate both the latest weather observations and the recent climatological data are not available at ACMAD RCC. In addition to that it is found that a large number of products on the ACMAD RCC website are outdated, and consequently less valuable for user's needs. Several charts and graphs on this website do not have any explanatory text or guidelines attached to them. All these limitations are essentially due to the existing human capacity gaps.

Through the MESA programme, ACMAD produce and deliver climate services for Disaster Risk Reduction (DRR). A dedicated project website is available with up to date climate services for the African platform for DRR and the African Group of Negotiators on climate change ([www.acmad-au.org](http://www.acmad-au.org)) but there is a significant need to develop the application of these services in a number of sectors, including the other GFCS priority areas that present the most pressing and immediate opportunity for bringing benefit to human safety and well-being. Currently, only limited use is made of ACMAD-MESA climate services and seasonal climate forecast mostly by the UN Office for the Coordination of Humanitarian Affairs (OCHA) and FAO for agriculture and disaster mitigation. However, there is a lack of effective institutional arrangements to facilitate a systematic integration of these services with other pertinent information in a form that planning and operational agencies can use at national and local level.

### 3.4.3 Technical Capacity Gaps

Gaps associated with climate services provision are mainly a result of limited capacities of the Centre, and this is because only a minor investment is made in ACMAD by few African countries despite our survey in the Sahelian countries of Burkina Faso, Mali, Senegal, Niger, and Chad reveals that there is so much need for climate products and services. There are severe limitations in terms of technical capacity, availability of professional staff and applications software. For example, recruiting and maintaining professional staff is a major challenge for ACMAD because the salary the Centre offers is not very attractive for young graduates, a consequence of the low-level of funding ACMAD receives from its member States.



The salaries of ACMAD's climate scientists languishes well below that of AGRHYMET's scientists, for example.

Perhaps climate variability must be managed vastly better to deliver the Millennium Development Goals (MDGs) in Africa (IRI 2008) which requires a major effort to integrate climate risk management into climate-sensitive development processes. Hence, national meteorological services across the continent need further access to quality climate information and to develop the scientific capacity that will allow their governments to integrate climate variability and climate change into development planning. But, the above underscore gaps significantly limit the pan-African RCC in providing the needed products and services to the NMHSs. ACMAD also suffers many other constraints, for example,

- The personnel manning level is inadequate relative to the mandated functions of a Climate and Environment Department that include the requirement for a systems manager/analyst, a dynamical climate modelling expert, and a long-range forecast expert, for example.
- ACMAD is not sufficiently engaged with the member countries national development agenda and its services for rural populations are very limited. For RCC to archive the goal of improving the use of climate services for development planning, it is necessary to understand the decision making process and how and when various types of climate information can be incorporated. Currently, there is a lack of understanding of what can be provided to meet the multi-sectoral user's needs.
- There is a gap between what ACMAD RCC currently provides and what is needed for development planning. In addition, farmers across the continent are interested in a broader range of characteristics of rainfall than just seasonal total, notably, patchiness of rainfall, intensity, season onset, and cessation date.
- There is a lack of knowledge and understanding of user needs and how national and regional development decisions are made, so there is little capacity to tailor information appropriately.
- There is a lack of institutional arrangement regarding climate data sharing between ACMAD and the member countries as it is with AGRHYMET and its member States. In practice, it is the responsibility of the NMHSs of member States to make observations and process climate data which are necessary for

the provision of services, and as stated in the WMO Resolution 40<sup>2</sup>, the data and products should be provided on a free and unrestricted basis for the provision of services in support of the protection of life and property and the well-being of all nations, particularly those basic data and products required to describe and forecast weather and climate, and to support WMO programmes. Yet, ACMAD has not been able to access to the countries long-term climate records essential to informing any development policy aimed at addressing the consequence of climate variability or climate change. This lack of observational data are seriously affecting the credibility of the ACMAD RCC products. For example, it is known that areas susceptible to flooding have changed and flood maps developed with past climate data lack enough precision to be useful for disaster management in the current climate. It is imperative to have new flood maps that incorporate recent data.

