ብሔራዊ የሚቲዎሮሎጂ ኤጀንሲ
NATIONAL METEOROLOGICAL AGENCY

PROCEEDING REPORT OF THE 40TH ANNIVERSARY OF

NATIONAL METEOROLOGICAL AGENCY

Official endorsement of the National Framework for Climate Services and International Scientific Conference

FORTY YEARS OF WEATHER AND CLIMATE SERVICES IN ETHIOPIA

NATIONAL METEOROLOGICAL AGENCY OF ETHIOPIA

25-26 May 2021, Skylight Hotel, Addis Ababa, Ethiopia

Proceeding Report of the 40th Anniversary of National Meteorological Agency, Official endorsement of the National Framework for Climate Services an International Scientific Conference

National Meteorological Agency
Addis Ababa, Ethiopia
P.O. Box 1090
Addis Ababa, Ethiopia
Tel. + 251-11-5512299 or 6615779
Fax: + 251-11-5587910
E-mail: nma1@ethiomet.gov.et
August 2021

Disclaimer
The responsibility for opinions expressed in presentations, studies, and other contributions in this proceeding rest solely with their authors and rapporteurs. This proceeding does not constitute an endorsement by the NMA of the opinions so expressed in them.

Design: Solomon Makau

National Meteorological Agency
Addis Ababa, Ethiopia
P.O. Box 1090
Addis Ababa, Ethiopia
Tel. + 251-11-5512299 or 6615779
Fax: + 251-11-5587910
E-mail: nma1@ethiomet.gov.et
August 2021

Reviewed and edited by

Abate Getachew	abateyy@yahoo.com
Asaminew Teshome	asmin2met@gmail.com
Fetene Teshome	fetenekoket@yahoo.com
Kinfe Hailemariam	Kinfe_hm@yahoo.com
Leta Bekele	Letaabreham@gmail.com
Mulualem Abera	yonasmulu2006@gmail.com
Kassa Fekadu	k_fekadu01@yahoo.com
Maren Radeny	M.radeny@cgiar.org
Teferi Demissie	T.Demissie@cgiar.org
Brook Makonnen	Brook.Tesfaye@cgiar.org
Dawit Solomon	D.Solomon@cgiar.org

TABLE OF CONTENTS

Foreword i
Acronym and Abbreviation ii

1. Acknowledgements
1.1. Objectives of the 40th year Anniversary iv

2. Introduction v

3. Panel Discussion on Climate Services in Ethiopia 1

4. Session I: Opening of the 40th Anniversary 2
4.1. Summary of welcoming speech by NMA Director General 2
4.2. Summary of keynote speech by WMO Secretary General 3
4.3. Summary of Opening Speech by H.E Minister 4

5. Session II: National Framework for Climate Services 6
5.1. NMA history and 40th years Weather and Climate Services (by Fetene Teshome) 6
5.2. National Framework for Climate Services (NFCS) of Ethiopia (by Mr. Kinfe H/Mariam) 7

6. Session II: Certificate Award 13
6.1. Former General Managers of NMA 13
6.2. Local and International Institutes which Support NMA on Capacity Building 13
6.3. Organizations which Support NMA through different Projects 14
6.4. Ethiopian Scientist in the Country and Diaspora 15
6.5. Former and current Minsters of the Ministry of Water, Irrigation and Energy 15

7. Session III: - Parallel Session I: Capacity Building and Research Development 16
7.1. Accelerating the impact of consultative group for International Agricultural Research climate research in Africa contribution to the capacity building of NMA)-Ethiopia project: 16
7.2. Meteorological data, Climate service and NMA Map-room 16
7.3. Capacity Building Needs and Possible area of cooperation 17
7.4. NMA Research Priority Area and University Linkage 17
7.5. Human Resource Development, Capacity Building and Research Collaboration for the Betterment of Operational Services of Arbaminch Universities 18
7.6. The role of MU-ICS (Institute of Climate and Society) on the capacity building of professionals in Ethiopia & Sub-Saharan Africa 18
7.7. Basic principles of cloud seeding and pilot progress in Ethiopia 19
7.8. A Successful Bilateral Cooperation Between ESSTI and NMA to Develop Improved Weather and Climate Services 20
7.9. Application of Artificial Intelligence in Meteorology 21
7.10. Enhancing Climate Services Education in Ethiopia through ACToday project 21
7.11. WMO Capacity Development Programme 22

8. Session III: Parallel session II: Agriculture and Environmental, Forest and Climate Change Sectors 24
8.1. General Description and Roles of NMA on the Implementation of NFCS 24
8.2. NFCS-E (Focusing on Agriculture Sector) 26
8.3. Environment, Forest and climate change commission 27
8.4. AICCRA Project Contribution to NFCS 29
8.5. Enhancing climate Services Ethiopia: IRI's Role 30
8.6. Monitoring localized climatic extremes using Climate Hazards Center Early Warning Tools 31
8.7. Assessing the Scientific Benefits of the UCSB/CHC and NMA Partnership 33

9. Session III: Parallel Session III: Aviation Sector 36
9.1. Aeronautical Meteorology Services Delivery, Challenge and Opportunity 36
9.2. WMO Aeronautical Meteorological Services Program (AeMP) 38
9.3. Meteorological Service for International Air Navigation (Annex 3) 39

10. Session III: Parallel Session IV: Water, Health and Disaster Risk Management Sector 42
10.1. The Roles of National Disasters Risk Management Commission in Implementation the National Framework for Climate Services (NFCS) 43
10.2. The Roles of Health Sector in Implementation of the National Framework for Climate Services (NFCS) 44
10.3. The Roles of Water Sector in Implementation of the National Framework for Climate Services (NFCS) 44
10.4. Using Climate Information in the Health Sector, Application of ENACTS for Malaria Surveillance in Ethiopia 45
10.5. Accelerating the Impacts of CGIAR Climate Research in Africa (AICCRA): Ethiopia project: Co-Development Ag Data hub and decision support systems 46
10.6. Global Framework for Climate Services (GFCS) 47
10.7. African Ministerial Conference on Meteorology; Its Contribution to the National Framework for Climate Services (NFCS) 49

Annexes 52
Annex I: Program of the event 52
Annex II: List of participants 55
Annex III: Award 57
Annex IV: Photos taken during the conference 59

FOREWORD

The National Meteorological Agency of Ethiopia has been operating as an autonomous Agency in the territory of Ethiopia since 1980, even though there had been air navigation-related meteorological activities under the auspices of the then Civil Aviation Authority before this time. Through its 40 years' service provision, the Agency strives hard to meet user needs. Networks of stations of different sorts, both conventional and automatic, have been expanded to widely monitor the weather and climate of the country and deliver a range of weather and climate services to the user community. The Agency witnessed the use of data, information, and products generated by its various directorates used in long-term planning, saving life and property in time of weather and climate extremes, and other purposes. This proceeding highlights the events on the 40th anniversary of the Agency's establishment as an independent government agency. The celebration of the 40th anniversary was also held together with the endorsement of the National Framework for Climate Services (NFCS) – Ethiopia and side events of scientific paper presentations and discussion.

The National Framework for Climate Service – Ethiopia is an output of the cooperation among the five NFCS priority sector institutions (MoA, MoWIE, MoH, NDRMC, EFCCC) and NMA with the technical and financial support of Christian Aid, Farm Africa, Mercy Corps IRI and WMO. The NFCS first launching Conference was held in April 2018 under the sponsorship of WMO. Then, following the step-by-step guideline developed by WMO, priority sector institutions and NMA were engaged in developing the framework together with the assistance from partner institutions to form the NFCS-Ethiopia. The NFCS-Ethiopia was endorsed by a higher government official, NMA and the five climate-sensitive sectors on the 25th of May 2021. We hope its implementation will begin soon.

The event, 40th anniversary with a different session on NFCS endorsement, scientific conference, exhibition, panel discussions on NCOF, Recognition and award has the following objectives,

1. Celebrate the 40th anniversary of the National Meteorological Agency,
2. Endorse the National Framework for Climate Services officially and discuss the future works of its implementation modalities
3. Create a platform for NMA, International Climate Research Centers, Foreign and National Universities on future collaboration in research, capacity building and climate-based service delivery systems and
4. Explore ways and develop national research agenda for young meteorologists and scientists toward their contribution to the improvement of future climate services in Ethiopia

Some three hundred fifty participants - including retired employees of NMA, scientists from Ethiopia and abroad working at different academic institutions, and representatives from national organizations, NGO's and private institutions - interested in weather and climate-related issues took part. A total of twenty-one papers were presented in the plenary and side events. I would like to take this opportunity to express my sincere appreciation to the Chairman and all the Organizing Committee members for the time and effort they have devoted to preparing this valuable event. Last but not least, I would like to thank all sponsor organizations for availing required budget.

Mr. Fetene Teshome
Director-General
National Meteorological Agency and Permanent Representative of Ethiopia with WMO

ACRONYM AND ABBREVIATION

ACToday	Adapting Agriculture to Climate Today, for Tomorrow
AeMP	Aeronautical Meteorological Services Program
AI	Artificial Intelligence
AICCRA	Accelerating the Impact of CGIAR Climate Research for Africa
AMDAR	Aircraft Meteorological Data Relay
AMHS	Aeronautical Message Handling System
AMSD	Aviation Meteorological Services Directorate
ASBU	Aviation System Block Upgrades
ATC	Air Traffic Control
AtCLim	Atmospheric and Climate Science
ATM	Air Traffic Management
ATVET	Agricultural Technical and Vocational Training
AWOS	Automatic Weather Observing Systems
AWS	Automatic Weather Station
BoA	Bureau of Agriculture
BoH	Bureau of Health
BoWIE	Bureau of Water Irrigation and Energy
CD	Capacity Development
CGIAR	Consultative Group for International Agricultural Research
CHC	Climate Hazard Center
CIS	Climate Information System
CMIP6	Coupled Model Intercomparison Project Phase 6
CRGE	Climate Resilience Green Economy
CHIRPS-GEFS	Climate Hazard Infrared Precipitation with Station- Global Ensemble Forecast System
CIMMYT	International Maize and Wheat Improvement Center
CSA	Climate Smart Agriculture
CSIS	Climate Service Information System
CSP	Climate Smart policy and Planning
DA	Development Agent
DPPOs	Disaster Prevention and Preparedness Offices
DRM	Disaster Risk Management
EAL	Ethiopian Air Lines
ECAA	Ethiopian Civil Aviation Authority
ECS	Ethiopia Cloud Seeding
EEP	Ethiopia Electric Power
EEU	Ethiopia Electric Utility
EFCCC	Environmental, Forest and Climate change Commission
ENACTS	Enhancing National Climate Service
EPHI	Ethiopian Public Health Institute
ESSTI	Ethiopian Space Science and Technology Institute
EtMS	Ethiopian Meteorology Society
FAO	Food and Agriculture Organization of the UN
FIR	Flight Information Region
GANP	Global Air Navigation Plan

GFCS	Global Framework for Climate Service
GHG	Green House Gas
IBF	Impact Based Forecasting
ICAO	International Civil Aviation Organization
ICTP	International Center for Theoretical Physics
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute
LAN	Local Area Network
LDC	Least Developed Countries
METAR	Meteorological Aerodrome Report
MoA	Ministry of Agriculture
MoH	Ministry of Health
MOU	Memorandum of Understanding
MoWIE	Ministry of Water, Irrigation and Energy
MU-ICS	Mekelle University Institute of Climate Science
NAP-ETH	National Adaption Plan for Ethiopia
NDRMC	National Disaster Risk Management Commission
NFCS	National Framework for Climate Services
NMA	National Meteorological Agency
NMHSs	National Meteorological and Hydrological Services
NRM	Natural resource Management
NWP	Numerical Weather Prediction
PICSA	Participatory Integrated Climate Services for Agriculture
QMS	Quality Management System
RBDA	River Basin Development Authority
RMP	Research Modeling and Prediction
RMSCs	Regional Meteorological Service Centers
SADIS	Satellite Distribution Information System
SDG	Sustainable Development Goal
SPECI	Special Weather Report
SWOT	Strength, Weakness, Opportunity and Threats
TAF	Terminal Aerodrome Forecast
TBO	Trajectory Based Operations
TITAN	Thunderstorm Identification Tracking Analysis and Now-casting
UAE	United Arab Emirates
UCSB	University of California Santa Barbara
UNDP	United Nation Development Programme
UNESCO	United Nation Educational, Scientific and Cultural Organization
UNISDR	United Nation International Strategy for Disaster Reduction
WAFS	World Area Forecast System
WAN	Wide Area Network
WDRP	Wereda Disaster Risk Profiling
WFP	World Food Programme
WHO	World Health Organization
WMO	World Meteorological Organization
WRF	Weather Research Forecast Model

1. ACKNOWLEDGEMENTS

NMA gratefully acknowledge the support of all sponsors, which includes; International Maize and Wheat Improvement Center (CIMMYT), CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Accelerating the Impact of CGIAR Climate Research in Africa (AICCRA) and International Research Institutes for Climate and Society (IRI), Ethiopian Electric Utility (EEU), Ethiopian Electric Power (EEP) and partners who helped Endorsement of NFCS-E and make the 40th anniversary a success as well as to all paper presenters of the parallel sessions.

2. INTRODUCTION

Ethiopia is located in the Horn of Africa within 3–15° N and 33–48° E, bordered by Eritrea to the north and northeast, Djibouti to the east, Sudan to the west, Kenya to the south, and Somalia to the south and east. It covers an area of about 1.14 million square kilometres. The country's topography consists of high and rugged plateaus and peripheral lowlands. Elevations in the country range from 160 meters below sea level (northern exit of the Rift Valley) to over 4600 meters above sea level (of northern mountainous regions). The highest mountains are concentrated on the northern and southern plateaus of the country. A large percentage of the country consists of high plateaus and mountain ranges, dissected by major rivers such as Blue Nile, Tekeze, Awash, Omo, Wabi Shebelle etc. Overall, Ethiopia consists of 9 major rivers and 19 lakes. The Blue Nile, the chief headstream of the Nile, rises in Lake Tana in northwest Ethiopia.

Meteorological observation started in the 1890s with few meteorological stations. In 1951, meteorological services were established as a small unit in the then Civil Aviation Department to render aeronautical services. Since then, meteorological observation has been expanding over Ethiopia. As the importance of meteorology was realized by other economic sectors, National Meteorological Services Agency (NMSA) was established by the Government Proclamation Number 201/1980.

Besides, NMA started seasonal forecasting and advisory service in 1987 for three seasons, namely Belg (February-May), Kiremt (June-September) and Bega (October-January). The primary duty of NMA is to support all socio-economic developments of the country by delivering climate services. Moreover, NMA has more than one thousand three hundred conventional Meteorological stations, three hundred automatic weather stations, five AWOS, three air pollution monitoring stations, three upper air stations, one radar and eleven satellite receiver stations.

The government of Ethiopia is determined to eradicate poverty and become a prosperous country by 2030. In this regard, addressing climate variability and change play a pivotal role in achieving this goal. To this effect, NMA is equipping with modern weather observing and monitoring capabilities, as well as improving processing, analyzing, interpreting and forecasting weather and climate capabilities at a high resolution and accuracy to meet the end-user's demands and to effectively support all socio-economic developments of the country.

NMA work in collaboration with all key stakeholders and partners through continuous engagement on climate services. The NFCS, endorsed during the NMA 40th Anniversary, is envisaged to strengthen collaborative co-production between climate services provider (NMA) and climate service beneficiaries institutions (MoWIE, EFCCC, MoA, MoH and NDRMC).

To commemorate its 40th anniversary, NMA has organized a conference with a theme of **"Forty Years of Climate and Weather Services in Ethiopia"** on May 25-26, 2021, at Skylight Hotel, Addis Ababa, Ethiopia. Generally, three main sessions were held during the conference. These include; Session one: panel discussion and opening ceremony, session two: presentations on the history of NMA and NFCS Ethiopia, official endorsement of NFSC Ethiopia, and certificate wards and session three: parallel session of four groups and paper presentations on different thematic areas were made.

The 40th anniversary was attended by ministers, commissioners, heads of organizations, and representatives from the WMO Africa regional office, international institutes representatives, experts from different organizations, lecturers, researchers, and NMA officials and staff.

This document is proceedings of the 40th anniversary, including summaries of the opening session and the presentations.

1.1 Objectives of the 40th Anniversary

- To celebrate the 40th anniversary of the National Meteorological Agency.
- To officially endorse the National Framework for Climate Services of Ethiopia and discuss the future works of its implementation modalities.
- Create a platform for NMA, International Climate Research Centers, Foreign and National Universities on future collaboration in research, capacity building and climate-based service delivery systems
- Explore ways and develop national research and capacity building agenda for Meteorologists and scientists toward their contribution to improving future climate services in Ethiopia.

3. PANEL DISCUSSION ON CLIMATE SERVICES IN ETHIOPIA

A panel discussion was held just before the official opening of the 40th Anniversary of the National Meteorological Agency. The panellists are senior experts and directors drawn from climate service user sector ministries and commissions in Ethiopia. These include: Dr Adugna Woyesa, Epidemiologist and Researcher at EPHI; Mr. Mohamod Andoshe, Director of Climate Change, Planning Implementation and Coordination, at EFCCC, Mr. Essayas Lemma, Director of Crop Development at MoA; Mrs Sahle Tefera, Senior GIS Expert at NDRMC, Mrs. Semunesh Gola, Director of Hydrology and Water Quality Directorate at MoWIE, and Mr. Kinfe Hailemariam, Deputy Director-General of the NMA were also one of the Panelists.

The panel discussion aims to raise the general public's awareness of Ethiopia's climate services supporting the country's socio-economic development in various sectors. The panellists discussed how meteorological services support health, water, energy, agriculture, environment-forest, and disaster risk management sectors in Ethiopia. All the panellists witnessed that climate services are crucial for their planning and day to day operations in their respective sectors. The panellist from NMA also demystified cloud seeding technology and the role of satellite information for generating climate services in Ethiopia.

The panel discussion was facilitated by Mr. Hailu Wudineh, former Director of Public Relations and Communication at the National Meteorological Agency and currently as Communication Expert for EU funded Project at the African Union Commission in Addis Ababa, Ethiopia.

Panellist's discussion on 40th anniversary of NMA

4. SESSION I: OPENING OF THE 40TH ANNIVERSARY

High-level government officials, invited guests, and NMA's current and retired staff attended the 40th anniversary Conference. The official opening session was preceded by an introduction of the program by Mr. Hailu Wudneh, moderator of the event. He introduced the program in detail and invited Mr. Fetene Teshome, Director General of NMA, to make a welcoming speech.

4.1 Summary of welcoming speech by NMA Director-General

Mr. Fetene Teshome, Director General of the National Meteorological Agency and Permanent Representative of Ethiopia with WMO, started his speech by acknowledging the presence of H.E. Dr. Engineer Sileshi Bekele, Minister, Ministry of Water Irrigation and Energy, Honorable Mrs. Fetia Yesuf, Head of Natural Resources, Water, Irrigation and Energy standing committee of House of People's Representatives, H.E. Dr. Amos Makarau, Director, WMO Regional Office for Africa, Members of Natural Resource, Water, Irrigation and Energy standing committee of People's Representatives and Invited guests and participants of the Conference.

He then welcomed all participants on behalf of NMA and himself to celebrate the 40th anniversary of NMA, which is marked under a theme "Forty years of weather and climate services in Ethiopia''. He then iterated the event as the platform where meteorological service providers and key stakeholders/users reaffirm to strengthen their cooperation and collaboration.

He said that while we celebrate the 40th anniversary of NMA since its establishment as an autonomous institution, we will review the progress made in establishing and modernization of meteorological stations and human capacity building and forecast and early warning service quality improvement in the past forty years. He also mentioned that the conference would review bottlenecks in the provision of meteorological services and explore the opportunity that weather and climate issues are high in the government's agenda to improve the ever-increasing demand of our users to their level of expectation from the Agency.

He then said that NMA is one of the pioneer institutions in Ethiopia and mentioned that the main objective of the Agency is:

- Establishing meteorological stations which represent the countries topography and climate
- Collect various Meteorological data
- Analyze the collected meteorological data and disseminate the information to support Ethiopia's development
- Exchange meteorological data under the auspices of WMO

He mentioned that the Agency has a head quarter in Addis Ababa and has established eleven Regional Meteorological Service Centers all over the country to serve users best. The Agency has established more than 1400 ordinary meteorological stations to collect, analyze and disseminate meteorological information. He also mentioned that the Agency was able to grow its automatic weather stations from 20 to 300 in the past few years. The government is providing the necessary budget to establish weather radars, air pollution monitoring stations and other modern technologies. This has made the Agency one of the best meteorological service providers in Africa.

He iterated that meteorological information is a vital input to ensure and sustain the development and prosperity of the country as the information is used to minimize risks of weather and climate hazards and maximize positive weather and climate situations. This capacity is developed at both headquarter and RMSCS levels. This achievement is a coordinated effort with our users and will be strengthened by working closely with our users and stakeholders.

He then indicated that during the celebration of 40 years of weather and climate services, a scientific conference would discuss various issues to improve gaps in meteorological service provision by engaging key stakeholders and users. He also indicated that a high-level endorsement of NFCS will be conducted by signing MoU between heads institutions including NMA, MoWIE, MoA, MoH, DRMC and EFCCC.

Finally, he urged participants to engage in the discussions in the scientific Conference, welcomed all participants and wished them a happy 40th anniversary of NMA.

