

COUNTRY HYDROMET DIAGNOSTICS

Informing policy and investment decisions for high-quality weather forecasts, early warning systems, and climate information in developing countries.



February 2024

Tanzania Meteorological Authority

Peer Review Report

Reviewing Agency: Danish Meteorological Institute

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List of Abbreviations

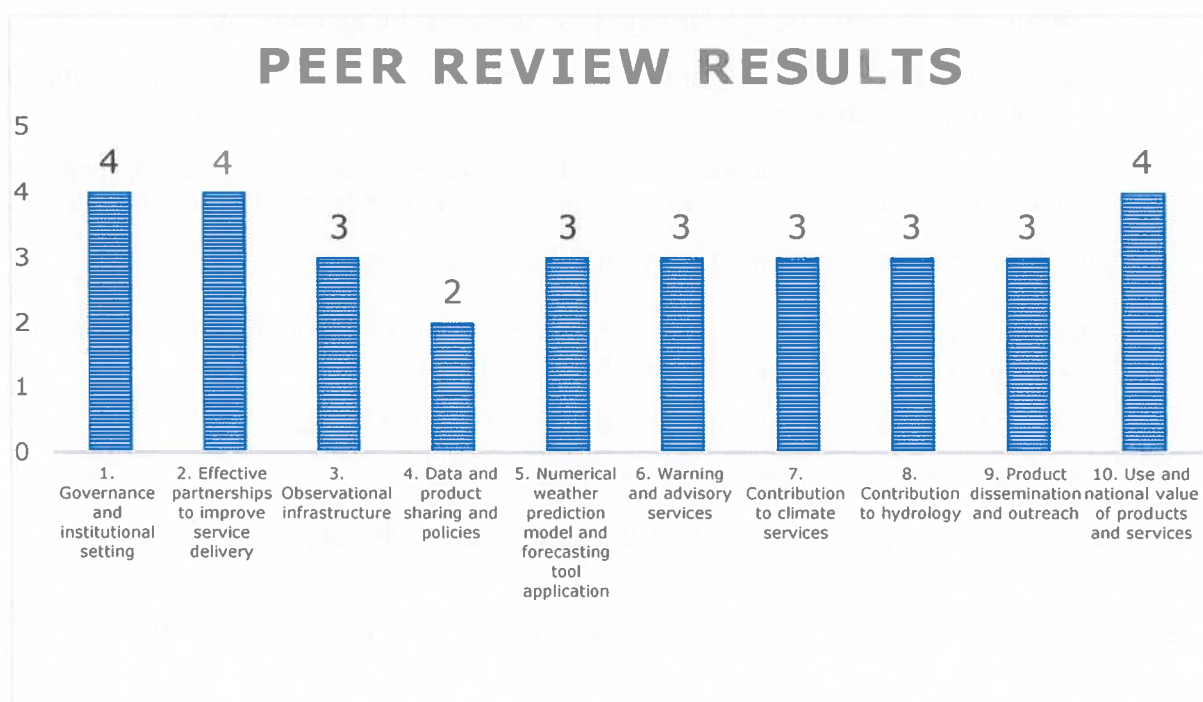
Abbreviation	Full Name
AMSS	Automatic Message Switching System
AWS	Automatic Weather Stations
CFO	Central Forecasting Office
CHD	Country Hydromet Diagnostics
DMI	Danish Meteorological Institute
DMO	Digital Meteorological Data Observatory
DOM	Directorate of Meteorology
EAMD	East African Meteorological Department
ECMWF	European Centre for Medium-range Weather Forecasts
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
EW4all	Early Warnings for all
EWS	Early Warning Systems
FYDP	Five Year Development Plan
GBON	Global Basic Observing Network
GTS	Global Telecommunication System
ICT	information and communication technologies
ISO	International Standards Organization
MAIS	Meteorological Aviation Information System
MES	Meteorological Message Exchanging System
MOU	Memorandum of Understanding
MMIS	Meteorological Marine Information System
MSL	Mean Sea Level
NCD	Non-communicable Diseases
NFCS	National Framework for Climate Services
NMHS	National Meteorological and Hydrological Service
NMTC	National Meteorological Training Centre
NWP	Numerical Weather Prediction
NTA	National Technical Awards
QMS	Quality Management System
SOFF	Systematic Observation Funding Facilities
SOP	Standard Operation Procedure
TMA	Tanzania Meteorological Authority
UNDP	United Nations Development Programme
URT	United Republic of Tanzania
WRF	Weather Research and Forecasting model
WFP	World Food Programme
WMO	World Meteorological Organization