- Decision-making timescale of 2 to 10 or up to 30 years are strategic for Africa policy and infrastructure planning. Yet, there is a lack of available climate information and services at these timescales because the research and services based on climate scenarios are not yet well developed as require by the RCC mandatory functions. As a result, capacity to develop and provide climate information at decadal to multi-decadal timescales is not available in ACMAD RCC web portal although some projects have identified long-term decisions that are being made in their project areas that could benefit from information about the climate. There is a strong need for technical advice on climate change projections and adaptation strategies.
- Locally downscaled climate projections products are not available because of the lack of expertise in the domain. There is a need to undertake a comprehensive research and development initiatives for climate change services at ACMAD RCC. However, the lack of research department at ACMAD is an impediment to the provision and delivery of climate projection products required for development planning. ACMAD also does not have the necessary institutional arrangements to benefit from available skilled labour in climate research institutes and universities.
- Satellite data often provide good approximations of rainfall in many areas but, interference from humidity, temperature and dust degrade their quality. Blending satellite data with the available rain gauge data would help to overcome these

<sup>2</sup><https://www.wmo.int/pages/about/documents/WMO837.pdf>

problems. However, there is an important technical gap related to the lack of broader understanding as to how best to use the satellite data services to meet the needs of multiple users, including in agriculture, food security, water resources, health, and energy.

- There is also a lack of manuals at ACMAD for the Data Management and Forecasting processes taking place.

### 3.4.4 Infrastructure gaps

Efforts to provide effective climate services for development planning in Africa will only be successful if the Pan-African Regional Climate Centre at ACMAD procures adequate infrastructure capacities for its operational activities. Unfortunately, there still are infrastructure gaps both at ACMAD RCC and the NMHSs the Centre intend to serve.

ACMAD's information and telecommunication infrastructure is constrained by unsecure power supply, a weak internet bandwidth, limited computer processing facilities and capabilities, and inadequate software packages and programs. ACMAD RCC lacks basic computers as well as powerful computers needed to process the sophisticated computer models used in regional climate forecasts. There is the need to improve ACMAD's infrastructure capacity and modernize its telecommunications system.

### Recommendations

- ***ACMAD should substantially increase the frequency to which its products are updated and posted online to provide users with most current information on which to base real-time decisions on preventive or ameliorative actions. This will require the Centre to recruit an Information Technology (IT) management expert to bridge the gap between the production of the information and the online dissemination.***
- ***It is imperative for ACMAD to revise the structure of its organogram to either create a new Department exclusively dedicated to the Pan-African***

***RCC or include the RCC governance under the Climate and Environment Department programme.***

- ***ACMAD should document full details on the methodologies they use for generating the RCC products in order for the NMHSs to understand these products and eventually detect potential errors and give their feedback. The Centre should also communicate to the NMHS uncertainties in the climate forecasts and publish forecasts verification results.***

## 4. Capacity Development Needs

We argue in this report that gaps associated with climate service provision in Africa are mainly a result of limited capacities of institutions that provide the services (e.g., NMHSs, ACMAD, etc.). Insufficient Institutional, human, financial and technological capacity in ACMAD continues to hamper effective climate services delivery. For example, only a minor investment is made in weather and climate services in Africa compared to the rest of the world despite that survey after survey in Sahelian countries and the humanitarian sector show that there is a demand for climate information and services.

Many African countries do not have the necessary basic capabilities to provide sustainable access to climate information and services as found by the Task Force created for formulating the GFCS. It is, therefore, recommends to establish a high profile programme of fast-track projects to build the necessary capacity of Institutions and countries, in accordance with their needs and priorities.

The pan-African RCC mandated to provide climate services relevant for African nations development planning, conduct applied climate studies, foster regional climate research and decision-support tools, is also confronted with capacity needs in a number of areas. In this Chapter, we describe the major capacities needed for ACMAD RCC to effectively produce and deliver climate services as recommended by the WMO/GFCS.

## 4.1 Human Capacity Needs

Of crucial importance to the work of ACMAD RCC is having competent and experienced staff in various climate fields. However, ACMAD has found it difficult to attract qualified high-level staff with specialised experience in their fields of activity, because the Centre is unable to offer adequate job security and stability due to its financial weakness. Hence, the staffing situation of ACMAD is becoming critical and it's adversely affecting the full implementation of the RCC. It is further mentioned during our discussion that a total of 12 experts would be required to operate the mandatory functions of ACMAD-RCC. Currently, the centre is in need of a minimum of six RCC support staffs to support a minimum optimal operation activities at ACMAD RCC. These include:

- Two (2) experts for long range forecasting;
- One (1) expert for Climate monitoring;
- One (1) expert for Information Technology (IT) including the RCC web portal;
- One (1) expert for data management
- One (1) expert for training;

It is worth to note that after the human capacity assessment of ACMAD conducted by the Norwegian Refugee Council (NRC) and the WMO/GFCS, an Expert on long rang forecasting was recruited by NRC to support ACMAD RCC activities for a period of one year.