4.2 Summary of the keynote speech by WMO Secretary-General

In his recorded video message, Professor Petteri Taalas, Secretary-General of World Meteorological Organization, expressed his great pleasure to address distinguished ministers and Mr. Fetene Teshome, Director General of NMA and PR of Ethiopia with WMO, on the occasion of the 40th anniversary of NMA. He said that he had visited NMA several times, and he was impressed with the progress made at NMA. He acknowledged the progress made on joining the GFCS by implementing NFCS and appreciated the heavy investment made on modern observation systems and the progress made to establish radar systems in Ethiopia. He said that the investments are huge but useful for diverse purposes. He then mentioned Ethiopia's efforts in joining the AMDAR activities as Ethiopian Airlines is one of the best airlines in Africa, and it is crucial to get atmospheric profile measurements. He appreciated Ethiopia for hosting WMO Regional Office for Africa. It makes the office closer to the African Union, an important WMO partner in climate change adaptation and mitigation, disaster risk management, and resource management. He said WMO highly value the premises provided to the Office and the decision made by the government to build a new office for NMA, which will also host WMO ROA.

He emphasized that Africa is at the heart of his daily activities and WMO as well. Africa is very sensitive to the impacts of climate change and specifically Ethiopia is impacted by weather and climate extremes, droughts and floods, which have big impacts on agriculture, human well-being, and infrastructure damage. He pointed out that the coming IPCC report indicates that climatic variability as well as occurrence of extreme events such as drought and floods are expected to continue in the following decades. He said that there is a need to adapt to climate variability and the best way is to invest in early warning services and basic observing networks. He said that basic observing networks in Africa need to be enhanced and WMO is creating a financing mechanism and donor investments to enhance the network.

He congratulated NMA for its decision to collaborate with the academic institutions in Ethiopia for joining forces with research institutions which is a powerful way to strengthen the service capabilities of the meteorological service.

Finally, he said that it is a pity that he couldn't join the event physically due to the pandemic situation and expressed his hope to be present during the inauguration of the new building for NMA and WMO. He wished happy 40th Anniversary and expressed he is looking to meet Mr. Fetene Teshome face to face as the pandemic situation allows.

4.3 Summary of Opening Speech by H.E Minister

H.E Dr. Eng. Seleshi Bekele, Minister, Ministry of Water, Irrigation and Energy, started his speech by acknowledging the presence of Excellency, Mr. Sani Redi, State Minister for Ministry of Agriculture, Excellency Commissioner Mitiku Kassa, Commissioner for National Disaster Risk Management Commission, Excellency, Professor Fikadu Beyene, Commissioner for Environment, Forest and Climate Change Commission. He then wished all participants a Happy 40th Anniversary. He warmly welcomed all participants to this event, where we celebrate the 40th anniversary of NMA and review the successes achieved and problems faced in the 40-year journey of NMA since its autonomy.

In order to cope up with and minimize the adverse impacts of weather and climate, we need to exercise different environmental, socio-economic and development activities based on advanced knowledge in weather and climate. NMA has shown improvement in the provision of meteorological services.

He said that the services provided by the Agency, including short, medium and long-range forecasts and advisories, have served the decision-makers to prepare policy directions. Therefore, climate issues have got a lot of attention from the user side. In this respect NMA is providing timely, spatial based and quantified forecast information to sectors to prepare for weather and climate related hazards and explore good weather and climate to support the development and vision of the country. The Agency should continue to provide meteorological services strongly, he said.

The government of Ethiopia is strengthening meteorological services in a coordinated manner with other relevant institutions. The future modernization plan of the Agency is aimed at equipping with appropriate technology and a relevant high skilled workforce in the field of meteorology. This will enable the Agency to support Ethiopia's prosperity. This anniversary Conference will strengthen the existing cooperation between the Agency and sector institutions.

He mentioned that NMA has long-standing cooperation at a global level. The reason for this is that weather and climate do not respect political boundaries. One meteorological phenomenon happening at one side of the globe affects what is happening at the other side of the world. Hence, meteorological information exchange between countries is vital to monitor weather and climate. In this regard, the World Meteorological Organization was established in 1953 by member states.

This global nature of weather and climate has increased the cooperation between countries. One way or another, weather and climate affect all sectors. Collaboration in weather and climate cannot be tied only to observation, and it should also be expanded to global cooperation in research. In this regard, the Agency has achieved significant milestones. However, I want to stress that there is much more to be done, he said.

He also said that today we would affirm another milestone by putting into place an NFCS agreement with key meteorological users who are impacted by weather and climate phenomena. This will allow us to put in place a coordinated effort with accountability to benefit users.

He mentioned that the NFCS was prepared by engaging all parties with a leading role of NMA. He also reiterated that even though NMA takes a leading role, generation, analysis, and meteorological information involves institutions, both governmental and non-governmental, stakeholders and the general public.

Finally, he thanked the staff of NMA, researchers at both local and international levels, institutions and development partners for their role in supporting NMA to enhance its services and wished a happy 40th anniversary and declared the 40th anniversary Conference of NMA is officially opened.

5. SESSION II: NATIONAL FRAMEWORK FOR CLIMATE SERVICES

5.1 NMA history and 40th years Weather and Climate Services (by Fetene Teshome)

Mr. Fetene Teshome, Director General of NMA and PR of Ethiopia with WMO briefly made a presentation on the "History of Meteorological Services in Ethiopia". He said that meteorological observations have started in the nineteenth century, mainly by European missionaries. Then in 1951, meteorological services were established as a small unit in the then Civil Aviation Department to render aeronautical services as the importance of meteorology was realized by other economic sectors, i.e., non-aviation sectors, other government offices used to provide meteorological information that tended to duplicate meteorological works. In 1971, the meteorological unit (under Civil Aviation Authority) was promoted to Meteorological Department. Further, renovation in meteorological information and a significant increase in the need for meteorological services reinforce the government to establish an agency that dully takes the responsibilities. Hence, National Meteorological Services Agency (now NMA) was established by Government Proclamation Number 201/1980, accountable to the Water Resource Commission (Currently, MoWIE) Ministry of Water, Irrigation and Energy. Then he described the main objectives of NMA, as stated in the proclamation as follows:

- To investigate and study the weather and climate conditions of Ethiopia to exploit its beneficial effects for economic and social development
- To protect and control Ethiopia's atmospheric environment to combat the harmful effects of the atmosphere
- To carry out the tasks of fulfilling these national needs and discharging international obligations regarding meteorology, and giving meteorological services
- To establish and operate communications systems to collect and exchange meteorological data according to international agreements, give warnings on adverse weather conditions, and disseminate advice and educational information to the public on the weather. Furthermore, he explains the Agency vision, mission and values:

Vision: To be a world-class provider of weather and climate services to foster Ethiopian socio-economic development by 2030.

Mission: NMA provides weather, climate and early warning services that contribute to socio-economic activities of the nation and protects lives and property. This will be achieved by collecting, analysing, forecasting and communicating meteorological and related information.

Values: Quality Services – reliable, timely, efficient, user-friendly weather and climate services – accessibility, innovation, and professional ethics - e.g., respect, teamwork, mentoring, transparency and value for money.

Mr. Fetene also presented NMA organizational structure and the three strategic areas, including meteorological data provision, reliable weather and climate forecast, early warning and advisory, and meteorological research and studies. He further discussed meteorological data observation in Ethiopia. To collect meteorological data, NMA has deployed manned Surface Observing Stations such as Synoptic, Indicative, Ordinary and Precipitation station and Upper-Air Stations like Radiosonde and Pilot Balloon, Automatic Observing Stations, Satellite Data Receiving Stations, Airport stations (SADIS and AWOS) mainly for air navigation, Weather Radar, Air pollution station and Lightning detection network. He explained about NMA blended data set, which is produced by merging station data with satellite data. Moreover, he also acknowledged the support provided by IRI in this regard. Under reliable weather and climate forecast and early warning, he briefed the following key points:

- Weather and climate monitoring, weather forecasting and climate prediction (short, medium and long-range time-scales), early warnings on unusual, extreme weather-related events
- Applied Meteorology such as Aeronautical meteorology, Agro-meteorology, Hydrometeorology and Biometeorology for socio and economic activities

Furthermore, he discussed Meteorological research and study program activities and publications. Finally, he talked about NMA international relations and cooperation and the way forward and closed his presentation.

5.2. National Framework for Climate Services (NFCS) of Ethiopia (by Mr. Kinfe H/Mariam)

Session II:

In this presentation, Mr. Kinfe Hailemariam, Deputy Director General of NMA, discussed the NFCS with an introduction, global perspective, climate service, Ethiopian NFCS process, and finally, the way forward as presented in the subsequent paragraphs.

The NFCS is part of a global initiative, which was formulated in line with the GFCS guideline. The GFCS is a UN lead initiative established at Geneva's third World Climate Conference from 31st August to 4th September 2009. The then UN Secretary-General Ban Ki-moon had addressed the conference, and Ethiopia was represented by the late president H.E Mr. Girma Woldegeorgis. At a global level, GFCS is led by WMO in collaboration with UNISDR, WHO, WFP, FAO, UNESCO, UNDP, and others for the United Nation System Organizations to deliver as one on climate knowledge. It is meant to guide the development and application of science-based climate information and services to support decision-making in climate-sensitive sectors by pooling their expertise and resources. The role of the Framework is to coordinate, facilitate and strengthen the collaboration among institutions to avoid duplication of efforts.

The main concern for establishing GFCS was the ever-increasing frequency and intensity of hydro-meteorological hazards, vulnerability, exposure to those hazards, but limited capacity to cope.

GFCS identified five priority sectors; agriculture and food security, disaster risk reduction, water, health and energy. It also set the following five overarching goals:

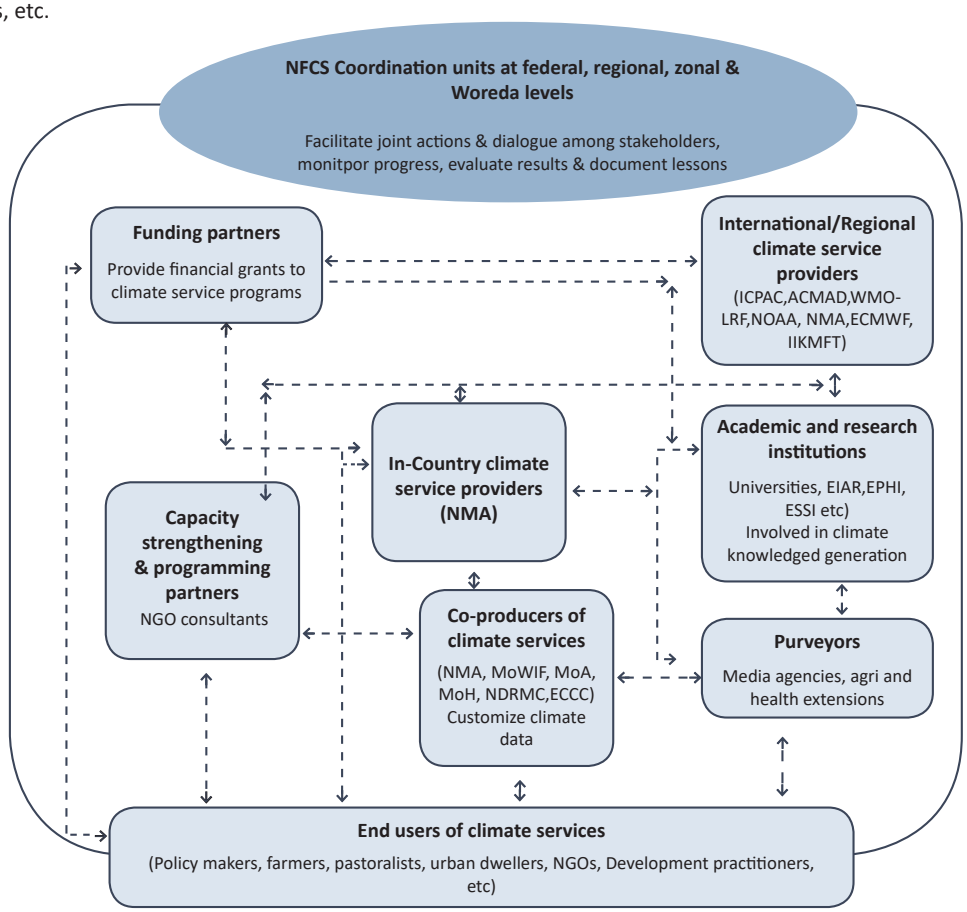
1. Reducing the vulnerability of society to climate-related hazards through better provision of climate information and services;
2. Advancing the key global development goals through better provision of climate information and services;
3. Mainstreaming the use of climate information and services in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

GFCS also identified five pillars for effective delivery of climate services: Observation and Monitoring (O&M); Research, Modeling and Prediction (RMP), Climate Service Information System (CSIS), User Interface Platform (UIP) and Capacity Development (CD). It operates on three geographic scales, namely global, regional and national. O&M ensures that climate observations and other data necessary to meet the needs of End-Users are collected, managed, disseminated, and supported by relevant metadata. RMP is to foster research towards continually improving the scientific quality of climate information. CSIS is the mechanism through which information about climate (past, present and future) is routinely collected, stored and processed to generate products and services that often inform complex decision-making across a wide range of climate-sensitive activities and enterprises. UIP is a structured means for users, climate researchers and climate information providers to interact at all levels. CD addresses the particular capacity development requirements identified in the other pillars and, more broadly, the basic requirements for enabling any Framework-related activities to occur.

Climate service is a key teem in GFCS, which entails providing climate information that assists decision-making by individuals and organizations. It must respond to user needs. Its core postulates are that climate information is not a climate service. Its core rule is the co-production of Climate Services with users. Co-production is intended to transform climate data into information and then into client-tailored Climate Services, including relevant forecast-

based advisory services and decision-making tools that the client can use. It follows the iterative cycle of co-design, co-production, co-delivery and co-evaluation for climate services between climate information producers and users. Eventually, the users get the information generated to satisfy their informed decision-making needs for their respective sectors. It is a new climate service discourse that NMA and climate service institutions became on-board for collaborative work in addressing climate-related challenges and opportunities.

The NFCS of Ethiopia has been formulated with the GFCS guideline developed by WMO. It is a tool designed to strengthen the production, availability, delivery, and application of science-based climate prediction and services in Ethiopia. It aims to coordinate and enable institutions to work together to co-design, co-produce, communicate, deliver and make use of Climate Services for decision-making in climate-sensitive socio-economic sectors. Five priority sectors identified for NFCS implementation in Ethiopia are Agriculture, Water and Energy, Health, Disaster Risk Reduction and Environment. However, there are many actors in the value chain of climate service provision, including but not limited to the following as depicted in figure 1 below; International and regional climate service providers, Academic and research institutes, purveyors, funding partners, capacity strengthening and program partners, etc.



Inter-linkage between partner institutions for NFCS

Launching workshop (26-27, April 2018)

Ethiopian NFCS development launched through a consultative Conference with key stakeholders in April 2018 in the presence of the WMO representative. Following the Conference, a national NFCS steering committee has been established, lead by NMA and top management of the five priority sector institutions (NMA, MoA, MoH, EPHI, NDRMC, EFCCC and RBDA). Their task is to give high-level guidance for the NFCS development. Similarly, four sectoral technical task forces have been established to execute the technical part of the framework development: Climate -Agriculture Team, Climate

- Disaster Risk Management Team, Climate - Water and Energy Team, and Climate - Health Team. NMA technical team has also been formed in parallel to the sectoral technical team. Furthermore, a team of consultants to execute climate service baseline assessment and assist the climate service strategy document has been deployed with a financial and technical support of Christian aid lead consortium including Farm Africa and Mercy Corps.

The framework development took about two years, and three main documents were developed with the above-described organizational setup. These documents are Climate Service Baseline Assessment, NFCS 10 year's strategy (with costed action plan) and NFCS governance. These documents have been reviewed in several conferences, meetings at different levels. Finally, the three documents are reviewed by WMO and IRI and published by NMA. The objectives of the climate service baseline assessment were to identify stockholders/actors in the national chain of climate service; to examine climate services that are currently being provided, needs and gaps, to assess capacities of relevant institutions in the country against 5 GFCS pillars and to assess the country's state of readiness to implement NFCS. The scope of the study was at a national level, 48 Woreda in 8 rainfall-homogenous zones, and key federal climate service-related institutions, Academia, projects, professional societies and partners are covered. Key findings of the baseline study are:

- The major economy is climate-sensitive /dependent
- Low capacity in decision-relevant climate services → low resilience of sectors and livelihood to impacts of extremes weather and climate
- Lack of solid policy and Standard Operational Procedure (SOP)
- Coordination is loose and not binging
- Staff knowledge and skill is minimal
- Climate service infrastructure, technology and finance is insufficient
- Climate data quality, timeliness, reliability, uptake and use are limited
- Assessment of users need, and co-development culture and practice is low

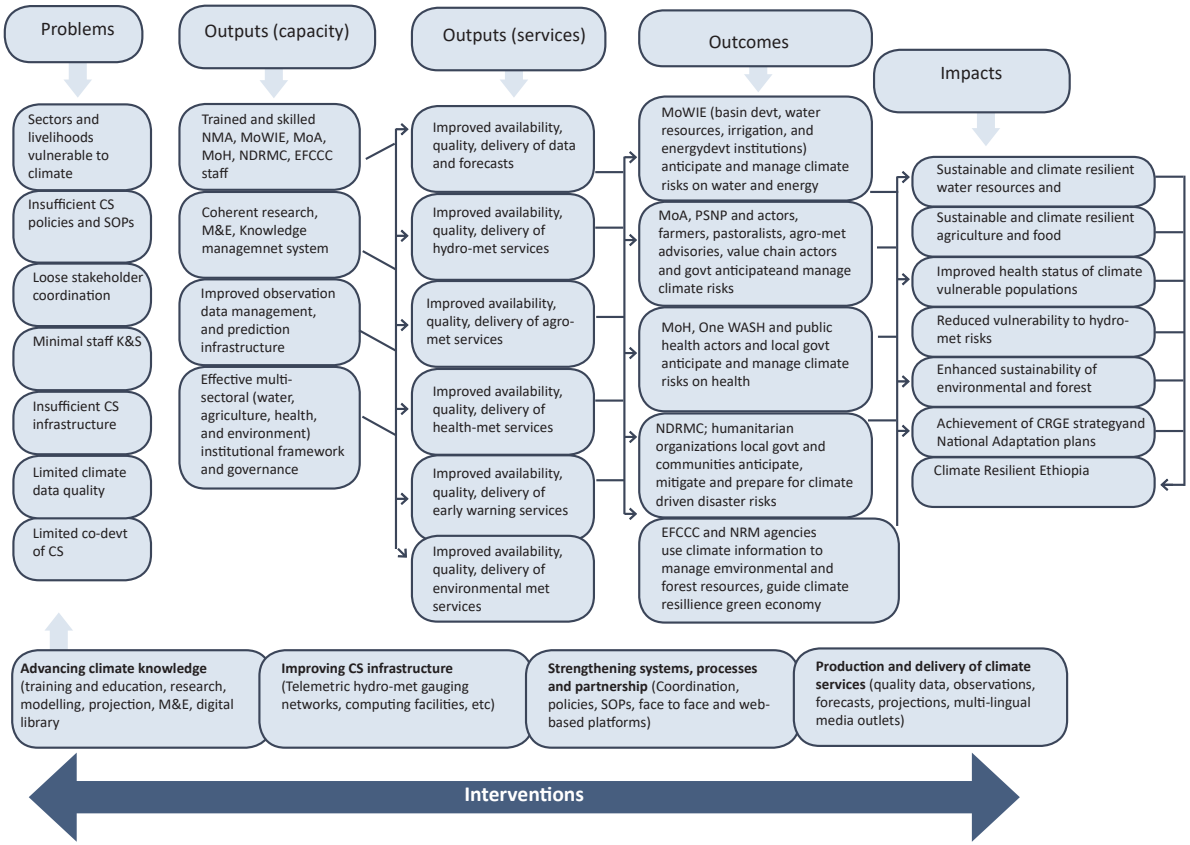
The NFCS strategy plan set a vision that "Seeing Ethiopians whose livelihoods are resilient through climate-informed decisions", with a mission to build climate institution's capacity; ensuring co-development of climate services for different groups of users; provide user-driven, high-resolution and accurate climate services; and continuously learn and improve climate services in Ethiopia. The strategy also set the following values: Co-design and co-production, Users first (users at the centre of its processes and delivered are based on users' needs); excellence and sustainability. It identified four key areas of intervention:

- human resources (NMA and within the target sectors);
- knowledge management (including research, monitoring and evaluation);
- infrastructure for observations, data management and prediction; and
- climate services governance (policy framework, institutional arrangements and coordination processes)

Furthermore, the strategy set two goals and ten objectives, with an estimated budget of 143,354,900 USD for the framework implementation. The two goals are:

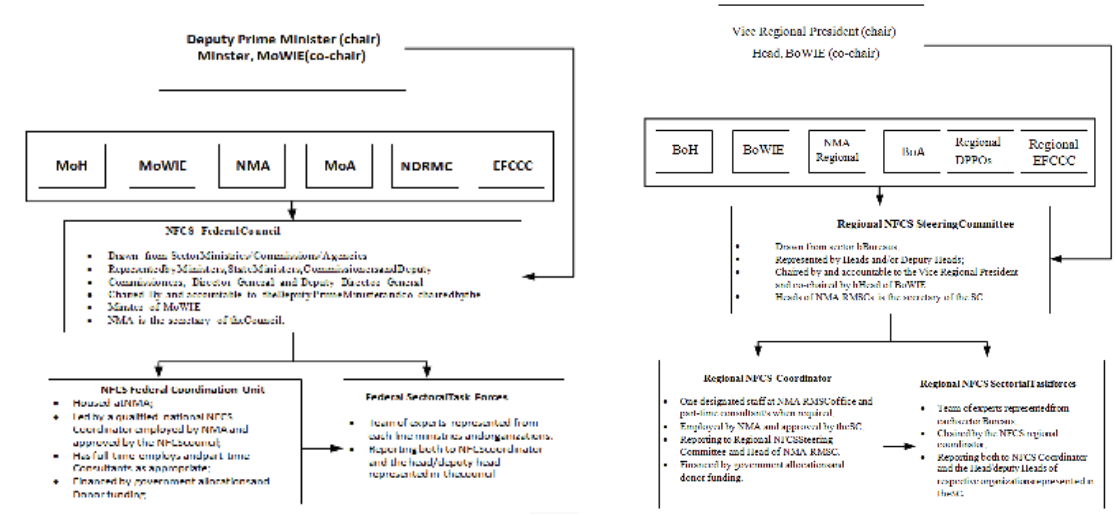
1. Institutional capacities built to deliver high quality, decision-relevant, timely, reliable and sustainable climate services.
2. Climate services, adapted to the diverse needs of users, are implemented, delivered and adopted at all levels and at all times

The strategy development followed the theory of change approach, which starts with identified problems as an input, institutional capacity building and climate service provision as an output with the impact in each priority socio-economic sector that anticipate and manage climate risk so that overall country-level climate risk resilience is built (see figure 2).