Executive Summary

In this Country Hydromet Diagnostics report Danish Meteorological Institute (DMI) has evaluated Tanzania Meteorological Authority (TMA) on the ten elements suggested by the WMO CHD methodology and provided a maturity level score for each of them.

The evaluation has taken place as part of the project Systematic Observations Financing Facility (SOFF), in which DMI and TMA work together with UNDP under WMO umbrella to support strengthening of the meteorological observation infrastructure network in Tanzania.

TMA is a comparably strong Meteorological Service Provider with a clear legal mandate and a solid governance and management structure in place. The strength of TMA is partly contributed by the commitment of the Government of the United Republic of Tanzania in collaboration with stakeholders and partners to invest in enhancing weather and climate services, including through enactment of the Tanzania Meteorological Authority Act No. 2 of 2019. The Authority has strong relationships through Memorandums of Understanding (MoUs) and Standard Operating Procedures (SOPs) with a range of partners, including other government entities, national and international development organizations, research institutions and some private sector entities. TMA is also playing an active role in supporting other NHMSs in Eastern and Southern Africa and beyond. The overall maturity rating of TMA across the ten elements therefore lands on an average of 3.2.



Element	Maturity level score
1. Governance and institutional setting	4
2. Effective partnerships to improve service delivery	4
3. Observational infrastructure	3
4. Data and product sharing and policies	2
5. Numerical weather prediction model and forecasting tool application	3
6. Warning and advisory services	3
7. Contribution to climate services	3
8. Contribution to hydrology	3
9. Product dissemination and outreach	3
10. Use and national value of products and services	4

In order to increase the maturity level, the following elements have been found to be the most critical.