Human capacity in climate sensitive sectors also needs to be addressed in order to achieve the GFCS goals. These are in priority order:

- Food Security Analysis;
- Communication of climate information (Climate Information Services);
- Provision of differentiated climate information to humanitarian sector;
- Provision of differentiated climate information to health sector;
- Provision of differentiated climate information to energy sector

## Recommendation

- **ACMAD should improve its staffing expertise, skills, competencies and knowledge to meet the challenges of a pan-African multi-functional RCC.**
- **Donors should help the Centre to recruit high-skilled and experienced professional in climate monitoring, long range forecasting, data services, and information technology as stated above with a long-term contract.**
- **ACMAD should initiate salary reviews to the levels comparable to the international standards in order to attract high-skilled human resources in the continent and abroad.**

## 4.2 Financial Need

ACMAD Constitution in its Article 12 stated that the Centre shall derive its finances from donors and contributions made by the member States as determined by the Conference of Ministers. The Centre may also derive further resources in cash or in kind from the United Nations and its specialized agencies, and such other institutions and organizations as may be interested in the activities of the Centre. It is expected that the member States contributions shall cover the operating cost of the Centre. Nevertheless, as we argue in this report, many of them do not pay their fair share, and for those who does, payments are irregular, fractions of the commitments and provided late.

Since many African countries were at present undergoing severe financial strain due to social and economic crisis which is prevent them financing ACMAD, the centre is forced to rely on partners for much of its activities. A critical first step, therefore, is for the donors to provide financial aid to ACMAD RCC for its expenditures to produce and deliver climate information and services, including to initiate the routine integration of this information into development planning in Africa for at least three (3) to five (5) years before the member countries can take over the financial responsibility of the RCC.

## Recommendations

- **ACMAD partners are urged to accompany the Pan-African RCC to attend its maturity phase with their financial support for the at least 10-year period.**



**Afterward, the ACMAD member States should take over all the financial expenditures of the RCC.**

To ensure ACMAD RCC continue to receive contributions from members States, it is recommended that:

- **Member States should paid their share through an intergovernmental organization such as the African Union (AU) or through each of the sub-regional economic communities such as the Economic Community of West African States (ECOWAS), the East African Community (EAC), the Southern African Development Community (SADC), the Intergovernmental Authority on Development (IGAD) and the Arab Maghreb Union as does the AGRHYMET centre and the ASECNA training schools whose operations are financed by the contributions of member States through the parent intergovernmental organizations, namely CILSS and ASECNA respectively.**

### **4.3 Infrastructure capacity Needs**

- *Need for Computers*

ACMAD RCC will require powerful computer facilities, satellite image reception capability, reliable communications for receiving data and information from the Global Producing Centres for Long-range Forecasts and from observation sites in Africa; a broadcast-mode means of communicating charts, diagrams and other output to sub-regional RCCs and to the national meteorological centres, probably through satellite communication.

- *Telecommunication System Need*

Near-real-time observations of variables such as rainfall, temperatures, humidity serve as a useful proxy for climate-sensitive variables. For instance, crop production, the risk of drought or flooding, vector-borne diseases outbreak, locust population are all sensitive to the recent climate records and so, forecasting these impacts for early warning and decision-making derive at least some of their predictability from near-real-time observations. Since ACMAD does not have access to near-real-time observations, satellite data becomes a unique and immensely powerful for them in monitoring the environment and conveying information in near-real-time.

Satellite is an invaluable tool playing an increasingly important role in the field of meteorology especially in Africa where the in situ network stations is very sparse

compared to the rest of the world. The imagery is used for various applications such as storms tracking, cloud movement, precipitation measurement, Sea Surface Temperatures estimation, forest fires detection, and vegetation monitoring etc. The soundings from satellite platforms/instruments enable upper air data collection in data-sparse areas such as oceans, dense forests and desert regions. The satellites provide much-needed input into climate models as well as measurements of various parameters not obtained in balloon soundings.

Since ACMAD only relies on RETIM communications system, it is urgently in need of ground equipment, which includes satellite receivers, computers, and software programs to be able to receive and display satellite data stream and products broadcast from local weather service offices and other sources. In addition to the satellite-based data distribution systems RETIM-Africa, there are several satellite systems that can be useful in supplementing GTS connectivity and that ACMAD needs to be connected too. These include:

- International Satellite Communications System (ISCS)
- Emergency Manager's Weather Information Network (EMWIN)
- EUMETCast, the UK Met Office's Satellite Distribution (SADIS)
- Radio and Internet for the Communication of Hydro-Meteorological and Climate-
- Related Information (RANET)
- Global Marine Distress and Safety System (GMDSS)

ACMAD's information and telecommunication system are constrained by an unstable power supply, a low internet bandwidth, a limited computer processing speed, and inadequate software packages and programmes. The IT infrastructure is inadequate for generating robust climate information and lacks efficient communication platforms essential for data sharing and finally, knowledge of how to package the information for use. In addition, there is no dedicated link with any regional WMO Integrated Global Observing System (WIGOS)/WMO Information System (WIS) network. The ACMAD IT department does not have adequate human resources and only rely on one staff who is working round the clock.