The theory of change for NFCS-Ethiopia

The third document dictates the NFCS governance, which shows a hierarchical yet decentralized climate service governance from federal to Woreda level, as shown in the diagram below for federal and regional state levels. A similar structure was proposed at zonal and woreda levels to reach the last mile users in climate service.



Finally, the way forward for effective implementation of the NFCS require the following additional work:

- High-level endorsement (singing of MOU) and ownership
- Legal instruments for NFCS implementation
- The establishment of NFCS coordination unit at the National, Regional, Zonal and Woreda level
- Official launching and kick-off
- Capacity building and climate service delivery at all levels
- Monitoring, Evaluation and Learning, thus sustain climate service

In the end, Christian Aid, Farm Africa, Mercy Corps, IRI, and WMO-GFCS secretariat partners have been acknowledged for their contribution to the development of Ethiopia's NFCS.

NFCS high-level MoU signing ceremony 2021

6.1 SESSION II: CERTIFICATE AWARD

As part of the 40th anniversary, the certificate award ceremony took place, aiming to provide recognition for those who support and contribute to the development of NMA. The award was given to individuals and organizations, which categorized into five based on the support and contribution they have made (please refer to Annex III for a list of recognized institutions and individuals)

6.1. Former General Managers of NMA

Since its establishment, NMA has been led by six managers, excluding the current director-general Mr. Fetene Teshome. During their leadership time, the unreserved services they provided to NMA contribute a lot to the status where the agency reaches now. Thus, NMA recognized Mr. Workneh Degefu, Mr.Kinfemichael Tekle, Mr. Eshetu Hailemariam, Mr. Tesfaye Haile, Mr. BekureTsion Kassahun and Mr. Kidane Assefa.

Recognition ceremony of former General Managers

6.2. Local and International Institutes which Support NMA on Capacity Building

Through the course of NMA's 40 years, many staffs have been trained and capacitated in different institutes and universities. The training was from short to long term. Some of the local and international organizations played a significant role to support NMA on capacity development. These institutions are ICPAC, IRI, CCAFS, NOAA, ACMAD, WMO, IMD, KMD, AMU, MU, HU, ASTU and EWTI.

Recognition ceremony of local and international institutes which support NMA on capacity building

6.3. Organizations that Support NMA through different Projects

NMA modernize its services under the different projects offered by many international and local organizations. The projects enabled NMA to enhance its service by using modern meteorological Instruments, technologies, capacitated its staff, etc. In this regard, UNDP, Farm Africa, Christian Aid, WFP, KOICA, FewsNet/USAID/, Mercy Corps, ATA, EFCCC, ACPC, ADB, Care Ethiopia, ILRI, CCAFS, and SMHI are the organizations that support NMA through different projects.

Recognition ceremony of Organizations that Support NMA

6.4. Support through international research centres

In this category, five climate scientists and researchers working at different international organizations and well-known universities and research centres were given recognition. Some of the reasons that NMA recognize them included; their contribution to capacity building and research, and some brought projects to NMA. Accordingly, Dr. Tufa Dinku (IRI), Dr. Zewdu Tesema (ICPAC), Dr. Teferi Dejene (Norway). Dr. Gulilat Tefera (Canada), Dr. Diriba Korecha (USGS), and Mr. Dula Shanko, former DDG of NMA, contribute to NMA capacity development.

Recognition ceremony of Ethiopian Scientist in the Country and Diaspora

6.5. Former and current Ministers of the Ministry of Water, Irrigation and Energy

The leadership provided by all former and current ministries deserves recognition and credit. Therefore, NMA recognizes Ambassador Shiferaw Jarso, Ambassador Asfaw Dingamo, Ambassador Alemayehu Tegenu, Mr. Motuma Mekasa and Dr. Eng. Sileshi Bekele, on this significant event.

Recognition ceremony of former and current Minsters of the Ministry of Water, Irrigation and Electricity

7.1 SESSION III: - PARALLEL SESSION I: CAPACITY BUILDING AND RESEARCH DEVELOPMENT

Summary of Session III

This session was chaired by Asaminew Teshome (PhD), and Mr. Yosef Tesfaye and Mr. Elias Fisseha were served as rapporteur of the session.

In total, eleven presentations were showcased in this session. Five of them were from NMA directorate directors and experts, and the others were from fellow partners from local and international universities. The presentations more or less aligned with the session theme, capacity building and research development. Things related to NMA present-day data provision capability, available NMA research capacities, use of artificial intelligence in advancing meteorological services, area of collaboration, bilateral or multilateral, between NMA and partners in research and capacity building, pipeline capacity enhancement projects and the like are among the things touched upon during the session. In the following few pages, we will describe each presentation individually.

7.1 Accelerating the Impact of Consultative Group for International Agricultural Research Climate Research in Africa (AICCRA) contribution to the capacity building of NMA-Ethiopia project:

Teferi Dejene *(Senior Researcher, PhD) at CGIAR*

In his presentation, Dr. Teferi tried to discuss about the activities of the AICCRA project in Africa. He pointed out AICCRA aspires a number of capacity building activities for the NMA, which included the following:

- Developing tools to strengthen data archiving and generation systems at NMA
- Strengthening weather forecasting capabilities of NMA at different timescales
- Strengthening NMA's research activities to improve the forecasting services
- Developing a meteorological derived flood forecasting using WRF-hydro
- Capacity building of NMA staff on the forecasting and data archiving and generation tools

He then briefly discussed the plan to develop tools to strengthen data archiving and generation systems at NMA. Strengthening the weather forecasting capabilities of NMA at different timescales was Dr. Teferi's next point of discussion. Some of the issues he raised were:

- Short and medium-range forecast which includes; Incorporating yr.no forecast into NMA's forecasting system, data Assimilation in WRF, and conducting sensitivity experiments in WRF at different resolution & physical parametrization.
- Sub-seasonal and Seasonal forecasting including NextGen forecasting system and make use of the S2S database to produce impact relevant forecast (e.g., agriculture, health), etc.

Dr. Teferi then shifted to Strengthening NMA's research activities to improve the forecasting services and stated that it could be strengthened through;

- Collaboration with international institutes such as the University of Bergen (NORCE)
- Collaboration through local universities
- Use of new re-analysis data, seasonal forecasts from Copernicus and NMME data
- Use of the MOS approach
- Use of impact models to quantitatively predict

Finally, he elaborated on developing a meteorological derived flood forecasting using WRF-hydro and capacity building of NMA staff on the forecasting and data archiving and generation tools.

7.2 Meteorological data, Climate service and NMA Map-room

Mr. Melesse Lemma, *Director for Meteorological Data & Climatology Directorate, NMA*

The second presentation was from Mr. Melesse Lemma, and it dealt with Meteorological data, Climate service and NMA Map-room. The first goal of Mr. Melesse's presentation was to show the infrastructures and systems in collecting, quality-assuring, processing and delivery of data. The presentation second goal is directly related to NMA's

online or web-based map analysis and application service, called map room. He showed how users could access and use information stored on this page and the logic of accessing the map room. Generally, the presentation touched upon the following points:

- Data Sources: 17 synoptic, 193 indicative, 792 ordinary, and 301 precipitation stations and 286 AWS
- Data Management and Administration: The main activities include real-time data collection and transmission, meteorological communication (data exchange) and data delivery and dissemination
- Main functions of data delivery and dissemination provide historical data, forecast publications, maps, and bulletins to the user community freely or with fees according to the Agency's data policy.

Next to this, the presenter explained detailed activities about Data processing and Climatology. He impressed upon the merging/blending data (Gridded and merged data from land stations and satellite data & reanalysis), rescue data and the NMA map room. As he pointed out, it is a collection of maps and other figures that monitor climate and societal conditions at present and in the recent past, which is developed in collaboration with IRI. Thus, the NMA Map Room has climate, climate and water, climate and agriculture, and climate and health (surveillance suite) service components.

7.3 Capacity Building Needs and Possible area of cooperation

Mr. Dereba Muleta, *A/Director for Meteorological Training and Education Directorate, NMA*

In the presentation, he noted that capacity building (or capacity development) is how individuals and organizations obtain, improve, and retain the skills, knowledge, tools, equipment, and other resources needed to do their jobs competently. And he said capacity building and capacity development are often used interchangeably. He then indicated the educational plan of NMA emphasizing the following activities;

- Meteorological station installation, weather observation and data management
- Forecast early warring and advisory service for sectors
- Applied meteorology services (Agrometeorology, Hydrometeorology and Biometeorology)
- Service delivery and problem-solving research and capacity building activities.

In addition to this, he also explained the existing resource and human capital which are used to strengthen the NMA service delivery system.

Surface weather observation and AWS, Upper air observation and Air quality monitoring, DataBase (CLIDATA), Radar observation, ENACT Data set, High-Performance Computing (HPC) with 20 nodes, 480 processor 300TB, and Run WRF 4X4 resolution.

Regarding ten years educational plan of NMA, he mentioned the agency planned to have at least 15 PhD and 146 MSc holders.

Finally, Mr. Diriba explains about the technology use needs, human resource development, short training, education and promising opportunities.

7.4 NMA Research Priority Area and University Linkage

Mr. Abate Getachew, *Meteorologist, NMA*

He began his presentation explaining NMA Meteorological Research and Studies Directorate (MRSD) mandates and structure. Thus, the mandates given are:

- To control air pollution and maintain the natural balance of the air in the country;
- To undertake meteorological studies and researches; implement fruitful results;
- To ensure implementation of international agreements regarding meteorology, which the government ratifies.

MRSD has Meteorological Research and Studies case team and Air Pollution and Climate Change case team. Furthermore, he started that the NMA approach for meteorological research is to encourage and facilitate so that all meteorologists in other directorates and regional meteorological service centres also carry meteorological research

of their respective areas of specialization. Thus, the directorate carries research and facilitates. These initiatives aim to improve the research culture for career development through publications. The Agency collaborates with the Ethiopian Meteorological society to start publishing scientific journals annually, the Joint Scientific Journal of NMA and EtMS.

Mr. Abate ended his presentation addressing NMA and University/Research institutions Linkage on research and NMA research priority areas.

7.5 Human Resource Development, Capacity Building and Research Collaboration for the Betterment of Operational Services of Arbaminch Universities

Tadesse Tujuba (PhD), *Arbaminch University*

He explained some background information on Arbaminch University Faculty of Meteorology and Hydrology.

- It was initially established as the Department of Meteorology during the 2002/2003 academic year.
- The primary objective was to train the manpower required by NMA.
- Six batches of BSc students and two batches of advanced diploma students graduated between 2005 and 2010 years.
- The curriculum was revised to accommodate hydrology in the 2008/2009 academic year
- The department was then renamed the Department of Meteorology and Hydrology
- Eight batches of BSc students graduated, including foreign students
- Graduates work in the ministry of Water, Irrigation and Energy, Regional Water Bureaus, Agricultural Research Centers, Water Works etc.
- There is finalized curriculum revision currently to be implemented in 2021
- The current revision of the curriculum is initiated by the Ministry of Science and Higher Education. It aims to include courses from social sciences and humanities to enhance graduate's self-confidence, reasoning, ethics, professional competency at the international level, understanding of diversity and national unity. In this revision, recent developments of knowledge and skills are included.
- The faculty also runs graduate programs such as MSc in Meteorology since 2007, MSc in Climate change and Development since 2011 and PhD in Geoinformation and Earth Observation for Hydrology since 2019.
- The faculty is developing an MSc curriculum in Geoinformation and Earth Observation for Hydrology

He then clarified that the faculty runs graduate programs and is developing an MSc curriculum in Geoinformation and Earth Observation for Hydrology. Some of the exciting areas of collaboration mentioned by him included;

1. Internship

- Meteorology and Hydrology students join NMA for practical training
- The internship offers students the chance to put what they are learning into action in a real-world environment.

2. Graduate Students advice and attachment

- MSc and PhD students are advised by NMA staff and/or use NMA facilities and data for their research work.

Finally, Dr. Tadesse indicated Arbaminch University's resource profile, future plans and possible areas of collaborations with NMA, such as validating and verifying existing operational services, weather and climate modelling, and applying new technologies.

7.6 The role of MU-ICS (Institute of Climate and Society) on the capacity building of professionals in Ethiopia & Sub-Saharan Africa

Amanuel Zenebe (PhD), *Mekelle University*

Dr. Amanuel Zenebe presentation focused on Partnership the university has, Projects & benefits, Operational MSc and PhD programs, and Opportunities for MU-ICS.

He introduced the vision, mission, goals and objectives of MU-ICS. Furthermore, Dr. Amanuel addressed institutional building, partnership and networking and projects and benefits. He emphasized partner or stakeholder capacity building on long term training and short-term training.

Lastly, in his presentation, he explained their plan, which included

- Establishing two centres at ICS: Weather prediction Center and Climate Risk Management Center
- Diversification MSc. Programs: Climate and Food Systems, Climate Science and Modelling, Climate change and Development, Climate and Urbanization and Climate and Forest resources modelling
- To work with existing and interested partner universities: To attract more funding for research and Opening joint PhD & MSc programs.
- To continue writing proposals to Intra-Africa mobility program as coordinating or partner University

7.7 Basic principles of cloud seeding and pilot progress in Ethiopia

Mr. Mulualem Abera, *Meteorologist, NMA*

The recently implemented cloud seeding technology was the main topic discussed by Mr. Mulualem, and his discussion points were;

- Objectives of ECS as Pilot Initiative, the significance of ECS Experiment, technologies required for cloud seeding, TITAN (RADAR) and ECS experiment results, as well as the way forward

Mr. Mulualem elaborated the definition of the term 'Cloud Seeding' and its three types. Thus, Cloud Seeding is defined as a process in which the precipitation is encouraged by injecting artificial condensation nuclei through aircraft or a suitable mechanism to induce rain from rain-bearing clouds. In addition, the three types of cloud seeding are:

- Static mode cloud seeding increases rainfall by adding ice crystals (usually in silver iodide or dry ice) to cold clouds.
- Dynamic mode cloud seeding increases rainfall by enhancing "vertical air currents in clouds and thereby vertically process more water through the clouds." Basically, in this seeding method, many ice crystals are added to the cloud than in the static mode.
- In hygroscopic seeding, salt crystals are released into a cloud. These particles grow until they are large enough to cause precipitation to form. Clouds can be seeded from above with the help of aeroplane that drop pyrotechnics or from the ground by using artillery or ground-to-air rockets. A more recent cloud-seeding technique HS (Water-attracting) particles such as potassium or sodium chloride.

Moreover, he explained the objective of cloud seeding thus, as he told the main goals of ECS- Enhancing Rainfall of Belg seasonal rainfall for the selected areas such as (Deficit) lack of Belg rainfall, capacity building, Experience sharing, Technology transfer and practising the experiment of Cloud Seeding initiative as well.

He then discussed the history of cloud seeding and implementation in Ethiopia,

- The ECS & UAE Joint cloud seeding experiment is started in March 2021
- The initiative was come to practice with great aspired by the foresighted Prime Minister of Ethiopia, H.E Dr. Abiy Ahmed Ali.
- The Ethiopian Cloud Seeding experiment started to implement as Co-Working principles with different National organizations as one,
- NMA is the owner of the whole process, for cloud seeding command office, issue forecast at different time scale, plan and execute the cloud seeding operation from the centre, evaluate the effect, with the help of and together with UAE experts.

Finally, he mentioned the way forward for cloud seeding experiment, to increasing the number of weather radar spatial coverage in the future, a capacity building training for experts of NMA and assessing the feasibility study of cloud seeding experiment.

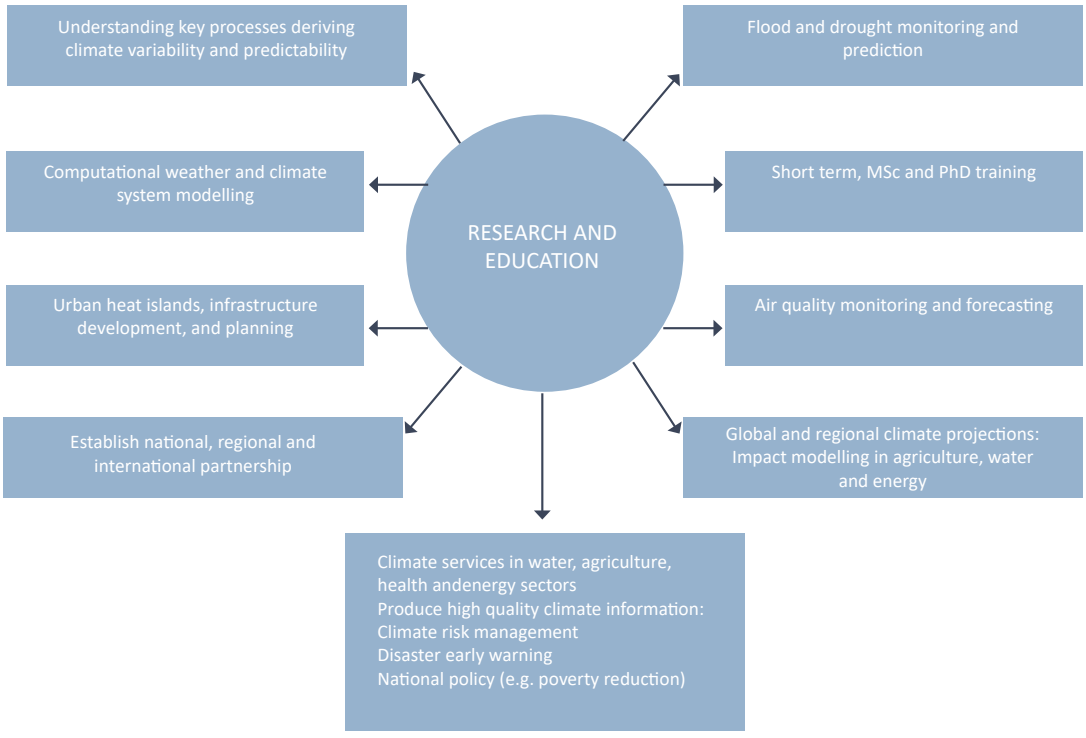
7.8 A Successful Bilateral Cooperation Between ESSTI and NMA to Develop Improved Weather and Climate Services

Titike Kassa (PhD), ESSTI

He highlighted the following Mission and Vision of ESSTI

- To enable the country to exploit multi-dimensional uses of space science and technologies fully.
- To produce demand-based knowledgeable, skilled, and attitudinally matured professionals in aerospace science, enabling the country to become internationally competitive in the sector.
- To develop and strengthen space science and technology infrastructures to speed up space science and technology development.
- To enable the country to be a robust contributor to the development of aerospace science and technology.

Dr. Titike addressed what we do/ research on the Atmospheric and Climate Science program (AtCLim) at ESSTI by the following diagram.



Purpose of the MoU between NMA and ESSTI as

- Short term and long term technical and scientific training for human capital development;
- Weather and climate extremes (i.e., drought and flood disasters) forecasting and prediction services;
- Weather and climate monitoring and technological development (mainly manufacturing and launching of weather monitoring satellite technology development);
- Sharing a considerable amount of earth observation, meteorological and ground-based measured meteorological and climate datasets; and
- Improving Agromet, Hydromet and Biomet services and equip experts in the area for the national development plan of the country

So far, has been done by AtCLim was1st Capacity Building Training focused on Regional Climate Modeling and Atmospheric data Analysis and Display Tools also 2st Capacity Building Training focused on High-Resolution Regional Climate Change Simulations, Sensitivity Experiments and Analysis.

Finally, he concluded his presentation by explaining the aim of the capacity building training so far as:

- This capacity development training aims to strengthen and improve the capability of NMA to undertake its full range of responsibilities and provide efficient weather and climate services for the safety and well-being of society.
- To produce high-resolution future climate change scenarios in Ethiopia to develop studies that should be raising awareness among government and policymakers in assessing Climate Change impacts, vulnerability and designing adaptation measures.
- To build expertise on using and applying ICTP RegCM and simulation techniques to carry out high-resolution analyses of Ethiopian climate phenomena.
- To better understand relevant regional/local climate phenomena, their variability and changes, through downscaling.

7.9 Application of Artificial Intelligence in Meteorology

Mr. Samuel Rahamatola, *Ethiopian Artificial Intelligence Center*

He presented in detail the application of AI in weather forecasting, climate modelling, Prediction of Extreme Weather, Cloud Seeding, and meteorological applications (crop yield prediction, seasonal disease prediction, and prediction of turbulence for aviation).

With regard to weather forecasting, it is a complex and challenging science that depends on the efficient interplay of weather observation, data analysis by meteorologists and computers and rapid communication systems.

In modern forecasting models mainly apply Numerical Weather Prediction (NWP) technique

- In NWP, a set of simplified equations is used to calculate changes in atmospheric conditions
- The process of writing these equations, imposing the boundary conditions and solving them using supercomputers is known as numerical modelling

AI techniques aren't being used to generate forecasts on their own partly because the traditional methods are quite good. However, today's numerical forecast models have limitations due to large volume of imperfect data. For instance, satellite data are global, but researchers in data assimilation are still trying to figuring out how this data can be appropriately given to the models. The diversity and many forms of uncertainties exist in the datasets. The spatio-temporal correlations between datasets are unknown chaotic nature of the atmosphere and the system of partial differential equations that govern physics-based models can be unstable.