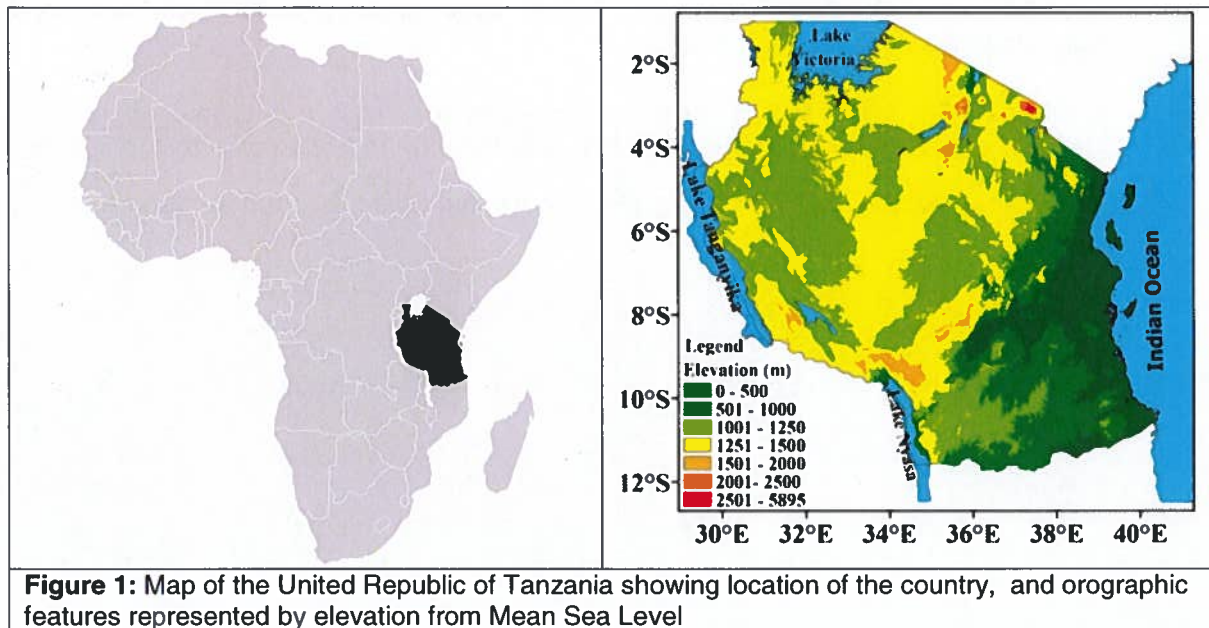
- i. Continue to advocate the government for sufficient budget allocation.
- ii. Conduct impact studies to provide evidence for the socio-economic value of weather and climate services.
- iii. Make TMA key documents readily available to stakeholders and partners, including development partners, to facilitate various uses related to the TMA strategic goals.
- iv. Continue to expand partnerships with the private sector.
- v. Ensure successful implementation of the SOFF project. This is the primary pathway to increasing the maturity level for Elements 3 and 4.
- vi. Update OSCAR Surface and develop a plan for regular updates.
- vii. Articulate data sharing aspects in the TMA data policy.
- viii. Conduct a cost benefit analysis of the business case for service provision, such as open data availability.
- ix. Train staff in data assimilation, verification, and post-processing methods of NWP models.
- x. Raise more awareness to stakeholders on compliance to the Tanzania Meteorological Authority Act No. 2 of 2019.
- xi. Ensure wider participation of Stakeholders in the National Climate Outlook Fora, including gender representation.
- xii. Enhance availability of vulnerability data to support Impact Based Forecasting.
- xiii. Develop a strategic approach, including continuous cross-sectoral engagement for development of a comprehensive Multi-hazard Early Warning System.

- xiv. Proactively engage with government and development partners and international finance institutions to advocate for funding for EW4ALL in Tanzania.
- xv. Monitor the implementation of the National Framework for Climate Services (NFCS 2018 -2025) and make necessary reviews, considering also that the NFCS is close to the end of its timeframe.
- xvi. Strengthen the observation network to provide improved data on the unique topographical/orographic features of Tanzania, considering also the large size of the country.
- xvii. Expand the Hydromet Section to ensure capacity to provision of tailor-made support to the hydrological agency.
- xviii. Continue efforts to raise awareness targeting the most vulnerable populations, including rural populations who do not use or have unlimited access to social media.
- xix. Strengthen data collection from stakeholders and users through survey data.

Chapter 1: General information

The United Republic of Tanzania is the country located between the Great Lakes of East Africa and the Indian Ocean (Figure 1). Total area land is 947,323 km², and a total coastline of 1,424 km with about 30 islands. Tanzania is thus one of the largest countries in Africa and the 31st largest country in the world. It is surrounded by the Indian Ocean to the east, Lake Victoria to the North, Lake Tanganyika to the west, and Lake Nyasa to the southwest.

Tanzania has unique orographic features with average elevation of 1,018 meters above sea level. The highest mountain peak (Kibo on Kilimanjaro) is at 5,895 meters, and lowest being few meters below Mean Sea Level (MSL) (Figure 1).