The sub-regional RCC and NMHSs will also require communication reception and information processing facilities to obtain and use the charts and other bulletins produce by ACMAD RCC, and training for staff to ensure that they know how best to



apply the information and services to the particular needs of their sub-region or country.

## Recommendations

- To efficiently produce and deliver climate information for decision-making processes across Africa, ACMAD needs support to improve its infrastructure capacity and modernize its telecommunication system.
- There is a crucial need at this moment for ACMAD RCC to acquire several desktop computers, laptops and high-performance computing system for data management, climate simulations, and analysis. At least ten (10) new desktops and three (3) laptop computers are currently needed.
- ACMAD should upgrade its Internet connectivity to access to a broadband high-speed Internet for support of climate prediction activities, downscaling, research and reaching out with the NMHSs, sub-regional RCCs, and stakeholders by email, file transfer, web browsing, etc.
- A sustainable power generation system is also required to overcome the common Power supply outages the Centre frequently experienced.
- National meteorological services and the sub-regional RCCs are the first beneficiaries of the pan-African RCC products and services. In this sense, these centres also need to be strengthened with well-trained staff who are capable of tailoring climate information and services they provide directly to local population and planners in their respective sub-regions and countries.

## 4.4 Capacity Building

Effective climate services will depend on the human technical capacities and expertise to generate appropriate climate information and products that meet the user needs. Many NMHSs in Africa face difficulties in providing national initial and ongoing meteorological education and training to their staff. ACMAD's RCC who has the ability to provide training for its member States also, lacks human scientific talent to perform this task. Consequently, short-term training and other capacity building at

ACMAD are limited to basic statistical analysis and statistical seasonal rainfall prediction.

Capacity building must be seen as a long-term relationship of listening and learning between climate information providers and users. Such a relationship requires access to data, methods and tools along with community collaboration and the ability to generate knowledge, and knowledge transfer. More generally, mainstreaming climate change education is needed in curricula at all educational levels to ensure that there is a greater awareness of the impacts of climate variability and change, and foster interests in effective ways of managing them.

Progress has been made in some areas in terms of short-term training, seasonal forecasting for example for effective decentralization of service delivery and information service delivery. However, there still is an urgent need to further develop climate services that are commensurate with the particular needs of development stakeholders, and scale of action required to meet the development challenge. Capacity building to meet this demand should include:

- Awareness raising, within the NMHSs, Sub-regional RRCs and the pan-African RCC, of national development priorities, roles of National Adaptation Programs (NAP) and Poverty Reduction Strategy (PRS), and rural community information needs;
- Management training in the participatory process of developing a strategic plan and evolving the service to meet the needs of development partner priorities as an effective climate services provider;
- Training in communication, working with development partners and the media, to bring climate information to where it is needed;
- Technical training to decentralize services, to enable widespread best practice, and to collect and process the data needed to deliver the information services required by the local development stakeholders; and
- Training in resource mobilization and management of interdisciplinary projects for development in order to obtain more resources and extend their reach.
- Training the Trainers in order to maintain a pool of skilled professionals whom the centre can rely on to promote ongoing training of staff in the NMHSs and sub-regional RCCs.

## Recommendations

- **ACMAD should be helped to provide short-term professional training to its core staff, including staff from the NMHSs and the sub-regional RCCs. Such short-term training should be upscale, and strongly oriented toward a clearly defined development strategy that recognizes the importance of climate information to development services.**
- **ACMAD, in collaboration with its partners (e.g., WMO, AMCOMET, ACPC, etc.) should sponsor careful assessment of the ability of current programmes in climate and related fields, and train new personnel who are capable of working in interdisciplinary mode required by many climate-related problems. This should include examination of the employment and professional opportunities for those interested in this type of work. Such assessment may, among others, suggest important institutional arrangements at regional and country levels to ensure that sufficient human resources are developed to meet future needs.**

## 4.5 Research and Development Needs

The successful climate services information will depend on maximising the potential of existing knowledge, new research developments and strong support from and strengthened collaboration between all relevant research communities (WMO-No 1065). Despite the advances in climate science, there are significant gaps in our understanding of the climate system specially the monsoon variability and prediction. One of the challenges is our incapability to better understand the feedbacks between the various components of the coupled atmosphere-ocean-land surface. Decades of research also have highlighted the highly variable and unpredictable nature of African climate, and without new research initiatives, this is unlikely to change.