7.10. Enhancing Climate Services Education in Ethiopia through ACToday project

Tufa Dinku (PhD), *Senior Research Scientist, International Research Institute for Climate and Society (IRI), The Earth Institute, Columbia University.*

He noted the goal of the ACToday project aimed at creating climate-service solutions that help end hunger, achieve food security, improve nutrition, and promote sustainable agriculture. Explained the two main premises to ACToday as:

- Climate/weather information of the present and near-term is more relevant for adaptation than long-term projections and scenarios
- Creation or strengthening of climate services, can facilitate progress towards SDG2.

Finally, Dr. Tufa addressed APPROACH: Strengthen all aspects of climate services by working with the most relevant institutions on the main points as:

- Short training courses for professionals

- Embedding climate services education into formal education at different levels
- Two-week professional development for DA's: Climate Risk Management in Agricultural Extension
- One-week professional development for NGO's: Understanding and using ENACTS map rooms for risk management
- Two-week training on Climate Services for NMA Staff
- One semester course for ATVET school: Climate Risk Management in Agricultural Extension
- Three-week certificate program for university students: Climate Risk Management in Agriculture
- Participatory Integrated Climate Services for Agriculture (PICSA) for Farmers

7.11. WMO Capacity Development Programme

Ernest A. Afiesimama (PhD), WMO Regional Office for Africa, World Meteorological Organization (WMO)

He informed the participant about some background information on WMO capacity building Programme. He then shifted into components of the program, which included;

- Voluntary Cooperation Programme - Focuses on meeting members' needs through direct financing and/or transferring expertise and technology between Members.
- Resource Mobilization and Development Partnerships
- Regional Programme: to ensure the efficient and effective functioning of the six Regional Associations of the Organization and provides a framework for regional cooperation in the implementation of the WMO strategies, policies and programmes;
- Small Island Developing States (SIDS) and Member Island Territories (MITs) –Investments in disaster risk reduction, including early warning systems and adaptation measures for critical sectors, are essential for building resilient communities and facilitating sustainable development (SIDS Accelerated Modalities of Action - SAMOA Pathway)
- Least Developed Countries (LDCs) Programme – Enables NMHSs to enhance both human and institutional capacities to eradicate poverty in order to achieve internationally agreed development goals (Istanbul Programme of Action - IPoA).
- Education and Training Programme – Assists NMHSs in developing the qualifications and competencies

WMO Capacity Development Strategy assists members in identifying the services, addressing gaps, formulating appropriate national strategies and action plans. In addition, it helps in the exchange of information on the needs of their NMHSs and identifies possible sources of assistance - may it be other Members or development partners. The speaker then stated WMO Capacity development for climate services. He finished his presentation by saying that WMO has an integrated approach for climate services' capacity development that includes institutional capacity, infrastructural capacity, human capacity, and procedural capacity to meet the mandate.

Group discussion: questions, answers and comments

After the presentations ended, Dr. Asaminew summarized the key points grounded on the eleven presentations. He then opened the floor for discussion.

Q1: As the presentation, AICCRA contribution to the capacity building project is for NMA Ethiopia. If so, your capacity-building project is that only for NMA. What about Universities in Ethiopia?

A1: AICCRA contribution to the capacity building project is only for NMA Ethiopia, but we will plan to support relevant universities for NMA besides advising students at the national level.

Q2: Is there a way to include WRF-chem, regional modelling and performance evaluation of CMIP6 on the project?

A2: Research on performance evaluation of CMIP6 can be included in this capacity-building project, but there is no option for WRF-chem and regional modelling.

Q3: To access the product of the NMA Map Room from the website is too complicated, and we cannot get the image and raw data from it. So, is there a possibility to download this using password if there is privilege and permission? What is the method you used for merging station data with satellite and reanalysis data?

A3: The Map Room products made using kriging statistical methods and from NMA website can access Map Room product in terms of image with country, zonal and woredas administration boundary. But merged data can't be gotten from the map room; however, one can obtain raw data from the NMA office as per the agency's data police.

Q4: Are there similarities between the air quality project proposed by NMA with that of Professor Solomon Bililign?

A4: There is no similarity between the two projects.

Q5: NMA, in collaboration with the Ethiopian Meteorological Society, started publishing scientific journals annually. It is good progress, but the authors are from only the agency's experts pool. Furthering this progress by including foreign experts is suitable for advancement. How do you look at this?

A5: Since we are a beginner on the journal, other scholars have not reviewed it, but we will include other reviewers in the future.

Q6: Besides the station data, what other data sources are you using for blending?

A6: For Rainfall blending, we use satellite data while we use re-analysis data for temperature.

Q7: Cloud seeding is a new science for our country but does it has side effects on the environment and soil science?

A7: For cloud seeding, Ethiopia uses sodium chloride and potassium chloride, and they have no environmental impact.

Q 8: Meteorological science is observational science, and students at the university level need to engage in the practical activity; thus, how is the experience of Arbaminch university in this regard?

A8: The university has AWS and laboratory staff to engage students in the practical exercises. We also provide the students with an apprenticeship in other institutions like NMA to gain practical exercises.

8. SESSION III: PARALLEL SESSION II: AGRICULTURE AND ENVIRONMENTAL, FOREST AND CLIMATE CHANGE SECTORS

Summary

Dr. Dawit Solomon was the chair, and Mr. Yimer Assefa and Tamiru Kebede were rapporteurs for this agriculture, environment, forest and climate change sector session.

As everybody knows, agriculture is the backbone of the economy for countries like Ethiopia. Although climate and weather are critical to the socio-economic activities in general, the agricultural sector is one of the most affected sectors in Ethiopia as it is highly dependent on rainfall. Therefore, it is crucial to work together to support the agricultural sector vital for the country's economic activity. Accordingly, the national framework for climate service (NFCS), which National Meteorological Agency coordinates has been established. This framework plays a vital role basically in generating meteorological information, providing timely and reliable information to the community and sector offices, preparing platforms, preparing impact-based forecast (IBF), providing capacity building training, knowledge sharing, creating well-educated personnel and promoting sophisticated technology that enables experts their forecasting capacity. It also helps to minimize paradoxical information from being provided to the community. In order to carry out the above tasks, all stakeholders need to have a strong relationship.

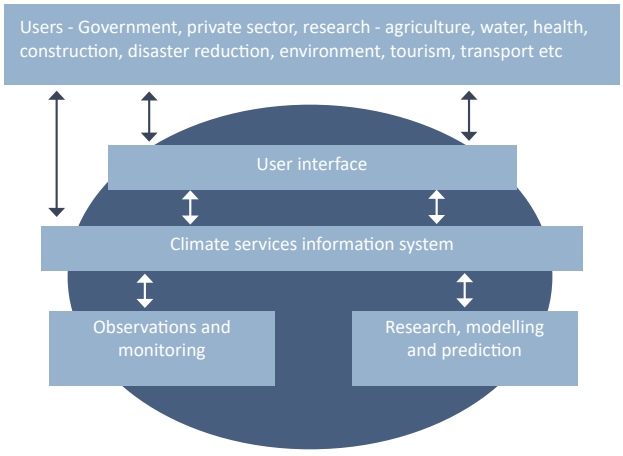
8.1 General Description and Roles of NMA on the Implementation of NFCS

Mr. Leta Bekele and Mr. Mohamed Abera, *Meteorologist, NMA*

Mr. Leta's presentation was mainly focused on the general description and roles of NMA on the implementation of NFCS. He pointed out the three components of NFCS which are the NFCS baseline assessment study, the NFCS strategic plan and the NFCS coordination guidelines. In his presentation, points like NFCS priority sectors, climate service settings, gaps found within sectors were capitalized.

NFCS Priority Sectors are: - under this title, he mentioned details about the key sectors that play a significant role in implementing NFCS. According to his explanation, MoWIE, MoA, MoH, NDRMC, and EFCCC are the NFCS priority sector institutions.

Climate Service Setting: he explained well about multi-stakeholder user interface platforms that enable the development and delivery of climate services at the country level shown in pictorial form.



Climate Services Setting

In addition to this, he also pointed out the gaps throughout the implementation of NFCS mainly with respect to sectors and pillars. He highlighted the gaps in every sector according to NFCS baseline assessment and strategic plan documents. Accordingly, the following are sector-wise limitations that are expected to be overcome.

1. National Meteorological Agency

- Limited weather and climate modelling capacity and research;
- Lack of high-resolution climate products;
- Lack of staff incentive mechanism;
- Slow growth in instrumentation, calibration & maintenance and ICT capability;
- Limitations on sustaining regularity of training opportunities and maintaining standards;
- Poor coordination among climate service actors.

2. Water and Energy sectors

- Limited staff expertise;
- Low staff incentive mechanisms;
- Slow growth in Hydro-met instrumentation, calibration & maintenance including ICT capability;
- Limited practices in generating and disseminating Hydro-met services to users;
- Limited practices in Hydro-met knowledge management;
- Slow adaptation to institutional reforms;
- Limitations in financial resources.

3. Agriculture Sector

- Lack of Agro-met specific staff in various fields of agriculture (crops, livestock and NRM);
- Limited staff capacity at all levels;
- Limited practices in Agro-met knowledge management;
- Limitations in financial resources;
- Limited capacity in Agro-met instrumentation, calibration & maintenance, including ICT capability;
- Slow adaptation to institutional reforms

4. Health Sector

- Low track records in implementation and documenting results of the health adaptation plan;
- Low staff capacity in Bio-met services;
- Inadequate capacity in Bio-met knowledge management;
- Low utilization of technology and innovations;
- Lack of research on the link between climate and health

5. Disaster Risk Management (DRM)

- Limited staff expertise;
- Inadequate capacity in DRM knowledge management;
- Limited ICT capability;
- Low quality of Woreda Disaster Risk Profiling (WDRP) to inform risk management decisions (covering limited woredas, old, and dominantly qualitative information);
- From the national to woreda level, the organizational structure is not well connected (for example, the woreda DRM function under the Office of Agriculture).

Pillar-wise limitation

According to Leta's presentation, there are also pillar-wise limitations in addition to sector-wise limitations. The main problems here are the lack of a web portal that should have included multi-sectoral products, user-based research, lack of awareness of climate information services, language barriers, and accessibility problems. He also mentioned gaps in station distribution, limited length of historical data at the intended station, digitized data, data package (format) problems and data resolution problems needing end-users.

He also highlighted gaps such as observations and monitoring, which needs additional station establishment and sustainable maintenance of existing networks, developing standardization of quality control mechanisms. Further, he mentioned the gaps regarding research, modelling, and application, which are crucial in seasonal forecasting challenges, including uncertainty in the predictions and limitations associated with delivering and updating the forecast information for the end-users.

He then pointed out the gap regarding capacity building required for experts, providers, intermediaries, users, and policymakers related to policy planning. Mr. Leta also clearly discussed the following NFCS benefits for the sectors.

- Relevant training and applied in practical settings
- Tailored training and reference materials in climate services jointly developed
- Priority research needs for different groups of users co-identified and co-designed
- Increased national availability of and access to high computing facilities
- Improved policies and procedures for effective climate services
- Improved partnership among climate stakeholders at all levels
- Quality and timely meteorological data and data products made available
- Quality and timely health-met/agro-met/hydro-met data and products made available

In general, Mr Leta raised the following critical issues regarding the role of NMA in implementation for NFCS.

- Create a platform for collaboration.
- Modernizing Weather Observing Station networks
- Capacity building of regional meteorological service centres
- Delivery of diverse climate data and products
- Strengthening climate data quality management system
- Implementing on-site meteorology service
- Implementing Impact Based Forecasting (IBF) for weather and climate extremes
- Implement the NFCS: a coordinating office will be established within the structure of the NMA at the level of the Directorate.
- Climate information raises awareness among end-users and agricultural and health extension professionals to understand and apply weather forecasts

8.2. NFCS-E (Focusing on Agriculture Sector)

Mr. Esayas Lemma, *Director for Crop Development Directorate, MoA*

Mr. Esayas started his presentation by describing the activities performed by the Ministry of Agriculture across the country in collaboration with stakeholders at federal, regional, zonal and wereda levels.

In his presentation, he mainly focused on the goal of NFCS- Ethiopia in the context of climate-related hazards, the role of MoA on climate service, SWOT analysis on agriculture, strategies of NFCS on agriculture.

Mr. Esayas explained in detail the goals of NFCS-Ethiopia in the following manner

- Building the Resilience of Ethiopians to climate-related hazards through better provision of climate information and services;
- Advancing the key national and global development goals through better provision of climate information and services;
- Mainstreaming the use of climate information and services in decision-making; and
- Strengthening the engagement of providers and users of climate services; and maximizing the utility of existing climate service infrastructure.

He stated the role of MoA on climate service regarding meteorological data and information for the production of agro-met services, creating collaboration with producers, co-producers, boundary organization, mixed farmers, pastoralists and commercial farmers.

Moreover, he mentioned the detailed role of MoA, which is the establishment of CRGE unit to implement climate-resilient and low carbon agricultural projects and dissemination of agro-meteorological advisories for end-users through agricultural task force and regional agricultural extension system.

According to his presentation, many points were raised regarding the strengths, weaknesses, opportunities, and threats analyzed throughout the implementation of NFCS. The presentation was also focused on SWOT Analysis related to Agriculture, and those SWOT analyses are described as follows.

Strength: - Strong institutional presence from national to local levels, better use of Climate information and dissemination, existing partnership with other climate institutions and research to improve agro-met services (agro-met platform).

Weakness: - Lack of agro-met specific staff in various fields of agriculture (crops, livestock and NRM), limited staff capacity at all levels, limited practices in agro-met knowledge management, limitations in financial resources, limited capacity in agro-met instrumentation, calibration & maintenance including ICT capability and slow adaptation to institutional reforms.

Opportunity: - The majority of citizens are dependent on climate-sensitive agriculture and increasing demands for agro-met services; and growing national and international collaboration for agro-met services, increasing numbers of graduates in agro-meteorology and Climate change (to tap agriculture-related benefits that come along with climate change).

Threats: - Frequent organizational re-structuring, efficiency in agro-met services would be compromised by actions in other sectors, uncertainties associated with climate and environmental change, Fast changes in agro-met technology and innovations globally and Staff turnover.

Finally, he summarized his presentation by pointing out two strategies of NFCS related to agriculture and their objectives.

Strategies for Goal 1: Institutional capacities are built to deliver high quality, decision-relevant, timely, reliable and sustainable climate services

- Objective 1.1: Knowledge and skills of staff in climate services institutions at all levels enhanced
- Objective 1.2: Coherent research, M&E, Knowledge management system
- Objective 1.3: Improved observation, data management, and prediction infrastructure
- Objective 1.4: Effective multi-sectoral (water, agriculture, health, DRM, and environment) institutional policy framework and governance

Strategies for Goal 2: Climate services, adapted to the diverse needs of users, are implemented, delivered and adopted at all levels and at all times.

- Objective 2.1: Improved availability, quality and delivery of agro-met services

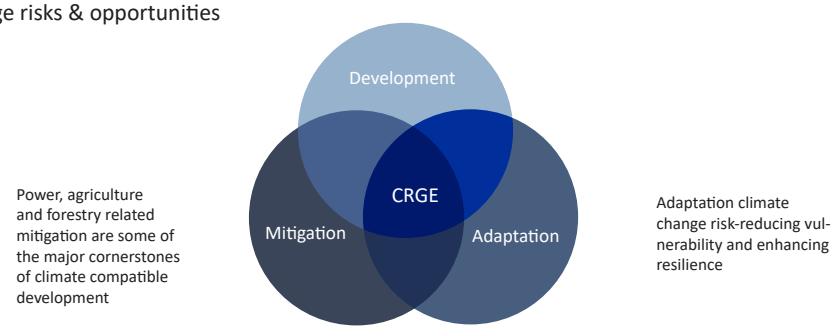
8.3 Environment, Forest and climate change commission

Mr. Mohammed Andoshe, *Director for Climate Change Planning Implementation and Coordination Directorate, EFCCC*

Mr. Mohammed presentation was mainly focused on climate resilience, green economy, the role and responsibility of his organization, challenges and way forward.

He then pointed the main components, which are fundamental for CRGE. Those essential components are described clearly in the following figure.

Economic development, although essential for the job and income creation, cannot be addressed independently of climate change risks & opportunities



He also demonstrated the three complementary objectives for CRGE strategy as follows

1. Improving resilience to climate change.
2. Ensuring reduction and avoidance of future emissions, i.e., transition to a green economy; and
3. Fostering economic development and growth

According to Mr. Mohammed's presentation, sustain economic development, net-zero emissions, and building resilience are the primary and concrete goals of the CRGE.

Key roles and responsibilities

- Ensure that CRGE strategy is planned and mainstreamed across all implementing sectors and regions
- Identify and disseminate appropriate technologies that help to adapt and mitigate climate change
- Participate in the negotiations of international multilateral environment agreements and coordinate the nationwide responses to the agreements
- Prepare and verify the GHG emission reduction by source and removal by sink reports
- Develop standardized guidance for CRGE implementation
- Provide awareness-raising and capacity building supports and
- Coordinate actions on soliciting the resources required for building a climate-resilient green economy

Objectives of NAP-ETH

1. To reduce vulnerability to the impacts of climate change by building adaptive capacity and resilience

2. To facilitate the integration of climate change adaptation:

- Introduce relevant new and existing policies, programs and activities, in particular development planning processes and strategies,

Scope and Vision of NAP-ETH

Vision: The Ethiopia NAP (NAP-ETH) vision is to create climate change impact resilient development for Ethiopia and its people.

Scope: The scope of NAP-ETH embraces development and service sectors.

Within these sectors, 18 adaptation options have been identified for implementation at all levels and across different development sectors, recognizing the considerable diversity in context and vulnerability across regions and social groups. These options are:

- Enhancing food security by improving agricultural productivity in a climate-smart manner;
- Improving access to potable water;
- Strengthening sustainable natural resource management;
- Improving soil and water harvesting and water retention mechanisms;
- Improving human health systems;
- Improving ecosystem resilience through conserving biodiversity;
- Enhancing sustainable forest management;
- Building social protection and livelihood options of vulnerable people;
- Enhancing alternative and renewable power generation and management;
- Increasing resilience of urban systems;
- Building sustainable transport systems;
- Developing adaptive industry systems;
- Mainstreaming endogenous adaptation practices;
- Developing efficient value chain and marketing systems;
- Strengthening drought, livestock & crop insurance mechanisms;
- Improving early warning systems;
- Developing and using adaptation technologies; and
- Reinforcing adaptation research and development

NAP-ETH Strategic Priorities

- Mainstreaming climate change adaptation into development policies, strategies and plans
- Build the long-term capacities of institutional structures involved in NAP-ETH
- Improving the knowledge management system for NAP-ETH
- Establish effective and sustainable funding mechanisms
- Advancing adaptation research and development in the area of climate adaptation

Apart from the above-stated issues, he also mentioned the challenges within his organization to implement the NFCS as follows

- Week coordination and integration with sector implementing and coordinating entities (hort/vert)
- Gaps in planning and mainstreaming CRGE and in cascading it
- Lack of effective resource mobilization
- lack of effective and sustainable capacity development
- Lack of strengthening effective use of green technologies (mainly adaptation)
- Lack of human power
- High turnover of experts

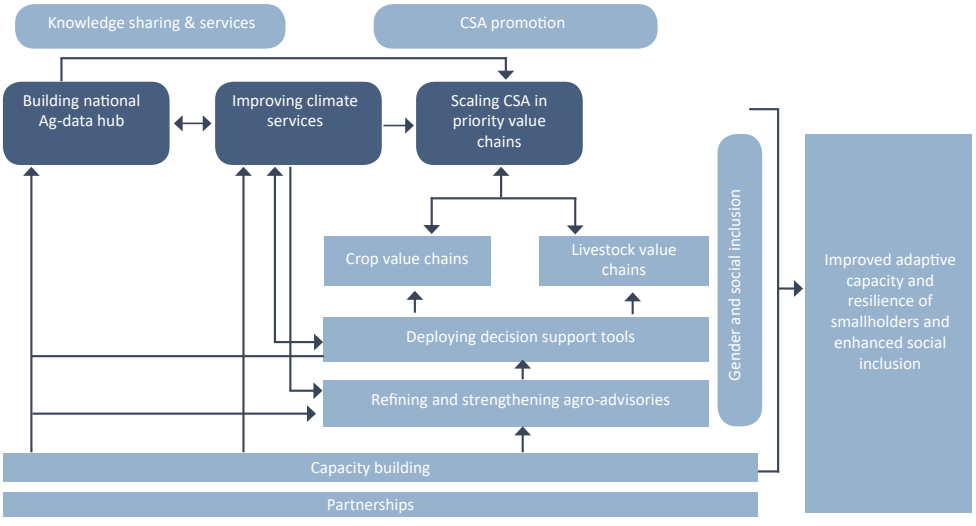
Finally, Mr. Mohammed pointed out the way forward that needed attention.

- Strengthening vertical and horizontal integration
- Established and Strengthening data management system
- Strengthen the concept and its implementation of climate change mainstreaming
- Employ best practices on climate change adaptation activities in the relevant sector
- Implement and practices adaptation technologies
- Established capacity development
- Established an effective and sustainable resource mobilization system
- Strengthening adaptation and its related research

8.4. AICCRA Project Contribution to NFCS

Dr. Kindie Tesfaye, *CIMMYT*

Dr. Kindie started the presentation by describing the components of Accelerating the Impact of CGIAR Climate Research for Africa (AICCRA) which are ultimately very important to develop improved adaptive capacity and resilience of smallholders and enhanced social inclusion briefly. These components are described in the figure below.



AICCRA-Ethiopia project intervention framework.

The presentation highlighted that Ethiopia's rainfed agriculture is under the mercy of climate and stated the climate factors that affect Ethiopian agriculture. According to Kindie's presentation, parameters such as soil condition, type of crops/varieties and production system, type of animals and production system, water supply, annual and seasonal variabilities and extremes are among the parameters that affect all aspects of Ethiopian Agriculture. He then indicated the need to address climate-related challenges' impacts on agriculture by designing smallholder friendly climate risk management strategies.

Accordingly, he stated the importance of the provision of climate agro-advisories to enhance decision making on activities such as crop variety selection, crop field selection, sowing time, harvest time, post-harvest management, pest and diseases early warnings, the timing of fertilizer and irrigation applications at different time scales (days, week, month and season).

Dr Kindie outlined the activities and deliverables of the AICCRA project relevant to climate services as follows.

- Strengthening the national digital ag-extension systems -integration of tailored EWS, CIS and digital ag-advisories for priority crop and livestock value chains (refined agro-advisories and EW systems, customized delivery tools and DTS tools)
- Dissemination of contextualized and validated CIS and CSA packages to be widely accessible to partners and end-users (targeting GSI, the local language, agro-ecologies and value chains)
- Identification of constraints and policy options for broad-scale CIS and CSA adoption identified (evidence-based policy priority setting, CIS and CSA packages reaching farmers with focus on GSI via national and sub-national programs)
- Scaling strategies for validated and customized CIS and CSA packages in priority value chains put in place and big-ticket national investments to facilitate scaling leveraged
- Increased access to CIS, ag-advisories and CSA packages in priority value chains, and NARES capacity on CIS and CSA co-development and scaling enhanced
- National policies, strategies and programs informed, and CIS and CSA investments influenced by AICCRA Ethiopia outputs (*national policies and big investment decisions informed through AICCRA funded partnerships, outputs ad outcomes*)
- CSA next users' (extension agents, input providers, farmers) capacity on CSA technologies and practices built, national platforms strengthened to support adoption at scale.

Finally, he listed the specific contribution of AICCRA's to NFCS which include:

- Support endorsement of NFCS
- Support establishment of NFCS coordination for multi-stakeholder engagement
- Providing training on resource mobilization for the implementation of NFCs
- Building capacity at different levels

8.5 Enhancing climate Services Ethiopia: IRI's Role

***Tufa Dinku (PhD)**, Senior Research Scientist, International Research Institute for Climate and Society (IRI), The Earth Institute, Columbia University.*

His presentation mainly focused on Enhancing climate Services in Ethiopia. He started his presentation by stating overall about IRI. He then continued his presentation by defining the term "climate service" from different points of view.

According to the definition he provided, GFCS (Global Framework for Climate Service) is a decision aid derived from climate information that assists individuals and organizations in society to make improved decision making. He also defines CSP as the climate service that involves the production, transportation, transfer and use of climate knowledge and information in climate-informed decision making and climate-smart policy and planning.

He also stated the essential components and pillars, which is briefly described by the following figure.

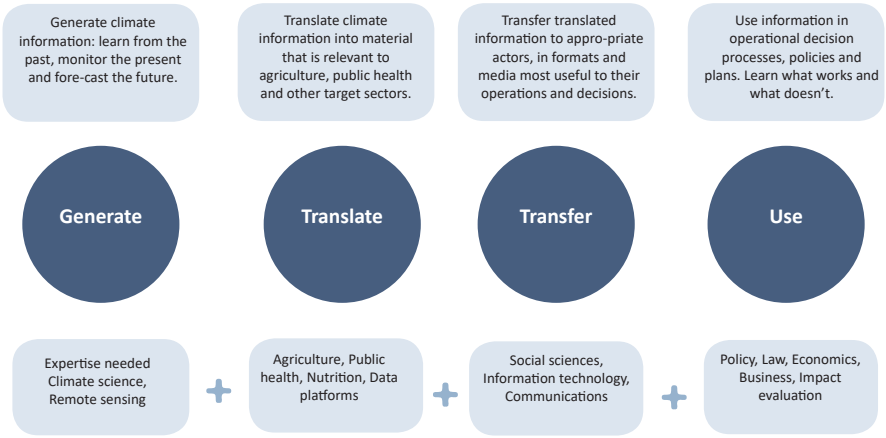


Figure: The schematic indicates the 4 Pillars of climate services. The colored arrows indicate that information flows from left to right, and is enhanced and made more relevant, and finally put to use. The grey arrows indicates feedback and iteration. The text above explains each of the Pillars. The 'Expertise' listed below each Pillar, builds as you proceed from left to right, with considerable multi-disciplinarity required to effectively transfer and use the information.

Components and Pillars of climate Services

Tufa also stated the key actors involved in climate service as follows

1. Climate service provider: NMHS played a great role in providing forecasts and research centres that provide agrometeorological advisory products.
2. Climate service end-users: can be categorized as national level and final beneficiaries
3. Communication translation: these actors are boundary organisations that link climate service providers and climate service end-users.

Moreover, Tufa briefly discussed the activities performed by ENACTS (Enhancing National Climate Service). According to his description, the followings are the three main pillars of ENACTS;

- Improve data availability, enhance access and promote the use

Finally, he described the ENACTS outputs that are very important for multi-sectoral stakeholders.

ENACTS Outputs: - Over 40 years of rainfall and temperature data for every 4km grid across each country through a combination of station observations and satellite and reanalysis products, Unprecedented online access to climate information products and Built capacity at NMA and some user communities.

8.6 Monitoring localized climatic extremes using Climate Hazards Center Early Warning Tools

Diriba Korecha (PhD), *University of California Santa Barbara Climate Hazards Center, Field Scientist for Eastern Africa based in Ethiopia*

Dr. Diriba started his presentation by conveying a happy 40th Anniversary message sent from Dr. Funk, Research Director of Climate Hazards Center, University of California Santa Barbara.

Dr. Diriba's presentation was mainly focused on Monitoring localized climatic extremes using Climate Hazards Center Early Warning Tools. He then briefly discussed understanding the climate system concerning the time scale, space-wise, quantity and quality, which are closely related to the climate system and complexity in nature that plays a vital role in monitoring climate and providing early warning. Particularly, he noted that many weather and climate extremes are the result of natural climate variability (including phenomena such as El Niño), and natural decadal or multi-decadal variations in the climate provide the backdrop for anthropogenic climate changes. While inferring IPCC (2012), he mentioned that even if there were no anthropogenic changes in climate, a wide variety of natural weather and climate extremes would still occur (IPCC, 2012).

Dr. Diriba also stated the activities such as routine observation and baseline references, which are performed throughout the monitoring of the climate system. However, he pointed out that there is a number of limitations encountering institutions' skill and capacity during monitoring localized climatic extremes. Some of the resources, knowledge and capacity gaps that dismay real-time agro-climatic observation and monitoring include,

- Limited number of observational sites
- Unevenly/coarse distribution of stations
- Use of outdated instruments
- Inaccessibility/remote/ of regions due to nature /topography, harsh weather, off-road, man-made problems/ conflict/war
- Data handling, archive, usable/accessible format
- Fast technological innovation
- Costly

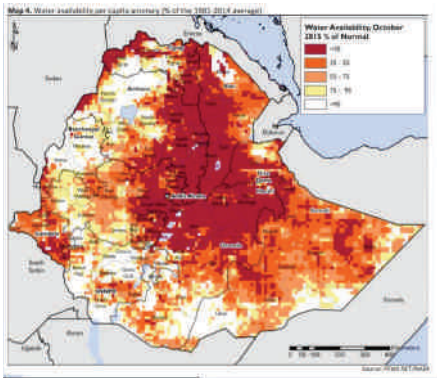
Furthermore, Dr. Diriba highlighted how emerging climatic extremes and consequences have adversely impacted societal livelihood in Ethiopia. These climatic extremes, which are mentioned among others;

- Recurrent of severe droughts
- Uneven distribution of seasonal weather events
- Occasional floods
- Heat/cold waves (frosts)
- Undependable start/end/length of growing seasons, and
- Insufficient in amount and poor quality.

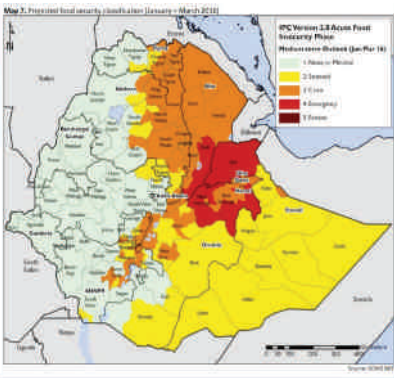
As climatic extremes are becoming more prominent due to unavoidable changing climate, Dr. Diriba listed some of the unbearable consequences

- Food insecurity: - Malnutrition, Famine, starvation, depletion of individuals/national/ assets
- Water scarcity
- Health problems: emerging of both endemic and epidemic diseases
- Environmental degradation
- Unmanageable natural resource exploitation
- Conflict/societal unrest, and
- Ecosystems change

He noted how the strongest 2015 El Nino led into high food insecurity disasters in Ethiopia by providing pictorial evidence as given below.



Water availability per capita anomaly (% of the 1981-2014 average)



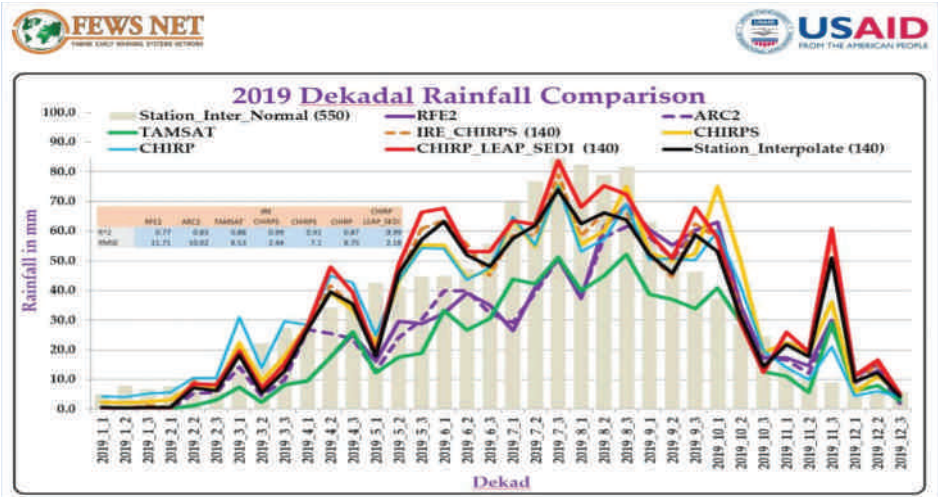
Projected food security classification (January — March 2016). Following the worst drought in more than 50 years, a major food security emergency is ongoing in central and eastern Ethiopia. The Government of Ethiopia estimates that 10.2 million people will require emergency food assistance in 2016, making Ethiopia the country with the largest acutely food insecure population in the world.

In linking the role of climate science in revitalizing the scope of CHC's early warning tools, Dr. Diriba highlighted two successes. These are;

- Enhancing weather/climate monitoring skills
- Based on existed real-time observation
- Use of pure remote sensed/satellite-derived products
- Remote-sensed blended with ground observations
- Model-based simulation and forecast/prediction/projection
- Combinations of parts or all items listed above
- Improving/strengthening weather/climate forecasting capability, the products that are being utilized as key input in the provision providing agro-climatic and food security outlook for arts of Eastern Africa where climatic extremes always emerged with the severity have been increased from year to year.

Finally, Dr. Diriba provided a key diagram that depicted the level at which CHC products and services excelled other remote-sensed products that are routinely produced by other similar regional and international centres.

Validating the skills CHIRS/IRE versus various rainfall estimates (blended with ground observations



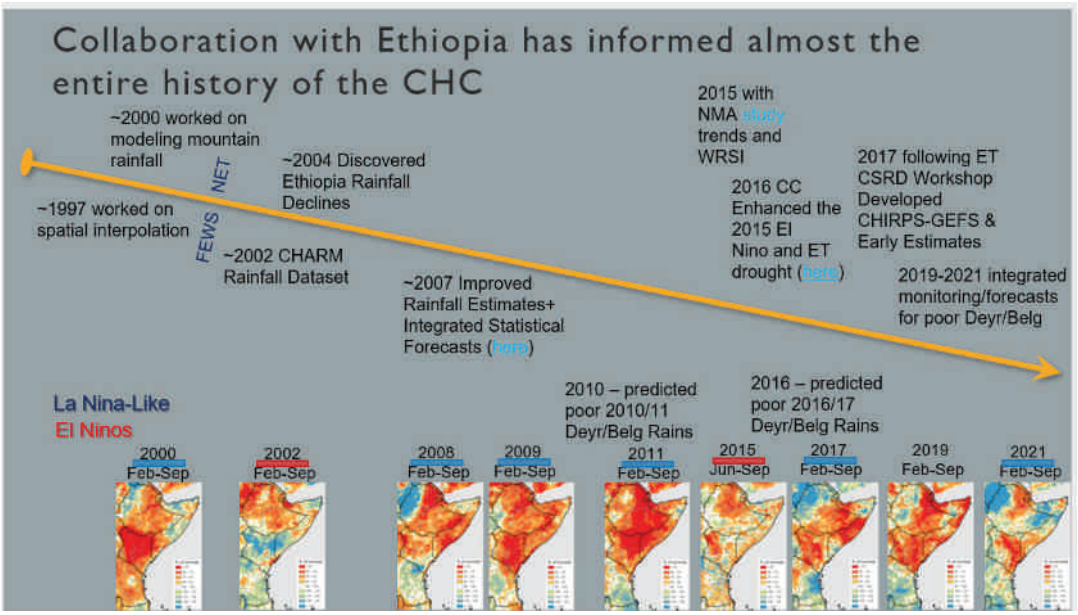
8.7 Assessing the Scientific Benefits of the UCSB/CHC and NMA Partnership

Video presentation from Dr. Chris Funk, *Research Director of Climate Hazards Center, University of California Santa Barbara.*

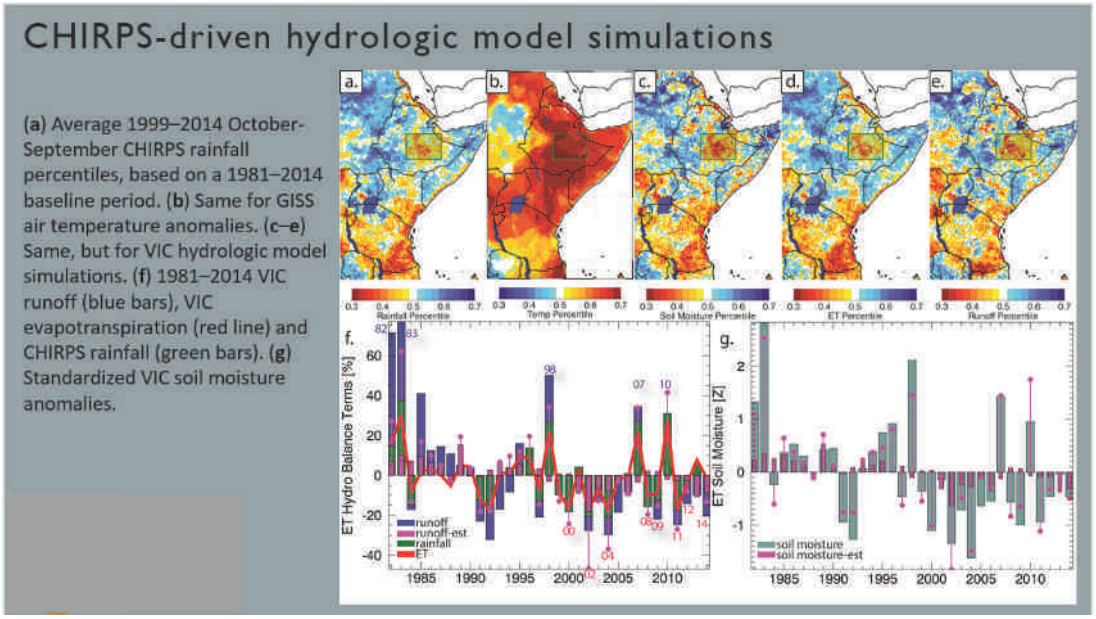
In his presentation, Dr. Chris mentioned that the CHC is a unique combination of American and African/Central American Scientists. As a science partner of the FEWSNET project, CHC provides technical and scientific supports both for FEWSNET Home Office and regional offices, notably Central America, Western Africa, Southern Africa, Eastern Africa and Central Asia. His presentations focused on the following points;

- Assessing the Scientific Benefits of the UCSB/CHC and NMA Partnership
- Collaboration with Ethiopia has informed almost the entire history of the CHC
- Climate Change, Rainfall Declines, La Niña, El Niño and Prediction
- Improved Rainfall Estimates and CHIRPS
- CHIRPS-GEFS, Early Estimates and Integrated Outlooks, and
- How long term declines in the Belg rains over Ethiopia

Dr. Chris has shown well-established collaboration between CHC and Ethiopian NMA produced successful early warning information on past climatic hazards. His presentation revealed that most of the past climatic extremes and associated socio-economic impacts in Ethiopia have been well forecasted in advance by CHC and well communicated to NMA.



The main topics that Dr. Chris ironically rounded include Climate Change, Rainfall Declines, La Niña, El Niño and Prediction; Improved Rainfall Estimates and CHIRPS; and CHIRPS-GEFS Early Estimates and Integrated Outlooks. Dr. Chris uses Walker Circulation patterns as key scientific nobility to reason out how long term declined in the Belg rains became evident over Belg-rain-receiving arts of eastern Ethiopia. For instance, he noted that Equatorial west Pacific Sea Surface Temperature has shown an increasing trend and hence the climate is becoming more La Niña-like, but El Niños are also becoming stronger in recent years. This west pacific SST association with Ethiopia's seasonal climate patterns offers opportunities for skilful seasonal forecasts in Ethiopia. Besides, CHIRPS-driven hydrologic models simulated excessive and deficient runoff and soil moisture conditions over more than three decades.



Dr. Chris summarized his video presentation by iterating that conversations, innovation, integration and discovery drive improvements in CHC-NMA climate services. In general, Dr Chris emphasized that

- Conversations drive innovation, integration and discovery, leading to improved climate services.
- The ~20-year CHC NMA partnership has led to the development of very good monitoring and forecast capabilities – CHIRPS, CHIRPS-GEFS, Early Estimates, and very long lead climate forecasts.
- Science is powerful because solving a problem in one place often leads to global solutions. Innovations focused on improved monitoring and forecasting in Ethiopia led to global products used to help millions of people. That is great. In 2019 and 2020, 71 terabytes of CHIRPS data have been downloaded from the CHC from ~20,000 unique internet addresses.
- In Ethiopia, climate change is strengthening strong ties to El Niños, LaNiñas, and the Indian Ocean Dipole, amplifying risks.
- At both seasonal and weather scales, there is a lot of potential for effective prediction in Ethiopia. Leveraging that predictive skill can help us prepare for climate change, and these early actions can help safeguard livelihoods and boost crop production.
- Collaborations with the NMA have played a central role in the growth and development of the CHC.

In the kind invitation of the event organizing committee, Dr. Chris and Dr. Diriba were privileged to make another presentation on the same topics on the special event organized by NMA headquarter and regional meteorological centre's directors and experts.

Questions and answers

Q1. The synergy between Environmental, Forest and Climate change Commission and IRI directly forwarded to Dr. Tufa.

A1. There has been a collaboration between IRI and EFCCC so far. However, there is loose communication that should be improved.

9. SESSION III: PARALLEL SESSION III: AVIATION SECTOR

Summary:

Mr. Tafesse Regassa was the chair and Mr. Getahun Bekele was rapporteurs for Aviation sector session.

The mission of the Aviation Meteorological Services Directorate is to enhance the safety, regularity and efficiency of national and international civil aviation operations through the provision of accurate, timely and relevant forecasts, warnings and other information whilst meeting Ethiopia's obligations under international agreements for the provision of meteorological services for international aviation.

Ethiopia is a signatory (a Contracting State) to the Convention on International Civil Aviation, known as the Chicago Convention. The convention established the International Civil Aviation Organization (ICAO) and vested it to adopt and amend international standards and practices concerning global air navigation. Annexe 3 to the Chicago Convention sets out the relevant standards and recommended practices about providing the meteorological service for international aviation. It states that 'the objective of meteorological service for international aviation shall be to contribute towards the safety, regularity, and efficiency of international air navigation, for the Chicago Convention, the National Meteorological Agency (NMA) of Ethiopia.

The session intends to enhance stakeholder's cooperation to provide meteorological service for safe, economical and regular flight air operation. In this session, three consecutive presentations were presented according to the timetable. The first presentation provided a brief introduction on 'Aeronautical Meteorology Services Delivery, Challenge and Opportunity', the second on 'WMO Aeronautical Meteorological Services Program', and the third presentation focused on 'Meteorological Service for International Air Navigation (Annexe 3).

9.0. Aeronautical Meteorology Services Delivery, Challenge and Opportunity

Mr. Kassa Fekadu, *Director, Aviation Meteorological Services Directorate (AMSD)*

He gave a brief introduction starting from the mission, vision and objective of the Meteorological service for aviation. Since National Meteorological Agency (NMA) is the designated Meteorological Authority providing Aviation Meteorological Services in Ethiopia, the service is providing in accordance with the standards and recommended practices set out in Annex 3 to the Convention on International Civil Aviation Organization (ICAO).