ACMAD lacks a vibrant research team and infrastructures that can help and support the centre respond to scientific challenges. The Centre has an extremely low level of expertise in climate science as shown by the quasi-inexistence of publishing material in international journals. Development of reliable climate information and services requires new research initiatives in a number of areas, including the El-Niño Southern

Oscillation (ENSO). The ENSO signal dominates the year to year variability in the African climate, thus, crucial to seasonal forecasting needs to be fully understood.

RCMs are the tools to experiment on the African climate system in order to better understand current climate and its future variability. Yet, no RCM is run at ACMAD RCC to understand how well these models represent the climate of African region despite the needs for progress to be made in a number of areas, including:

- Precise positioning, timing and intensity of specific features, such as the onset of the Sahel precipitation which happen several months early in some models,
- The precipitation gradient across southern Africa, and the orientation of tropical convection over East Africa.
- Coupled land-surface atmosphere feedbacks.

There is a need for Climate Data Management research projects for a rigorous quality check, and blending satellite data with the available rain gauge network of synoptic and secondary stations data to provide gridded data which can be easily used with sector oriented data, including agriculture, food security, water resources, health, and energy.

### Recommendations

- **ACMAD should initiate an advance scientific research and application to conduct operational and applied research in meteorology and related sciences.**
- **Improved communication and dissemination of new research results and techniques in a timely fashion are an important need.**
- **A useful contribution might be for ACMAD RCC to report briefly on its recent climate-related research in some easily accessed regular publication such as newspapers or magazines published in Africa. Close interaction with the research and applications components of the Global Producing Centres is also encouraged.**

## 4.6 Institution Coordination

ACMAD RCC currently lacks an effective institutional arrangement to facilitate the generation, analysis and systematic integration of relevant climate information with other pertinent information in a form that planning and operational agencies can use. Part of the reason is that within different sectors, there may be a very wide range of institutions working at different administrative scales that are generally poorly coordinated. This does not allow coherence in policy or to coordinate institutional strategies to share the capacity to analyse climate data or develop crosscutting approaches to support risk management. There is a need for engaging institutions such as national research centres, universities, and NGOs in the development of demand-led climate information.

Timely climate-informed decision are critically important for disaster response management, but analyses tend to be duplicated by multiple institutions. This confuses the international organisations in determining policies and programmes and further imposes a constraint on national-level decision-making. ACMAD RCC should assessed such consideration to make sure that its climate information and services can be integrated effectively and used by all organisations together for planning a coherent early response.

The Centre should create close bonds with the NMHSs while reinforcing its presence at the continental level through an improved communication and information-sharing strategy that is innovative, dynamic, and in the official languages spoken across the continent (i.e. English, French, Arabic, and Portuguese). The Centre should also take a lead role in fostering coordination and communication regionally, not only with NMHSs but also with the sub-regional RCC within and outside the continent. An experienced communicator tasked with providing strategic communications advice to the RCC service providers including the development of messages and plans to engage stakeholders/users is needed. He/she must be a capable self-directed and strategic thinker who is comfortable in an advisory role to climate professionals and executing a wide range of communication deliverables, from webcasts and face-to-face presentations to emails and news articles.

### Recommendations

- **ACMAD RCC need to develop a strategy for engaging national research institutions, universities, and NGOs in the development of demand-led climate information.**

- The Pan-African RCC should foster institutional coordination and communication regionally, not only with NMHSs but also with the sub-regional RCC within and outside the continent.

## 5. Strategic Plan for RCC Development

### 5.1 Introduction

This chapter highlights the strategic issues that ACMAD RCC needs to address in order to fulfil its mandate, vision, and mission. The strategic plan emanates from the environment analysis discussed in the above chapters whereby the identified capacities need of are the main challenges of the continental RCC role in delivering reliable and tailored climate information services for development planning. It is intent to help the Pan-African RCC to enhance its capacity to satisfy societal needs in the production and delivery of climate information and services for sustainable economic development in Africa.

The African Centre of Meteorological Application for Development and the Pan-African Regional Climate Centre serve the African National Meteorological and Hydrological Services and stakeholders, through a partnership with other international climate agencies and development donors. ACMAD and the RCCs form a unique climate provider system to support African climate-sensitive institutions. This system provides climate information services for development planning and practice

in Africa. Achieving a high level of user's satisfaction among a diverse user base is a challenge, particularly given that:

- African society is extremely vulnerable to climate conditions at different scales of interest and action, ranging from individual citizens to households, communities, and countries as a whole.
- User needs for climate information vary markedly by geographic region and by season.

The focus over the next 5 to 10 years will be to build on the ACMAD RCC modernization and provide a seamless climate information, products and services with time scales ranging from 10 days (dekade) to century. These products will be relevant to user needs, accurate, and timely.

This strategic plan, through the goals, objectives, and performance measures, lays out the path ACMAD RCC will take to accomplish the mission and achieve the goals set by the Global Framework for Climate Services.