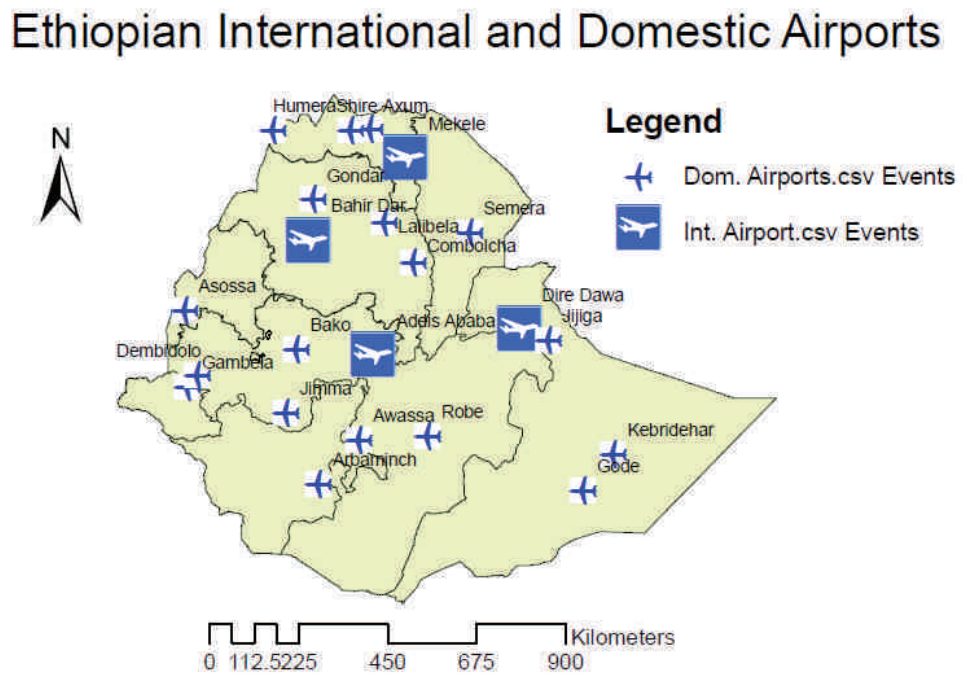
He further explained the organizational structure of AMSD and the mission of Meteorological service to enhance the safety, regularity and efficiency of national and international civil aviation operations through the provision of accurate, timely and relevant forecasts, warnings and other information whilst meeting Ethiopian obligations under international agreements for the provision of meteorological services for international air navigation. As the organizational structure Lead by the Director General of the National Meteorological Agency, AMSD also had two teams responsible for the Aeronautical Meteorological office for 4 international and 18 domestic airports and the Meteorological Watch office assigned for Flight Information Regions (FIR) of Ethiopia centred at Addis Ababa Bole International Airport.

He then stated products and services that are available for Aviation meteorology services (aviation weather reports-routine and special (METAR, MET REPORT, SPECI and SPECIAL REPORTS); forecasts (Terminal Aerodrome Forecast, TREND, Take Off and Wind and Temperature Forecast surface and aloft); Flight Documentation (Written or printed documents, including charts or forms, containing meteorological information for a flight); Briefing (oral commentary on existing and/or expected meteorological conditions); Consultation (discussion with meteorologists or meteorological forecasting technicians of existing and/or expected meteorological conditions relating to flight operations).

These products are used at twelve stages of a flight (Preflight planning, Flight Plan Filing, Preflight Operations, Taxi out & Take Off Operations, Departure Operations, Initial Climb Segment, Initial Cruise Operations, Cruise Operations, Approach Operations, Landing Operations, Taxi in, Post Flight and Alternate Operations).

All 22 airports aerodrome observations and reports routine reports (METAR), special reports (SPECI), and METREPORT were fully providing through the Aeronautical Meteorological Office. And also, for four International airports and four Domestic airports, prepare and disseminate Terminal Aerodrome Forecast (TAF). As a hub, Addis

Ababa Bole International airport needs continuously monitoring weather conditions through 24 hrs by issuing TAF, Trend forecasts, Forecasts for take-off, Forecasts of en-route, Briefing, consultation, display of weather satellite, and Preparing Flight documentation. He profoundly discussed the current status of the aviation industry in Ethiopia, the list of air operators, distribution of airports workforce, infrastructures, products, and services available to provide meteorological service for the air navigation operation.



Meteorological Watch office providing services for Flight Information Region (FIR) Ethiopia Centered at Addis Ababa receiving and watching further from different international Centers of hazardous weather phenomena such as SIGMET information (Turbulence, thunderstorm, Convective storms Icing, etc.), AIRMET information, Aerodrome warnings, Wind shear warnings and alerts and volcanic ash advisory information.

He also discussed Quality Management System (QMS) for the Provision of Meteorological Service for International Air Navigation is mandatory on the International Civil Aviation Organization (ICAO) and The World Meteorological Organization (WMO). In line with this, he explains the Implementations of ISO 9001:2015 QMS, certified at Bole International Airport and planning to expand the scope on the remaining three international airports.

Mr. Kassa also discussed the manpower and the infrastructure of the aviation meteorological service under NMA.

Manpower:

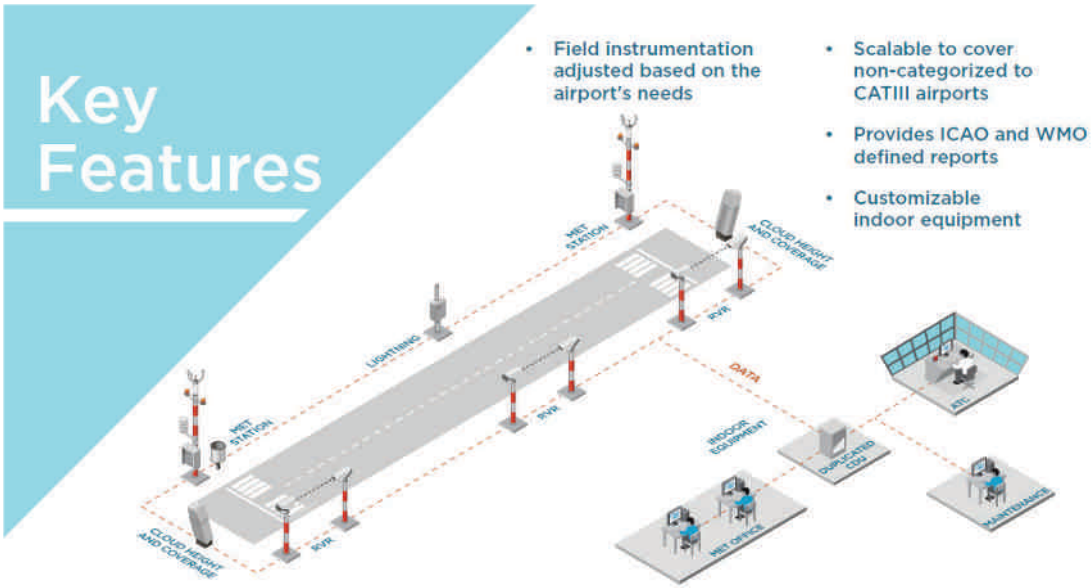
42 Meteorological Forecasters and 25 Meteorological Observers are working at the 4 international airports 32 Meteorological Observers at 18 domestic airports with 99 permanent employers engaged for this particular Aviation Industry in Ethiopia.

Infrastructure:

- 5 Automatic Weather Observing Systems (AWOS) at four international and one domestic airport
- 12 Avimet or Small AWOS at 12 domestic airports including Ethiopia Air force at Debrezeit
- 22 Conventional meteorological stations at eighteen domestic and four international airports
- 4 Satellite Distribution Information System (SADIS) at International Airports
- WAN –LAN network international Airports
- Aeronautical Message Handling System (AMHS) at Bole International Airport installed by Ethiopian Civil Aviation Authority

Mr. Kassa explained the cost recovery schemes prepared and studied based on WMO and ICAO principles and procedures. He described its purpose to recover the expenditure of service provision. Other features such as observations from aircraft aviation operations reports and Aircraft Meteorological Data Relay (AMDAR) also explained and discussed the implementation with the collaborations of Ethiopia Airlines.

He then discussed existing challenges and future plans on the provision of aviation meteorology service;



A typical AWOS solution consists of the field sensors, central data unit(s), communication interfaces and different workstation types.

Challenges:

- On-time maintenance Software upgrade & calibration of AWOS and small AWOS, which reflected in user's dissatisfaction
- Lack of sufficient and suitable office arrangement & transport as a Challenge for proper and standard services provision
- Limitations of observational infrastructures are bold challenges for the expansion of Airport systems in association with rapid technological changes in the aviation industry
- He concluded that collaborations are needed as follows.

Collaboration:

- Commence the strong attention on the integration of the service
- Increasing the scope of QMS ISO 9001:2015 implementation to other airports to provide quality air operation.
- Aeronautical Meteorological Service at the remaining four international airports as per ICAO and WMO QMS Guidelines,
- Fully implementation of Cost recovery, AMDAR Program and standardize and fully furnished office.
- Develop and commence the ready web-based aeronautical meteorological service.

9.2. WMO Aeronautical Meteorological Services Program (AeMP)

Behalf of Earnest A. Afiesimama (PhD), Mariane Diop-Kane (PhD), *Program Manager, WMO Regional Office for Africa in Addis Ababa, Ethiopia*

Dr. Mariane gave a brief presentation on AeMP coordinates all WMO aeronautical meteorology related activities and ensured an effective liaison with ICAO by supporting the development of meteorological techniques and practices for providing services based on user-identified requirements.

She elaborates that Aeronautical meteorology services are governed jointly by the International Civil Aviation Authority (ICAO) and World Meteorological Organization (WMO). The two organizations work together to establish and implement a global regulatory framework for the National Meteorological Services of Members to use as a basis for meteorological service provision in a highly coordinated and interoperable manner. WMO established the AeMP to mainstream organizational activities related to aviation and ensure effective coordination with partners to further the application of meteorology to aviation. To this end, WMO and ICAO established working arrangements, specifying roles and responsibilities within the two organizations, to ensure efficiency and avoid duplication. She briefly discussed the coordinated coverage of the ICAO and WMO.

This coordination work covers:

- The establishment of basic meteorological networks and facilities required for effective provision of meteorological service to international air navigation;
- The setting of standards on aeronautical climatological information;
- The defining of qualification and competency standards for aeronautical meteorological personnel; and
- The advancement of science and technology is in support of the growing demand for interoperable, fit-for-purpose, quality information and services by the aviation transport sector.

Dr. Mariane then Discusses AeMP provides targeted capacity development to Members, particularly in developing and least developed countries (LDCs), in order to assist them in achieving international requirements for quality, competency and performance of aeronautical meteorological service. The Aeronautical Meteorology Programme also develops guidance material, best practice models, documentation, and training for members to assist them in meeting required standards. In this regard, the Programme promotes the establishment of fair, equitable and transparent cost-recovery mechanisms for sustainable and high quality aeronautical meteorological services.

As she concluded, AeMP ensures effective coordination within WMO in following up the recommendations of the Conjoint ICAO/WMO Meteorology Divisional Meeting: To do this:

- AeMP coordinates the meteorological aspects of the ICAO Global Air Navigation Plan (GANP) and its Aviation System Block Upgrades (ASBU) methodology (The Global Air Navigation Plan covers the broad spectrum of institutional, regulatory, technological and operational aspects of the envisaged performance improvements in support of the “One Sky” global Air Traffic Management (ATM) concept with a horizon of the year 2028 and beyond).
- The integration of the meteorological information in the System-Wide Information Management (SWIM), the enhancement of the international facilities like the World Area Forecast System (WAFS) and the International Airways Volcano Watch (IAVW), and the development of a new generation of services to support safe, effective and efficient Air Traffic Management and Trajectory Based Operations (TBO).
- The Conjoint ICAO/WMO Meteorology Divisional Meeting recommended that the AeMP investigate the impacts of climate variability and change on global aviation operations.

Dr. Mariane Diop-Kane finalized by indenting AeMP and WMO Reformes, which in short are:

- AeMP is under the Commission for Weather, Climate, Water and Related Environmental Services and Applications (SERCOM)
- SERCOM assist members to enhance service delivery capabilities and enable effective implementation and compliance
- SERCOM establishes close coordination and efficient working mechanisms with relevant international organizations such as ICAO in the area of service delivery
- Collaboration with ICAO and Airlines in Africa on the AMDAR Programme
- Regional Office for Africa will further discuss with stakeholders in Ethiopian Airlines and the Ministry responsible for Transportation.

9.3. Meteorological Service for International Air Navigation (Annex 3)

Mr. Getahun Seifesilassie, *Senior Air Traffic Controller, Ethiopian Civil Aviation Authority*

Mr. Getahun explains the Objective, Determination and Provision of Meteorological Service. The objective of

meteorological service for international air navigation shall be to contribute towards the safety, regularity and efficiency of international air navigation. This objective shall be achieved by supplying meteorological information's for the following users such as operators, flight crew members, air traffic services units, search and rescue services units, airport managements and others concerned with the conduct or development of international air navigation with the meteorological information necessary for the performance of their respective functions.

On his presentation, each contracting state shall designate the authority, hereinafter referred to as the meteorological authority, to provide or arrange for meteorological service for international air navigation on its behalf on a bilateral agreement. The meteorological authority shall designate a meteorological office to be associated with each air traffic services unit. After coordination with the air traffic services unit, the associated meteorological office shall supply or arrange for the supply of up-to-date meteorological information to the unit as necessary for the conduct of its functions.

Mr. Getahun then discussed that the associated meteorological office for an aerodrome control tower or approach control unit should be an aerodrome meteorological office.

He recommends that the associated meteorological office for a flight information centre or an area control centre by meteorological watch office. The contents and formats of meteorological information currently provided, in addition to the local routine and special reports and METAR and SPECI, shall contain the following elements in the order indicating below, identification of the type of report; location indicator; time of the observation; surface wind direction and speed; visibility; runway visual range (RVR), when applicable; cloud amount, cloud type (only for cumulonimbus and towering cumulus clouds) and height of cloud base or, where measured, vertical visibility; air temperature and dew-point temperature; and QNH and, when applicable, QFE (QFE included only in local routine and special reports).

Group discussion, questions and answers

After the three presentations, the floor was open for discussion; the participants discussed how aviation meteorological service improved and enhanced customer satisfaction in the aviation sector. User raised questions, and appropriate solutions and directions are set. The meeting seeks to confirm whether meteorological services can be organized based on customer needs conditions and what special features of this service would justify exclusive improvement for service provision. The questions from meeting attendants are raised and discussed briefly as follows:

Q1: Gave general comments on events and the sector future plan of action and asked the scope of QMS implementation and the status of current domestic airports service provision and challenges.

A1: NMA plans to implement and extend the scope of the ISO-9001:2015 QMS for all airports and will conduct a training program for all Ethiopian airports personnel.

Q2: Explained the importance of meteorological service for aviation industry and the request of quality and accuracy of forecast because since there is much flight diversion due to weather and the standard service provision, QNH availability and Altitude correction.

A2: Accept the whole comments and recommendations and answer gave the example Kombolcha airport has challenging terrain and topography so, the airport must have Instrument Landing Systems (ILS) and AWOS rather than small AWOS to address flight diversion and altitude issues on QNH reading the problem is known for diversion of aircraft, i.e. lack of cooperation.

Internet issues should be permanently solved with the cooperation of stakeholders. The other modernization of service, NMA procured web portal for international air navigation still not installed due to the lack of enough space to allocate the instruments server and work stations. AMSD used a very small office that was built 40 years ago the office was not appropriate both for staff and instruments at Bole international airport. The web portal has internationally standardized services especially for the international flights. But we must have strong cooperation to resolve problems and difficulties accordingly.

Q3: The limitation of aeronautical met station coverage as geographically insignificant. How we can get updated information for the new airports.

A3: It is known that and NMA is ready to provide service, even when new airports are built. But the offices issued for aeronautical service are mostly not standard and suitable for service giving like 360 degrees seen office is mandatory for monitoring visibility and clouds. Even here, Addis Ababa Bole international airport is fully covered with buildings, and the provision of the services is questionable. AMSD cannot enhance and modernize the service at Bole international Airport due to lack of proper office availability.

Q4: Explain the strong parts of AMSD has gotten TAF for 8 airports, but airports like Semera and Goba have not yet given services; how we can get service? What is the progress of AMDAR implementation?

A4: Domestic airports like Goba and Semera NMA already installed aeronautical stations and assigned staffs, but we don't have any information whether ECAA assigned ATC staff or not, because NMA provides the services via ATC. Nevertheless, on most domestic airports, the ultimate weather data users are pilots with telephone.

AMDAR program is very important, and the program is implemented between service providers and operators; hence, NMA and EAL have to have going forward to achieve both benefits.

Q5: Comments on the commitment of NMA, he thought NMA neglected Aviation industry because in NFCS endorsement no agreement with Air Transport and requests the status of MOU between AMSD and ATS.

A5: The response regarding the statement NMA neglects the aviation industry; the assumption is incorrect and misunderstood the whole service provision. It is well known that meteorological services for air navigation are well established, international standards and adequately managed by ICAO and WMO. The stakeholder engagement in this sector also has long-term cooperation well define and strong bond, so NMA doing according to well-established systems and don't neglect the Aviation industry sector.

10. SESSION III: PARALLEL SESSION IV: WATER, HEALTH AND DISASTER RISK MANAGEMENT SECTOR

Summary

Mr. Tsegaye Ketema was the chair and Mr. Tamirat Yohannes and Mr. Kidus Belay was rapporteurs for Aviation sector session.

Mr. Mohamed Abera, coordinator, Bio Meteorological Services Team, presented the importance of climate services to NFCS priority sectors in Ethiopia, the Setup of climate service, the gaps per sector, gaps per pillar, the roles and responsibilities of NFCS implementing institutions (Discussed his presentation on session IV).

Mrs. Sahle Tefera, Senior expert in Disasters Risk Early Warning Directorate under National Disasters Risk Management Commission, identified Strengths and Gaps in National Disaster risk management commission presented regarding the Roles of National Disasters Risk Management Commission in implementing the National Framework for Climate Services (NFCS) explained about its' strength, gaps, Opportunity and threats.

Mr. Misganaw Tewachew, Senior expert, Ministry of Health is presented the roles of the health sector in the implementation of the National Framework for Climate Services (NFCS). Moreover, explained about the importance of climate service for the health sector and elaborated its' strengths, gaps, opportunity and threats. In line with this policy improvement & development of early warning and preparedness for intervention and human resource development is required.

Mr. Mohammed Ali, Hydrologist in Ministry of Water, Irrigation and energy, presented about the Roles of Water Sector in Implementation of the National Framework for Climate Services (NFCS) and explained in detail the importance of climate service for the health sector and elaborated its' strength, gaps, opportunity and threats.

He also talked about the importance of climate service for the water sector, such as Policy improvement & development, the need to strengthen early warning and preparedness for intervention, human resource development for effective water service delivery, and supply and distribute water supplies and other logistics.

Dr. Adugna Woyessa, Senior Researcher, Ethiopian Public Health Institute, presented how using climate information in the health sector is useful. He noted the application of ENACTS for malaria surveillance in different ENSO episodes in Ethiopia is beneficial for Malaria surveillance.

Dr. Kalkidan, Senior expert in accelerating the Impacts of CGIAR Climate Research in Africa (AICCRA) presented about Co-development of agricultural data hub and decision support systems. She underscored the agricultural data hub and decision support systems have been collected in Ethiopia since the 1950s. Still, those data are scattered across institutions, individuals undermining to make an integrated analysis for making informed decisions. Great efforts have been underway to organize data systematically and make them interoperable.

Dr. Joseph R. Mukabana, Former Director WMO RA for Africa, the then Senior Scientific Officer, WMO Research Communities in LCD & NWP, presented the essence of GFCS. He elaborated the vision of GFCS to enable better manage the risks of climate variability and change and adaptation to climate change through the development and incorporation of science-based climate information and prediction into planning, policy and practice on the global, regional and national scale within every society, there is a certain capacity to cope with hazards.

Dr. Mariane, Program Manager WMO RA for Africa, presented about African Ministerial Conference (AMCOMET) on Meteorology; Its' Contribution to the National Framework for Climate Services (NFCS).

She explained that AMCOMET is a high-level intergovernmental body politically recognized as a ministerial body of the African Union, now a subcommittee on meteorology; it increases the political support and recognition to the national meteorological services' contribution to socio-economic development and poverty eradication in the continent.

10.1. The Roles of National Disasters Risk Management Commission in Implementation the National Framework for Climate Services (NFCS)

Mrs. Sahle Tefera, *Senior expert, NDRMC*

Mrs. Sahle identified strengths and gaps in the National Disaster risk management commission.

Strength: - DRM is Presence of clear policy and strategy on DRM; Good experiences in applying climate information for early warning (for example, disseminating forecast-based early warning bulletins); Launch of woreda disaster risk profiling approach and strong partnership with national and international DRM actors.

Gaps:- Limited staff expertise; inadequate capacity in DRM knowledge management; Limited ICT capability; Low quality of Woreda Disaster Risk Profiling (WDRP) to inform risk management decisions (covering limited woredas, old, and dominantly qualitative information) and the organizational structure from national to woreda level is not well connected (for example, the woreda DRM function under Office of Agriculture).

Opportunities and Threats in the DRM sector

Mrs. Sahle mentioned the Opportunities and Threats in the DRM sector.

Opportunities: Increased global and national collaboration with DRM.

Threats: Increased frequency and severity of disaster risks associated with Climate and environmental change; Staff instability and Potential overlap of roles with other institutions

Mrs. Sahle assessed the gaps per pillar in DRM sector; she defined sectoral gaps as follows:
Gaps in User Interface Platforms

Most platforms lack well-defined and binding coordination arrangements and Web-based platforms run by national agencies, but they lack strength in terms of the diversity of information available, consistency of access (web pages not available), and low level of user feedback mechanisms.

Gaps in Climate Services Information System

NDRMC is one of the co-producers, to transform meteorological forecasts into sector-specific forecasts, but their prediction of losses and damages, as well as their co-producing of advisory packages, have not strongly proved; timeliness of climate services, spatial resolution, availability, accessibility, reliability and uptake, for various reasons, are is limited, and the level of understanding on the same type of climate services differs among climate service actors at different levels.

Gaps Institutional Capacities

NDRMC have enabling policies, strategies, and plans for implementing the NFCS; despite the enabling policy and institutional environment for NFCS, significant capacity gaps have been noted in staff knowledge and skills, availability of knowledge products, climate service infrastructure, and finance.