## 5.2 Objectives

This strategic plan provides guidance and direction to ensure focused, measurable and coordinated pathways in the provision of climate information and services. Based on the assessment results, ACMAD RCC has four strategic goals to advance its services to Africa over the next 10 years.

Table 6 in Annex 1 summarizes the essential required capabilities and their expected products and services ACMAD RCC must produce for the benefit of African NMHSs. Table 6 is adapted from the conclusion of the GFCS Taskforce report.

## 5.3 Action Plan 2017-2026

### 1.0 Deliver Better Products and Services

Deliver a credible, timely, and relevant suite of seamless climate products and services which exploit technology to the fullest to meet user and stakeholder needs.

#### 1.1 Expand and improve the existing climate product and service line:

- ***Increase the accuracy and timeliness of ACMAD RCC warnings.***

*Performance Measures:*



- ✓ Reduce floodwarning false alarm rate and increase the probability of detection of drought and flood warning. Increase the lead time for the seasonal rainfall prediction from 1 month to 2 months.
- ✓ Increase the average lead time for high impact event forecasts to beyond 24 hours with no increase in warned area. Improve tropical cyclone wind speed forecasts by 20 percent for the coast of Mozambique.
- ✓ Increase Long-Range Forecast lead time.
- **Improve the accessibility and availability of climate information to the African NMHSs and international stakeholders.**

*Performance Measures:*

- ✓ Post ACMAD RCC products and data on the Internet in graphic-oriented format (2018).
  - ✓ Strengthen coordination and collaboration with NMHSs, sub-regional RCCs and stakeholders including Government agencies. (2021).
  - ✓ Deploy improved ACMAD RCC voice for critical products (2019).
  - **Improve accessibility of climate information to high risk communities**
- Performance Measures:*
- ✓ Increase ACMAD RCC coverage to 100 percent in hazardous weather high-risk areas (2018).
  - ✓ Convert ACMAD RCC products into multilingual formats (2018).
  - ✓ Enhance partnerships with the emergency management community in the region and increase the lead time for information delivered on emergency weather and climate situations (2018).
  - ✓ Establish two-way links to countries emergency management communications infrastructure (2017).
  - **Extend and improve the accuracy of marine (wind and wave) forecasts.**

*Performance Measures:*

- ✓ Improve the accuracy by 30 percent of wind and wave forecasts (2018).

- ✓ Extend the frequency of wind and wave forecasts (2017).
- ✓ Improve by 20 percent the lead time and accuracy for Storm, and Special Marine Warnings (2021).
- ✓ Tailor special marine products to the needs of marine community (2018).
- **Implement a seamless suite of fire-weather products and services uniformly across the Nation.**
  - Performance Measures:*
  - ✓ Implement Day 1 to seasonal outlook products for critical fire-weather elements and patterns (2018).
  - ✓ Specify the forecast confidence on all regional and national outlook and local forecast products (2019).
  - ✓ Develop baseline for fire-weather parameters and improve accuracy by 30 percent (2026).

## **1.2 Produce a seamless suite of products and services.**

- **Produce a seamless suite of products and services with an emphasis on emerging climate products.**
  - Performance Measures:*
  - ✓ Introduce threat assessments which link climate events to hazardous weather forecasts (2020).
  - ✓ Link climate forecasts and threat assessments to local weather forecasts (2022).
- **Improve the use, integration, quality, and cost effectiveness of observations.**
  - Performance Measures:*
  - ✓ Achieve the optimal mix of observing and satellite data processing systems to support the ACMAD RCC mission (2022).
  - ✓ Improve data sharing mechanism with NMHSs, data management and archival systems (2025)

### **1.3 Nurture critical partnerships to provide effective and efficient delivery of ACMAD RCC products and services.**

*Performance Measures:*

- ✓ Increase the number of sectorial users and local emergency managers trained in the use of climate information and service for decision-making by 10% annually (2026).

### **1.4 Implement a customer service improvement program.**

*Performance Measures:*

- ✓ Establish a customer satisfaction index (2019).
- ✓ Track customer index with the goal of a 10 percent increase yearly (2025).

## **2.0 Capitalize on Scientific and Technological Advances**

Sound science and innovative technologies are fundamental for a RCC to produce and deliver quality climate services. Improving products and services to meet user and stakeholder needs in the future is critically dependent on providing a well trained work force with a continual infusion of new and proven scientific ideas and technological systems.