Gaps: Users and User Interface

One main web portal to introduce all user interfaces available & data held; Fit for purpose: Scientists/ researchers are not fully aware of user requirements; Users are not clear on what information can be made available; Access mechanisms insufficient and Language barriers.

Mrs. Sahle mentioned the role of NFCS implementation in the DRM sector clearly as follows: Strengthening climate services management system; Part of climate service information system is in place, but new infrastructure is needed to fulfil the NFCS vision; Primarily responsible for the coordination and actions under each sector and are headed by respective relevant government line ministries UN agencies and civil society organizations; Implementing Impact Based Forecasting (IBF), for weather and climate extremes; Actively involved in the design and implementation of National Framework for climate system; Interaction with regional and international governments and agencies to

strengthen Early Warning capacities and ensure that warnings and related responses are directed towards the most vulnerable populations; DRM Policy and operational guidelines are supported to implement NFCS and Awareness and communication engagement among Regional offices through DRM structure.

She concluded her presentation by stating that, to use climate information and create a shared understanding effectively, it is essential for data-generating institutions and stakeholders to work closely together to generate climate information and create a platform for collaboration.

10.2. The Roles of Health Sector in Implementation of the National Framework for Climate Services (NFCS)

Mr. Misganaw Tewachew, *senior expert, Ministry of Health,* explained the importance of climate service for the health sector. In line with this policy, improvement & development; early warning and preparedness for intervention; Human resource development and/or deployment Effective health service delivery and to supply and distribute medical supplies and other logistics

He presented Gaps of climate services in the health sector as follows: Limited climate services except for malaria; the information is not specific in terms of health problems; Low utilization of the existing climate data; No software /tools to analyze, interpret and disseminate; Lack of skilled human resource for utilization of climate services; Lack of strategy to disseminate tailored climate services; Lack of research on the link between climate and health Limited knowledge on climate data pertaining to public health; Lack of awareness on the importance of climate services and Lack of attention and commitment from decision-makers and professionals

He mentioned the required capacity needed in the health sector. In line with this, the required skill needed for interpreting climate information and co-designing and co-producing climate services; Skill training on climate information, products and services that are available to the health sector; Utilization of climate data for health; Predicting and communicating future health impacts by using climate services; weather and climate-sensitive disease modelling and software /tools.

Skilled human resource on GIS (risk area mapping) and relevant topic; mapping and research skill on climate-sensitive disease; Technologies (HPC, internet, mobile apps, software/tools, etc.) on climate and health data utilization and distribution; experience sharing from other countries on climate services and utilization of climate data for health; Short and long term training.

The role of the health sector to implement NFCS

- Co-development and delivery of diverse health-met services (health-met observation, forecast, prediction, and projection including impacts and advisories);
- Strengthening health-met data quality management system (SOPs, monitoring, etc.);
- Document and share case definition for nationally prioritized Climate Sensitive Diseases (CSDs) and other health events;
- Develop modelling and provide prediction;
- Conduct research on impacts of air pollution on nationally prioritized CD, NCD and major food safety concerns over major cities;
- Delivery of tailored thematic training in priority sectors of climate services;
- Awareness creation and raising of climate services, including impacts of climate change on health for stakeholders and the general public at all levels; and
- Setting up digital climate services knowledge management library

10.3. The Roles of Water Sector in Implementation of the National Framework for Climate Services (NFCS)

Mr. Mohammed Ali, *Coordinator, Hydrologist in the Ministry of Water, Irrigation and energy*

He presented about existing climate services for the water sector. The existing partnership between the sector and climate service providers, at national, regional and local level: - Information sharing on climate data, Sharing of Forecast hydrological information based on climate data and stakeholder coordination on Dam operation.

He also discussed the importance of climate service for the water sector, such as Policy improvement & development; Early warning and preparedness for intervention; Human resource development and/or deployment;

Effective water service delivery and supply and distribution water supplies, and other logistics.

The Gaps of climate services in the water and energy sector

Limited climate services in water sector; the information is not specific in terms of water problems; Low utilization of the existing climate data; No software /tools to analyze, interpret and dissemination and Lack of skilled human resources for utilization of climate services

He presented the Required capacity needed for the water and energy sector: The required skill needs for interpreting climate information and co-designing and co-producing climate services; Skill training on climate information, products and services that are available to the water sector; Utilization of climate data for water predicting and communicating future water impacts by using climate services; Weather and climate-sensitive water modelling and Software /tools.

Skilled human resource on GIS (risk area mapping) and relevant topics; Mapping and research skill on climate-sensitive Areas; Technologies (HPC, internet, mobile apps, software/tools, etc.) on climate and water data utilization and distribution Experience sharing from other countries on climate services and utilization of climate data for water and short and long-term training

The role of the water and energy sector to implement NFCS

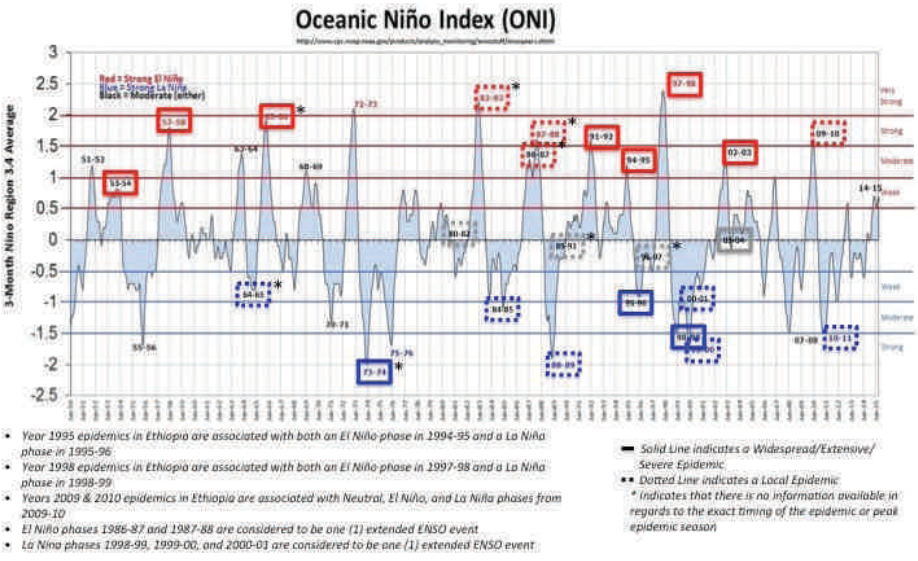
Delivery of tailored thematic training in priority sectors of climate services; Awareness creation and raising of climate services including impacts of climate change on the water for stakeholders and the general public at all level; Setting up digital climate services knowledge management library; Establish effective monitoring and evaluation system; Assessing capacity of water professionals on climate services; Conduct an assessment on flood-prone areas; Conduct water implication of seasonal forecast/climate outlook forum and Training on water and climate variability/change for the use of climate information for the water sector.

Training on weather and climate modelling, integrating climate information; Provide training on GIS and other relevant software of spatial modelling on climate services and provide long term training (MSc & PhD)

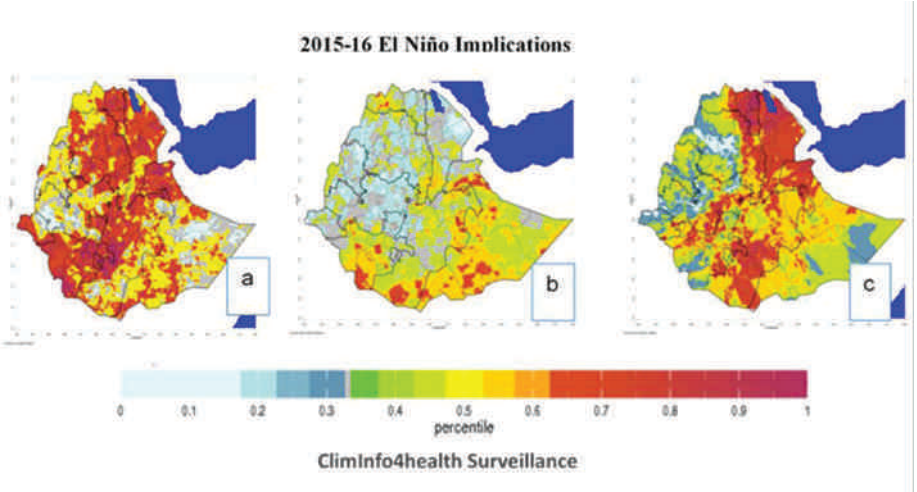
10.4. Using Climate Information in the Health Sector, Application of ENACTS for Malaria Surveillance in Ethiopia

Dr. Adugna Woyessa, *Senior Researcher, Ethiopian Public Health Institute*

He presented how useful it is to use climate information in the health sector. He noted the application of ENACTS for malaria surveillance in different ENSO episodes in Ethiopia is beneficial for early warning.



ENSO and malaria epidemics in Ethiopia. Note that 10 of the 11 "widespread" epidemic periods are associated with ENSO events (7 with El Niño and 3 with La Niña). The widespread epidemic of 2003 followed the El Niño of 2002/3 and occurred during a year where OND temperatures were unusually warm



Historical probability of seasonal monthly averages conditioned on El Niño in Ethiopia a) Low rainfall for Jul-Sep and (b) high rainfall Oct-Dec (c) high minimum temperatures Oct-Dec

He talked about the discussion points Malaria epidemics may occur during any ENSO episode, widespread epidemics appear to be more common during El Niño phases; while local epidemics are more frequently identified with La Niña or Neutral periods and however, inconsistencies in epidemic reporting make it impossible to quantify the precise relationship. Still, not all malaria epidemics were preceded by ENSO events.

He presented lastly about the recommendation how to use data from ENACTS products are accessible online that help to understand how climate variables and seasonal variability influence malaria transmission, particularly in various phases of ENSO and Climate is also a tool that can help health personnel in malaria-endemic areas for monitoring trends and considered for surveillance.

He discussed that experts in health and climate should engage leadership to revitalize the historic collaboration of NMA and the health sector, particularly the malaria program; the use of climate information can be initiated through organizing a training on the use of NMA's Maproom and the present NFCs platform is instrumental in harmonizing activities run by various units in the health system, example, PHEM, Research and MOH.

10.5. Accelerating the Impacts of CGIAR Climate Research in Africa (AICCRA): Ethiopia project: Co-Development Ag. Data hub and decision support systems

***Kalkidan, (PhD) Senior expert**, AICCRA*

Dr. Kalkidan presented about Co-development agr. Data hub and decision support systems. she mentioned the errors using inadequate data are much less than those using no data at all." *Charles Babbage.* "If the statistics are boring, you've got the wrong numbers." *Edward Tufte*. "Without data, you're just another person with an opinion." *Edwards Deming and Data is the basis to make informed and quality decisions!*

She defined the Agr. data hub and decision support systems: More systematic data have been collected in Ethiopia since the 1950s!; But those data are scattered across institutions, individuals undermining integrated analysis to make informed decisions; Recent developments show great opportunities to collect more spatial-temporal data rapidly!; Data storage, management and analytics are no more constraints! And there is thus a need to develop a harmonized and integrated database.

Great efforts are underway to organize data systematically and make them interoperable! The "coalition of the willing" - soils/agronomy database; Dtreo - genetic database platform to enhance genetic progress sheep and goat breeding programs

Partners and roles under this he divided into National and international partners.

From the national partners' side: MoA, ATA, EARCS, EIAR, CSA, NMA, GII, Inter Aide, RARIs, Universities, CoW members, Private sector, iCog Labs and

From the international partners' side: GIZ, BMGF, World Bank, USAID, IRI, WUR, PABRA. He also presented partners engagement including: Data sharing; Co-development of ag. Data hub; Promoting and supporting the ag. Data hub; Geospatial analysis community of practice; Development of decision support tool and Capacity development Projects that can be mapped: SSHI2, Africa RISING, EiA.

10.6. Global Framework for Climate Services (GFCS)

***Joseph R. Mukabana (PhD)**, Former Director WMO RA for Africa, the Senior Scientific Officer, WMO Research Communities in LCD & NWP.*

He elaborated the Vision of GFCS to enable better manage the risks of climate variability and change and adaptation to climate change through the development and incorporation of science-based climate information and prediction into planning, policy and practice on the global, regional and national scale within every society, there is a specific capacity to cope with hazards.

Climate variability and change increase uncertainty can increase or decrease this coping range; hence, through the GFCS, partners will be enabled to work together in an interdisciplinary manner, allowing coordination, synergies and linkage of various initiatives that contribute to climate services.

Through the Partners Advisory Committee in Africa, partners have agreed to showcase the benefits of collaboration in 6 countries (Burkina Faso, Bhutan, Dominica, Moldova, Papua New Guinea and Tanzania) to building a proof of concept that would enable scaling up of activities in various parts of the world. While collaboration of partners will be demonstrated in these six countries, the GFCS activities cover a wider geographical footprint than these countries.

Collaboration is being demonstrated in Malawi and Tanzania where for the first time seven partners (CCAFS, CICERO, CHR Michelsen Institute, WFP, WHO, IFRC, WMO) are working together to deliver climate services for DRR, health and agriculture and food security under the GFCS Adaptation Program in Africa.

Joint Offices were established with WHO, WFP and the Global Water partnership to advance the health, agriculture, food security, and water priorities of the GFCS. PAC has 17 membres (as of August 2016), the lattes onces are IRENA and ECMWF.

Regarding defined climate services, he mentioned that the provision of climate information in a way that assists decision making by individuals and organizations is vital. A service requires appropriate engagement along with an effective access mechanism and must respond to user needs.

There is an ever-growing knowledge of the causes and characteristics of seasonal to inter-annual variability, and decadal-time-scales changes are being translated into sound long-lead-time forecasts and a greater capability to project future climate albeit with uncertainty. It is clear that we need to use the best available scientific knowledge we have not only to understand the physical earth system better but also to make this information and knowledge available to ensure that the best planning decisions are made for humanity's sake.

He underscored what does the Met Community have to offer?

- Extended-range forecast: A forecast beyond 10 days and up to 40 days, describing the evolution of weather parameters, usually averaged and expressed as a departure from long term average climate values.
- Long-range forecast: From 30 days up to 1 year, but generally between 3-9 months. This is usually a description of averaged temperature and precipitation values, most often expressed as a departure from average climate values for the next few months or seasons.
- Annual forecast: This can be from 1 year to several years ahead, describing the large-scale climatic state over the coming years. This forecast is initialised with indicators of the current climate to capture the evolution of modes of internal climate variability, such as the El Nino Southern Oscillation (ENSO).
- Decadal forecast: Up to the next 10 years. This forecast is initialised with the current climate values but

extends to a period where the long term effects of greenhouse gas forcing also become important. This also includes the impact of external climate forcing from solar variations. The distinction between annual and decadal forecasting is often not clear, and many centres use these terms interchangeably.

He also mentioned new experimental products have been developed as part of CSRP to deliver the latest science to users:

- Experimental real-time forecasts of rainy season onset timing have been generated and disseminated to RCOFs in west and east and southern Africa. Feedback on these products has been very positive, and indeed the trial forecasts have been encouraging. For example, a strongly enhanced probability of early onset of the 2011 short-rains over East Africa was predicted - and early onset occurred.
- Similarly, an enhanced probability of delayed onset of the southern African season was predicted - and delays were observed.
- Three CSRP fellows are interacting with this work - helping to evaluate the usefulness of the onset predictions to applications in agriculture.
- The top 2 panels indicate the % probability of early-onset (red region indicates >80% probability of early-onset) and % probability of late-onset (blue region indicates <20% probability of late-onset). These predicted probabilities should be compared with the 'average' chances of early or late as defined here, both 33%.
- The observations (as plotted on a new CSRP monitoring product) indicate useful advice issued.
- Assessment over retrospective cases indicates forecast can discriminate early/late onset in ~70% of cases (Tanzania/Kenya) Note this work is still in development and an active research area, but trial products are already proving useful.

He stated as prerequisites for climate services, the following issues need to be considered:

- Available: at time and space scales that the user needs;
- Dependable: delivered regularly and on time;
- Usable: presented in user-specific formats so that the client can fully understand;
- Credible: for the user to confidently apply to decision-making;
- Authentic: entitled to be accepted by stakeholders in the given decision contexts
- Responsive and flexible: to the evolving user needs; and
- Sustainable: affordable and consistent over time.

Implementation focus: support through a systematic stepwise approach

- Step 1: National Baseline Capacity Assessment for Development of Climate Services;
- Step 2: National Consultation on Climate Services, Development of NHMS Strategic Plan;
- Step 3: Participatory Inter-sectoral Development of National Action Plan for the Establishment of a National Framework for Climate Services;
- Step 4: National Action Plan Endorsement Conference (High level); and
- Step 5: Launch of National Framework for Climate Services, Operational implementation of priority activities, rigorous M&E.

Lessons Learnt: GFCS implementation in Africa

1. Effective delivery of climate service interventions requires joint implementation, a common Masterplan (i.e., the National Action Plans)

2. Coordination vacuum: Incoherence in donor funding/multiplicity of duplicate initiatives, the most important barrier to GCFS implementation at regional and national levels. Information, 1st step in Coordination GFCS information go-to place. 'Spaces for coordination' should be set up at the country/regional levels, ensuring all relevant stakeholders are engaged and brought together around a common agenda on Climate services

3. Urgent need to Go from Pilot to Scale

- Give the Time for Change: Results at a large scale & institutional change will take time. Target: Horizon 2020 for frameworks to be self-sustaining horizon 2020: results at a large scale will take time.

10.7. African Ministerial Conference on Meteorology; Its Contribution to the National Framework for Climate Services (NFCS)

Mariane (PhD), *Program Manager WMO RA for Africa*

Dr. Mariane started her speech by elaborating why AMCOMET increases the political support and recognition of the national meteorological services' contribution to socio-economic development and poverty eradication in the continent.

She explained what AMCOMET is, the high-level intergovernmental body that is politically recognized as a ministerial body of the African Union, now a subcommittee on Meteorology.

AMCOMET Decision as flows

- WMO Congress, African Union, RAI Session, STC –ARDWE and AMCOMET Ministerial Decisions

AMCOMET GOVERNANCE

October 2017: Second Meeting of the AU STC on Agriculture, Rural Development, Water and Environment. Recommend that, in the short term, the Ministerial Conferences: African Ministerial Conference on Environment (AMCEN), African Ministers' Council on Water (AMCOW), African Ministerial Conference on Meteorology (AMCOMET), will be allowed to continue functioning in a transitional phase in accordance with the arrangements decided by the STC.

Endorse the report and decisions contained in the third AMCOMET Session held in Praia, Cabo Verde in February 2015, and the decisions of the AMCOMET Bureau Meeting and the Communiqué of the AMCOMET Africa Hydromet Forum in Addis Ababa, Ethiopia, in September 2017.

AMCOMET 4th session, Cairo, February 2019, Key points of Cairo declaration

- Reaffirm their commitment to AMCOMET, to ratify the constitution and pay their contribution;
- Approve 2-year extension of the strategy; and
- Welcome the establishment of the AfDB CDSF AMCOMET Facility.
- Encourage:
- Development of multi-hazard early warning systems to mitigate the impacts of extreme weather and climate events;
- Development of appropriate legislation for NMHSs;
- Implementation of NFCS involving national stakeholders in particular National designated authorities;
- Development of public-private partnership; and
- Creation of African meteorological satellite facility in line with African space policy and strategy.

Alignment of climate centres with regional economic groups, and ACMAD as AU technical arm for weather and climate issues.

3rd STC (ARDWE) October 2019: Meeting of the AU STC on Agriculture, Rural Development, Water and Environment (ARDWE)

The report and decisions of the AMCOMET 4th session endorsed the Cairo Declaration but some legal pending issues on ACMAD as its technical arm.

Implémentation of CAIRO déclaration:

- Establishment of AMCOMET CDSF Fund: in discussion with the partner AfDB;
- AMCOMET strategy updated and validated at AMCOMET-5; and
- AMSAF was established following the Abuja meeting, October 2019: composed of AUC (chair), RECs, AMCOMET and EUMETSAT (secretariat).

Now working on project concept to capacitate NMHS for the transition and readiness to MTG

- AU Validated National Strategic Plan Template and Guide (used by partners)
- Completed 14 NSP
- Developed Capacity Needs Assessment for ICPAC, Agrhymet, ACMAD. ICPAC, ACMAD WMO accredited RCC
- Received 14.6M CHF for Projects
- Organized AMCOMET-Africa and sub-regional Hydromet Fora, COVID-19 impacts on NMHSs webinar

Establishment of ECCAS RCC Projects implemented

- WISER Program (2017-2020)
- Operationalization of the Climate Research for Development (CR4D) platform, Grant Management Mechanism (Led by ACPC; AMCOMET is part of Oversight Board)
- AMDAR - Kenya (0.5M GBP)
- PPP with Kenya Airways and KMD to increase upper-air observations for improved weather forecasts
- Highway – Lake Victoria Basin Region (3.2M GBP + 2.5M GBP)
- Increase use of weather information to improve resilience and reduce the loss of life and damage to property in the East African region (Integrated EWS for East Africa)

Opportunities

- Relocation of RAF to Addis, close to AUC – Ethiopia, could play a significant role
- Collaboration with AUC strengthened
- More interactions with sister UN organizations in the region and the development partners for a better and more coherent projects' implementation
- Forward Plan
- Update the implementation plan
- On-going discussions with the African Development Bank to establish an AMCOMET Facility to support the implementation of the Integrated Strategy
- Member State outreach with regards to Ratification of the Constitution and AMCOMET Contribution (through support from WMO sub-regional Offices)
- Support to AMSAF and development of project proposal
- Support for the intra-ACP project implementation
- More possibilities to assist the member states

Discussion, questions and answers

Mr. Yaregal Tamene from MOH expressed their view in relation to the rainfall sacristy in agriculture and Water sectors are the main problem in the health sector too; therefore, the concept of the National Framework for Climate Services needs to be strengthened by creating synergy among our national institution. As a result, climate-resilient health system should be established as World Health Organization (WHO).