### **2.1 Expand cooperation with research community to promote and guide research and development toward product and service improvement goals.**

*Performance Measures:*

- ✓ Link research and development activities to ACMAD RCC improvement goals (2020).
- ✓ Based on ACMAD RCC service priorities, develop a multi-year research plan and process involving the ACMAD research partners (2026).
- ✓ Assess annually the impact of ACMAD RCC service improvement goals on research and development programmes and initiatives including the regional Disaster Reduction Initiative, the African Climate Change Research Programme (2017).

### **2.2 Reduce the time required to implement proven research and into operations.**

*Performance Measures:*

- ✓ Establish an experimental test beds to accelerate the infusion of new science and technology into the forecast process (2018).
- ✓ Develop and implement standardized procedures for introducing science and technology into the forecast process (2018).

## **2.3 Improve data assimilation systems.**

*Performance Measures:*

- ✓ Implement a climate research and data assimilation (2019).
- ✓ Implement the next generation Regional Climate simulation system (2018).
- ✓ Decrease by 50 percent the time necessary to incorporate new satellite data sets into an operational assimilation system (2018).

## **2.4 Improve understanding and prediction of long-term climate variability.**

*Performance Measures:*

- ✓ Increase forecast accuracy for long-term decadal trends (2020).

## **2.5 Leverage information technology to improve the cost effectiveness of ACMAD systems, and operations.**

*Performance Measures:*

- ✓ Equip ACMAD RCC facilities with computer resources, Internet, High Performance Computing platforms, verification software, necessary to achieve planned and evolving operational and strategic results.
- ✓ Acquire facilities to facilitate teleconferencing on weather and climate forecasts between the Pan-African RCC and the sub-regional RCCs.

## **3.0 Capacity Development**

### **3.1 Enhance the professional development and training program for RCC work force to include teamwork, leadership, diversity, and users interface service.**

*Performance Measures:*

- ✓ Complete leadership training for all supervisors and leaders (2017).

- ✓ Establish and apply Baseline Proficiency Standards to all operational positions (2017).

### **3.2 Capitalize on the diversity of Africa work force to improve participation, communication, performance.**

*Performance Measures:*

- ✓ Use geographically and functionally diverse teams to implement this strategic plan (2017).
- ✓ Set targets for Managing Diversity performance measures (2018).
- ✓ Increase the representation of women, and people with disabilities (2017).
- ✓ Recruit to have sufficient staff (2017).

### **4.0 To Engage in partnerships and collaborations for mutual benefits**

*Performance Measures:*

- ✓ Establish partnerships with users and stakeholders (2017)

## **6. Conclusion**

Sustainable development planning needs to rely on excellent climate information systems to better cope with climate variability and change. Across the African continent, however, though communities (individuals, farmers, local governments and countries) are consciously making decisions to respond to these changes, it appears, that climate information is marginally entering into development planning owing the challenges that exist in both the provision of climate information and its use. Climate-informed policy, planning and interventions result in more resilient, less vulnerable economies and societies, thus fostering sustainable development. We argue that achieving this goal will also depend on improved decision-making of stakeholders, including government planners, donors, extension workers, farmers and NGOs. Hence, the demand for climate information and services must come from their individual and collective awareness that managing climate variability can improve the return on development investments. However, this demand must be met by efficient supply of credible, timely and appropriate information in a form that supports the

particular management problem, as well as improved capacity for utilizing such information effectively.

The African Centre of Meteorological Applications for Development (ACMAD) has therefore been established to provide reliable weather and climate information and to promote sustainable development in Africa. It has also been designated as the continental multi-functional RCC in the framework of the GFCS. This assessment identifies ACMAD's human, infrastructural, institutional and governance, fiscal and legal, communication and outreach capacity needs for the international community to consider in order to support ACMAD improve its ability to deliver relevant climate services to NMHSs and the humanitarian sector in the continent.

It is found that ACMAD's main obstacles in the delivery of credible climate information include the lack of human capacity in the field of climate monitoring and diagnostic, long range forecasting and data services, the lack of financial support, the lack of high-performance computing infrastructure and internet connection capacity. Thus, strenuous efforts should be made to improve the ACMAD RCC provision of climate information.