Mrs. Semunesh, Director for Hydrology and Water Quality Directorate in MoWIE, expressed their opinion on strengthening human and forecasting capacity.

Another concern from MoH to do research works together with NMA on different diseases other than Malaria.

Other request in relation to the NMA advisory communication pathways research rose

Following the speech of Dr. Kalkidan, Senior expert in accelerating the Impacts of CGIAR Climate Research in Africa (AICCRA), Ethiopia Project Mrs. Semunesh emphasized the need for data collection Ag. Data hub –Ethiopia, however, data are scattered and owned by individuals, where violate Ag. Data hub – Ethiopia, therefore the issue needs to be wisely handled.

Mr. Fetene Teshome, Director General of NMA, Permanent Representative of Ethiopia with WMO, requested how WMO is supporting to strengthen the newly established NFCS in Ethiopia, given that NFCS implementing partners: Ministry of Agriculture (MoA), Ministry of Water, Irrigation and Energy (MoWIE), Environment Forest and Climate Change Commission (EFCCC), National Disaster Risk Management Commission (NDRMC), Ministry of Health (MoH),

as NFCS also brings all relevant institutions include research and academia this requires enormous investment to strengthen early warning system towards alleviate hazards occurring in these institutions and boost developmental activities in the context of NFCS?

Q1: Mr. Fetene requested WMO RA for Africa for support in relation to experience transfer while NMA conducting NCOFs three times per year for different seasons?

A1: Dr. Joseph R. Mukabana replied to Mr. Fetene's request, and he assured that there is the fund to support NFCS for African countries, where Ethiopia also will be benefited.

Q2: Mr. Henock Hailu asked about the coping range for climate hazards as it differs from country to country?

A2: Dr. Joseph R. Mukabana replied that the coping range for climate hazards differs from country to country. The coping capacity depends on the extent of investment and the type of climatic hazard. Developed countries could cope with huge climatic hazards than developing ones.

Q3: Mr. Kassa Fekadu asked if there is a possibility of the PUMA station can be updated?

A3: Dr. Joseph R. Mukabana replied that now the European generated their third-generation meteorological satellite. In this regard, the PUMA stations be upgraded with the facility of the newly coming third-generation meteorological satellite.

ANNEXES

Annex I: Program of the event

Day One (25 May 2021): The 40th Anniversary of NMA, NFCS endorsement and parallel sessions

Time	Program	Responsible	Facilitator
Session One: Opening Session			
08:30 – 09:00	Registration	Registration desk	NMA PR
09:00 – 09:50	Expert panel discussion	NMA PR	Mr. Hailu W.
09:50-10:00	Short video of NMA	NMA PR	Mr. Hailu W.
10:00-10:30	Tea/Coffee break and exhibition	Hotel	Hotel
10:30-10:40	Introduction of the session	Mr. Hailu Wudneh	Mr. Hailu W.
10:40-10:50	Welcoming address	Mr. Fetene Teshome DG NMA	Mr. Hailu W.
10:50-11:00	Key note Address from WMO Regional Office for Africa	Amos Makaraou (PhD)	Mr. Hailu W.
11:00-11:10	Virtual message from WMO SG	Prof. Petery.Taalas	Mr. Hailu W.
11:10-11:20	H.E Gust of Honor	H.E Dr. Eng.Sileshi Bekele	Mr. Hailu W.
11:20-11:30	Historical overview of the National Meteorological Agency of Ethiopia	Mr. Fetene Teshome DG NMA	Mr. Hailu W.
11:30-11:45	Strategic plan and roles of institutions on the implementation of NFCS	Mr. Kinfe H/Mariam DDG NMA	Mr. Hailu W.
11:45-12:00	Ministerial Endorsement of the NFCS	Ministers	Mr. Hailu W.
12:00-12:30	Individuals, development partners, national and International institutions acknowledgment	NMA and Gust of honor	Mr. Hailu W.
12:30-12:35	Parallel session announcement	Mr. Hailu Wudneh	Mr. Hailu W.
12:35-14:00	Lunch Break	Hotel	Hotel
Session Two: Parallel sessions structure			
14:00-15:45	Group One: Agricultural and Environmental sector	Dawit Solomon (PhD)	
14:00-15:45	Group Two: Water, Health and Disaster Risk management sector	Mr. Kinfe H/Mariam	
14:00-15:45	Group Thee: Aviation sector	Mr. Tafesse Regassa	
14:00-15:45	Group Four : Capacity building and Research development	Asaminew Teshome (PhD)	
15:45-16:15	Tea break		
16:15- 17:00	Parallel session discussion continued		
17:00	End of the day		

Day One: (25 May 2021) Afternoon detail programme of the parallel sessions

Time	Program	Responsible	Facilitator
Group One	Agriculture and Environment sectors		Chair: Dawit Solomon (PhD)
14:00-14:15	General description and roles of NMA on implementation of NFCS	Mr. Leta Bekele	Rap. Mr. Yimer A and Tamiru K
14:15-14:25	Roles of Agricultural sector to implement NFCS	Mr. Essayas Lemmma	

14:30-14:45	AICCRA Ethiopia - AICCRA's contribution to Ethiopia's NFCs	Kindiye Tesfaye (PhD)	
14:45-15:00	IRI's contribution to enhancing climate services in Ethiopia	Tufa Dinku (PhD)	
15:00-15:15	Discussion	Dawit Solomon (PhD)	
15:15-15:30	Monitoring localized climatic extremes using Climate Hazards Center Early Warning Tools	Diriba Korecha (PhD)	
15:30-15:45	Assessing the Scientific Benefits of UCSB/CHC and NMA Partnership	Chirs Funk (PhD)	
15:45-16:15	Tea/Coffee break	Hotel	Hotel
16:15-17:00	Parallel session discussion continued		
Day Two: Agriculture and Environment parallel session and presentations continued			
09:00-9:20	Recap of the first day		
09:20-09:40	Adapting Ethiopia's Agriculture to Climate Today for Tomorrow	Tufa Dinku (PhD)	
09:40-10:00	Parallel sessions discussion		
10:00-10:30	Tea break	Hotel	Hotel
	Plenary discussion		
10:30-11:30	Group report presentations	Each group	
11:30-12:30	Feedback from the sector and way foreword	Participants	
12:30-13:00	Closing Remark and speech		
13:00-14:00	Lunch		
Group Two	Water, Health and Disaster Risk management sector	Responsible	Chair: Mr. Tsegaye Ketema
14:00-14:15	General description and roles of NMA on implementation of NFCS	Mr. Mohamed Abera	Rapp: Mr. Tamirat Y. and Kidus B.
14:15-14:25	Roles of water sector to implement NFCS	Mr. Mohamed Ali	
14:30-14:45	Roles of NDRMC sector to implement NFCS	Mrs. Sahele Tefera	
14:45-15:00	Roles of Health sector to implement NFCS	Mr. Misganaw Tewachew	
15:00-15:25	Applications of climate information for health surveillance	Adunga Woyesa (PhD)	
15:25-15:45	AICCRA Ethiopia – Role of data hubs to implement NFCS	Dr. Lulseged Tamene	
15:45-16:15	Tea/Coffee break	Hotel	Hotel
16:15-17:00	Parallel session discussion		
Day Two: Water, Health and DRM parallel session and presentations continued			
09:00-9:20	Recap of the first day		
09:20-09:40	Global Framework For Climate Services	Joseph Mukubana (PhD)	
09:40-09:50	African Ministerial Conference on Meteorology contribution for water sector	Mariane Diop Kane (PhD)	
09:50-10:00	Parallel sessions discussion		
10:00-10:30	Tea break	Hotel	Hotel
	Plenary discussion		
10:30-11:30	Group report presentation	Each group	
11:30-12:30	Feedback from the sector and way foreword	Participants	
12:30-13:00	Closing Remark and speech		
13:00-14:00	Lunch	Hotel	

Group Three	Capacity building and Research development	Responsible	Chair: Asaminew Teshome (PhD)
14:00-14:15	AICCRA contribution to the capacity building of NMA	Teferi D. (PhD)	Rap: Mr. Yosef T. and Mr. Bekele B
14:15-14:25	Meteorological data, climate services and NMA map-room	Mr. Melesse Lemma	
14:30-14:45	Needs of Capacity building and area of collaboration	Mr. Deriba Muleta	
14:45-15:00	NMA Research priority area and University Linkage	Mr. Abate Getachew	
15:00-15:15	Discussion	Asaminew T (PhD)	
15:15-15:25	Research development and capacity building of Mekele and Arbaminch University	Tadesse T. (PhD)	
15:25-15:35	Research development and capacity building of Mekelle University	Amanuel Z. (PhD)	
15:35-15:45	Basic principles of cloud seeding and pilot progress in Ethiopia	Mr. Mulualem A.	
15:45-16:15	Tea/Coffee break	Hotel	
16:15-16:25	Application of AI for Meteorology	Mr. Mohammed	
16:25-16:35	Capacity building and research: Enhancing Climate Services Education	Tufa Dinku (PhD)	
16:35-17:00	Parallel session discussion continued		
Day two: Parallel session and presentations continued			
Day Two: Capacity building and Research development session and presentation continued			
09:00-09:20	Recap of the first day		
09:20-09:40	WMO capacity building to strengthen climate services	Earnest (PhD)	
09:40-09:50	Climate prediction and human resource development	Tixke Kassa (PhD)	
09:50-10:00	Parallel sessions discussion		
10:00-10:30	Tea break	Hotel	Hotel
	Plenary discussion		
10:30-11:30	Group report presentation	Each group	
11:30-12:30	Feedback from the sector and way foreword	Participants	
12:30-13:00	Closing Remark and speech		
13:00-14:00	Lunch		
Group Four	Aviation sector	Responsible	Chair: Mr. Tafesse Regasa
14:00-14:15	NMA Aeronautical service delivery system Challenges and opportunities	Mr. Kassa Fekadu	Rapporteur: Mr. Getahun Bekele & Gezaheng Lemma
14:15-14:45	WMO Aeronautical meteorological service programme	Earnest (PhD)	
14:45-15:00	Role of Aviation sectors to Strengthen NMA Service Provision	ECAA- Air navigation	
15:00-15:30	Meteorological service needs of Airline sector	ET- IOCC	
15:30-16:00	Tea/Coffee break	Hotel	Hotel
16:00-17:30	Parallel session discussion		

Annex II: List of participants

List of Participants on Aviation sector side event

No.	Full Name	Organization	e-mail
1	Mulutsehay Endeshaw	ECEA	mulutsehay@ecea.gov.et
2	Alamirew Getu	MOT	zobilfassil@yahoo.com
3	Molalign Sisay	Air force	MolalignsisayTarekegn@gmail.com
4	Tesfaye Desalegn	Air Force	
5	Nigussie Mulugeta	EAL	NigussiemaEthiopian-airport.com
6	Damene Tegegne(Capt)	EAL	damenet@ethiopianairlines.com
7	Amare Abay(capt)	AFS	flightoperation@abyssinianflight.com
8	Gobena Guangul	Aquarious	
9	Ayalikbet Lemma	ECEA	layalkbet@gmail.com
10	Getahun Seifeselassie	ECEA	Golf_sera@yahoo.com
11	Sisay Shewa	NMA	shewasis@yahoo.com
12	Bezawork Mulugeta	NMA	bezawork@gmail.com
13	Tafesse Regassa	ETMS	regassa.gurmu8@gmail.com
14	Dr.Mariane Diop-Kane	WMO	mdiopkane@wmo.int
15	Yosef Wabbe	EAL	ypsefwa@Ethiopianairlines.com
16	Tegenu Ayalew	EAL	TegenuA@ethiopianairlines.com
17	Roman Malede	NMA	
18	Fikirte Belayhun	NMA	fikirtb@gmail.com
19	Girma Gebre(Capt)	East African Aviation	
20	Kassa Fekadu	NMA	k_fekadu01@yahoo.com
21	Getahun Bekele	NMA	Getahunbekele48@yahoo.com

Capacity Building and Research Development participants list

No	Full Name	Institute	Address (Email)
1	Abate Getachew	NMA	abateyy@yahoo.com
2	Aklile Assefa	NMA	ma_assefa@yahoo.com
3	Amanuel Zenebe (PhD)	MU	amanuelzenebe@gmail.com
4	Asamnew Teshome (PhD)	NMA	asmin2met@gmail.com
5	Assalfew Nigussie	NMA	Asenigu20@yahoo.com
6	Atkilt Girma(PhD)	MU	atkiltg@gmail.com
7	Aynalem Shegaw	NMA	Aynalemshegaw17@gmail.com
8	Bahru Maregn	NMA	bahirumaregn@yahoo.com
9	Baweke Tadege	NMA	+251911813565
10	Chaka Natai	NMA	chaka.natae832@gmail.com
11	Driba Muleta	NMA	drbmgrs2007@yahoo.com
12	Elias Fiseha	NMA	eliasfiseha@gmail.com
13	Endalamaw Wonde	NMA	endalex2008@gmail.com
14	Endashaw Shewangizaw	NMA	endash2004@gmail.com
15	Engda Zenebe	NMA	+251921737088
16	Ernest A. Afiesimama (PhD)	WMO Regional Office for Africa	eafiesimama@wmo.int

17	Haileselassie GebreMariam(PhD)	MU	hssgmm@gmail.com
18	Henock Hailu	NMA	henmsg@gmail.com
19	Kassahun Zewude	NMA	Kassahun_zewdie@yahoo.com
20	Kebede Mengesha	EtMS	
21	Kinfe Hailemariam	NMA	Kinfe_hm@yahoo.com
22	Melese Lemma	NMA	mel_lemma2001@yahoo.com
23	Melkamu Driba	NMA	melkamu.diriba2007@yahoo.com
24	Mulualem Abera	NMA	yonasmulu2006@gmail.com
25	Nigatu Melse	NMA	nigatum214@gmail.com
26	Samuel Rahamatula	AIC	
27	Samuel Tilahun	NMA	sam_mail2010@yahoo.com
28	Solomon Tole	NMA	Solomontole404@gmail.com
29	Taddess Tujuba (PhD)	AMU	tade2g@gmail.com
30	Teferi Dejene(PhD)	CGIAR	tede@norceresearch.no
31	Tesfaye Haile	EtMS	
32	Titike Kassa (PhD)	ESSTI	titike.bahaga@gmail.com
33	Tofikk Redi	NMA	tofikk858@gmail.com
34	Tufa Dinku(PhD)	IRI	tufa@iri.columbia.edu
35	Workineh Degefu	EtMS	worknehdegefureta@gmail.com
36	Yadeta Abelti	NMA	
37	Yiktaktu Tesfatsion	Retired	yitaktu2013@gmail.com
38	Yosef Tesfaye	NMA	matyyos@gmail.com
39	Zenna Chekun	NMA	zennac@gmail.com
40	Zerihun Hailemariam	NMA	zerihun_hhmm@yahoo.com

Agriculture and EFCCC Participants list

No.	Full Name	Organization	e-mail
1	Leta Bekele	NMA	Letaabreham@gmail.com
2	Tamiru Kebede	NMA	tame.kebede@gmail.com
3	Yimer Assefa	NMA	Yimera649@gmail.com
4	Esayas Lemma	MoA	nebyuesayas@gmail.com
5	Mohammed Andoshe	EFCCC	mandoshe@yahoo.com
6	Tufa Dinku (PhD)	IRI	tufa@iri.columbia.edu
7	Kindie Tesfaye (PhD)	CGIAR	k.tesfayeFantaye@cgiar.org
8	Diriba Korecha (PhD)	UCSBCHC	Diriba.korecha@gmail.com
9	Dawit Solomon (PhD)	CGIAR	d.solomon@cgiar.org
10	Tolosa Denboba	MoA	
11	Adissu Debele	MoA	
12	Chris Funk (PhD)	UCSBCHC	chris@geog.ucsb.edu

Water, Health and DRM Sector Participants list

No	Name of participants	Organization	Email
1	Mr Meseganaw Tewabacbew	MoH	
2	Mr Mohammed Andoshe	EFCCC	mandoshe@yahoo.com
3	Mr Mohammed Ali	MWIE	Mohammedalis123@gmail.com
4	Mr Selommon Kebede	MWIE	Solzem2000@gmail.com
5	Mrs Semunesh Gola	MWIE	Semunesh_golla@yahoo.com
6	Adugna Weyesa(PhD)	EPHI	adugnawoyessa@gmail.com

7	Mariane DIOP KANE(PhD)	WMO	
8	Joseph R. Mukabana (PhD)	WMO	jmukabana@wmo.int
9	Mrs Sahela Tefera	DRMC	Sahs2008@yahoo.com
10	Mr Mohammed Abera	NMA	Aberam644@gmail.com
11	Mr Tamerat Yohanes	NMA	yohannestamirat81@gmail.com
12	Mr Tsegaye Ketema	NMA	tsegayeketma@gmail.com
13	Mr Alemu Gamini	NMA	almugamini@gmail.com
14	Mr Kidus Belay	NMA	Kibe_302001@yahoo.com
15	Mrs Samerawit Abebe	NMA	Samrnat16@gmail.com
16	Mr Deselegn Tarekegn	NMA	desalegntarekegn@gmail.com
17	Mr Kassahune Ayechelume	NMA	
18	Mr Tolossa Deneboba	MoA	Kenarabi.4@gmail.com
19	Mr Esayas Lemma	MoA	esayasl@hotmail.com
20	Mr Maseresh Kebede	MoA	kebedemas@gmail.com
21	Mr Menegestu Basho	EFCCC	
22	Mrs Lemelem Mohammed	NMA	
23	Mr Tayher Mohammed	MoWIE	
24	Mr Deriba Muleta	NMA	drbmltmgrs@gmail.com
25	Mr Bekele Kebebe	NMA	bekeleabeshu@gmail.com
26	Mr Kassa Fekadu	NMA	K_fekadu01@yahoo.com
27	Mr.Getahun Bekele	NMA	getahunbekele48@yahoo.com
28	Mr Yimer Asefa	NMA	Yimera649@gmail.com
29	Mr Henok Hailu	NMA	henmsg@gmail.com
30	Mr.Adissu Belachew	NMA	addisubelachew88@gmail.com
31	Mr.Bekalu Tamene	NMA	Bekalutamene2@gmail.com
32	Mrs.Chali Debele	NMA	chalidebu@gmail.com
33	Mr.Ajebush Goshu	NMA	ajebushgochaw@gmail.com
34	Mrs.Habtam Jember	NMA	
35	Mr.Estifanos Fekedu	NMA	
36	Mrs.Rahel Reda	NMA	
37	Mrs.Mihiret Muluneh	NMA	miheretmulu@gmail.com
38	Mr.Abebe Aytenfisu	NMA	
39	Mr.Desalegn Huluka	NMA	dessu_hul2006@yahoo.com
40	Mr.Messay Tolosa	NMA	mesaytolosssa@gmail.com
41	Mr.Hailu Negesse	NMA	
42	Mr.Addisu Debele	MoA	
43	Mrs.Dinknesh Abera	MoA	
44	Mr.Dagnew Tadesse	MoH	
	Mr.Yasin Mohammed	MoWIE	

Annex III: Award

1. Former General Managers of NMA

No.	Full Name	Time of service
1	Mr. Workneh Degefu	1973 to 1983
2	Mr. Knfemichael Tekle	1983 to 1984
3	Mr. Eshetu Hailemariam	1984 to 1986
4	Mr. Tesfaye Hauile	1986 to 1992

5	Mr. Bekuretsion Kassahun	1992 to 1998
6	Mr. Kidane Assefa	1998 to 2004

2. Local and International Institutes which Support NMA on Capacity Building

No	Name of the Institutions
1	IGAD Climate Prediction and Application Center (ICPAC)
2	International Research Institutes of Colombia University (IRI)
3	National Oceanic and Atmospheric Administration (NOAA)
4	African Center for Meteorological Application Department (ACMAD)
5	World Meteorological Organization (WMO)
6	Indian Meteorological Department
7	Kenya Meteorological Department
8	Arbaminch University
9	Mekele University
10	Haromaya University
11	Adama Science and Technology University
12	Ethiopia Water Technology Institute

3. Organizations which Support NMA through different Projects

No.	Name of the Institutions	No.	Name of the Institutions
1	UNDP	12	Care Ethiopia
2	Farm Africa	13	ILRI
3	Christian Aid	14	CCAFS
4	WFP	15	SMHI
5	KOICA		
6	FEWS NET/USAID		
7	Mercy Corps		
8	ATA		
9	EFCCC		
10	ACPC		
11	ADB		

4. Ethiopian Scientist in the Country and Diaspora

No.	Full Name
1	Tufa Dinku (PhD)
2	Zewdu Tesema (PhD)
3	Teferi Dejene (PhD)
4	Gulelat Tefera (PhD)
5	Diriba Korecha (PhD)
6	Mr. Dula Shanko

5. Former and current Minsters of the Ministry of Water, Irrigation and Electricity

No.	Full Name
1	Ambassador Shiferaw Jarso
2	Ambassador Assfaw Dingamo
3	Ambassador Alemayehu Tegnu
4	Mr. Motuma Mekasa
5	Dr. Eng. Sileshi Bekele

Annex IV: Photos taken during the conference

Photos taken during the conference


40 YEARS WE
LIMATE SERVIC


CL


CLIMATE
MAP-ROOMS
CLOUD

Photos taken during the conference

Sponsors of the Event

RESEARCH PROGRAM ON
Climate Change,
Agriculture and
Food Security

PROCEEDING REPORT OF THE 40TH ANNIVERSARY OF NATIONAL METEOROLOGICAL AGENCY, OFFICIAL ENDORSEMENT OF THE NATIONAL FRAMEWORK FOR CLIMATE SERVICES AND INTERNATIONAL SCIENTIFIC CONFERENCE

National Meteorological Agency
Addis Ababa, Ethiopia
P.O. Box 1090
Addis Ababa, Ethiopia
Tel. + 251-11-5512299 or 6615779
Fax: + 251-11-5587910
E-mail: nma1@ethiomet.gov.et
August 2021