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## Annex 1

**Table 5:** Actions for the development of climate services and expected outputs of the African multi-functional RCC.

<b>REQUIRED CAPABILITIES</b>	<b>Observations</b>	<ul style="list-style-type: none"> <li>• Conduct data management including quality assurance/quality control, using Quality Management Framework principles;</li> <li>• Develop and maintain data archives;</li> <li>• Conduct data rescue;</li> <li>• Design and conduct life-cycle management of national observing systems for climate purposes;</li> <li>• Provide oversight on adherence to climate standards for observations (e.g. Global Climate Observing System climate monitoring principles) and instruments for measurement;</li> <li>• Historical as well as real time observations in the atmosphere, the oceans, over land and ice of the Essential Climate Variables prepared by Global Climate Observing System and partners for climate purposes, exchanged freely for use in Regional Climate Centres, for at least one Global Surface Network site;</li> <li>• Contribute to interoperable access via WIS to all appropriate climate observations and metadata;</li> <li>• Undertake to improve station density for climate studies of temperature and precipitation;</li> <li>• Improve observations based on user feedback.</li> </ul>
	<b>Research</b>	<ul style="list-style-type: none"> <li>• Participate in funded projects, field experiments;</li> <li>• Some engagement in applied climate research using local and other datasets.</li> </ul>
	<b>Capacity building</b>	<ul style="list-style-type: none"> <li>• Participate in training, as required, for data management, Quality Management Framework, data rescue, basic analysis (using, e.g., Climate Database Management System), fundamentals of climatology, preliminary training for use of climate prediction products, etc.;</li> <li>• Participate as appropriate in Regional Climate Outlook Forums;</li> <li>• Participate in training for climate services specialties, including for seasonal prediction, basic downscaling techniques, climate applications, advanced statistical procedures, etc.;</li> <li>• Conduct training for data management, data rescue and basic climate data analysis.</li> </ul>

	<p><b>User Interface</b></p> <ul style="list-style-type: none"> <li>• Interact with users, to meet requests (for basic climatology questions) and gather feedback on products;</li> <li>• Conduct or contribute to regional and national climate outlook forums (Regional Climate Outlook Forums and National Climate Outlook Forums) and outlook communication;</li> <li>• Interact with users in one or more sectors to identify their requirements for, and provide advice on, climate information and products for their application;</li> <li>• Assist users to interpret/use climate predictions and products;</li> <li>• Get feedback from users on the usefulness and effectiveness of the information and services provided.</li> </ul>
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<p><b>EXPECTED OUTPUTS</b></p>	<p><b>Products</b></p> <ul style="list-style-type: none"> <li>• Datasets (land-based atmospheric and terrestrial, coastal/marine, some remotely sensed);</li> <li>• Time series for single parameters;</li> <li>• Long term trend maps;</li> <li>• Basic statistics (graphs, counts, etc.) on extremes, frequency of occurrence, spatial means for temperature (Max, Min, Mean), precipitation, and possibly relative humidity, evapotranspiration, thunder days, sunshine duration, cyclones, etc.), climatological norms;</li> <li>• Map analysis of T, P etc, and anomalies (weekly, monthly, etc.), showing spatial patterns and climate zones;</li> <li>• Some assessments and analyses of spatial and temporal factors and processes involved in observed climate patterns (e.g. diagnostics on Tropical cyclones, monsoon, synoptic-scale storms, etc.);</li> <li>• Hazards monitoring and Climate Watch products (basic assessments, advisories, analysis of climate extremes and extreme 'events', maps, graphs, imagery (e.g. satellite), observations on current (monthly) climate conditions vis-à-vis means, variance, thresholds, percentiles and weekly, 10-day, monthly, seasonal and annual basis, etc.;</li> <li>• Reviews and assessments of past climate patterns, e.g. World Meteorological Organization annual and multi-year reports on the State of the Climate</li> <li>• Application products including probable maximum precipitation, probable maximum floods , Intensity duration frequency , etc.;</li> <li>• National scale monthly and seasonal (generally three-monthly) climate forecasts and outlooks, plus related information on uncertainty, skill, etc. including maps of expected anomalies (e.g. for temperature or precipitation), in probabilistic format; consensus summary assessments of key features and, at national levels, may include advisories and warnings;</li> <li>• Improve services and products based on feedback from users.</li> </ul>
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	<b>Services</b>	<ul style="list-style-type: none"> <li>• Data services (where permitted under current mandate and legislation);</li> <li>• Conduct basic climate diagnostics and climate analysis (staff will have some proficiency in climate statistics, or be able to reliably use statistical software (e.g. Climate Database Management System);</li> <li>• Perform basic climate assessment;</li> <li>• Contribute to Regional Climate Outlook Forums;</li> <li>• Disseminate climate products (i.e. those based on data; regional and national climate monitoring products if available; seasonal outlooks provided by Regional Climate Outlook Forums and Regional Climate Centres);</li> <li>• Conduct advanced statistical activities including analysis and diagnostics; homogeneity testing and adjustment; regression, development of climate indices, etc.;</li> <li>• Develop and/or provide (have access to and can effectively work with) monthly and longer climate predictions including seasonal climate outlooks, both statistical and model-based (down-scaled);</li> <li>• Add value from national perspectives to the products received from Regional Climate Centres and in some cases Global Producing Centres</li> <li>• Conduct climate watch programmes and disseminate early warnings.</li> </ul>
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