Tanzania's diverse topography plays a significant role in shaping its climate, creating a rich tapestry of microclimates across the country. Here is how the different features impact:

a) **Altitude:**

- i. **Highlands:** Mount Kilimanjaro and the Eastern Arc Mountains create cooler conditions with temperatures ranging from 10-20°C. This creates a **subtropical highland climate** compared to the hotter lowlands.
- ii. **Central plateau:** This vast area sits at 3,000-4,000 feet, experiences hot and dry weather with limited rainfall (2-30 inches annually).
- iii. **Coastal plains:** Low-lying areas enjoy tropical temperatures and higher humidity, with rainfall ranging from 60-75 inches annually.

b) **Landforms:**

- i. **Great Rift Valley:** This enormous valley acts as a channel for warm, dry air from the north, contributing to the arid conditions in the central plateau.
- ii. **Lake Victoria:** The largest freshwater lake in Africa moderates temperatures in the surrounding areas, creating a slightly milder climate.
- iii. **Islands of Zanzibar:** Surrounded by the Indian Ocean, these islands boast a tropical climate with consistent temperatures and ample rainfall.

c) Overall climate zones:

Due to the diverse topography, Tanzania can be divided into four main climate zones:

- i. **Tropical:** Coastal plains and Zanzibar.
- ii. **Subtropical highland:** Mountains and plateaus.
- iii. **Semi-arid:** Central plateau.
- iv. **Arid:** Parts of the Great Rift Valley.

This creates a complex interplay of temperatures and rainfall patterns. For example, the Eastern Arc Mountains receive significantly more rainfall (40-100 inches annually) than the central plateau due to their elevation and influence on wind patterns¹.

The Tanzania Meteorological Authority (TMA) is the government institution under the Ministry of Transport mandated to provide meteorological services, regulate and coordinate meteorological activities within the United Republic of Tanzania. The Authority is also responsible for issuing warnings and advisories on severe weather events for protection of human life and properties. TMA was established through the Tanzania Meteorological Authority Act No. 2 of 2019 which into force on 14th June, 2019 through the Government Gazette No. 459 of 2019. The Authority succeeded the Tanzania Meteorological Agency which was established by the Executive Agency Act No. 30 of 1997.

Before the Tanzania Meteorological Agency weather services were provided by the former Directorate of Meteorology (DOM). DOM was established in the year 1977 by Act of Parliament No. 6 of 1978 as a specialized department responsible for the provision of meteorological services to the nation following the collapse of the former East Africa Community and the East African Meteorological Department (EAMD) in 1977. The Directorate of Meteorology was transformed into an Executive Agency, The Tanzania Meteorological Agency through the Executive Act No. 30 of 1997 with Government order No. 405 of 26th November 1999. The Tanzania Meteorological Authority (TMA) has superseded Tanzania Meteorological Agency activities within the country with additional regulation activities.

CHD methodology

This Country Hydromet Diagnostics (CHD) report is a part of the Systematic Observations Financing Facility (SOFF) project in Tanzania in which the Tanzanian Meteorological Authority (TMA) is the beneficiary. Danish Meteorological Institute (DMI) constitute the peer-advisor, and United Nations Development Program (UNDP) is the implementing entity. The CHD report supplements the Global Basic Observing Network (GBON) National Gap Analysis report and the GBON National Contribution Plan for Tanzania; both also part of the SOFF project.

The CHD report has been prepared using the methodology described in the 2022 update of the Country Hydromet Diagnostics. A desktop study of key documents provided by TMA, WMO and found online, including on the TMA website, formed the initial inquiry and foundation for further dialogue with TMA and stakeholders.

As part of the SOFF readiness phase, DMI has visited Tanzania a total of three times. The visits have helped inform development of the National Gap Analysis, National Contribution Plan and Country Hydromet Diagnostics for Tanzania. The field visits took place in May and September 2023, and February 2024. DMI staff have held meetings with TMA staff and management, met with the TMA board and conducted field visits to TMA observations

¹<https://www.oecd.org/env/cc/21058838.pdf>

sites, local TMA premises and local government offices. DMI has also held meetings with TMA stakeholders and partners. A Stakeholder workshop held in September 2023 provided an opportunity to engage with key TMA partners and service users such as various ministries and government offices, development partners and local NGOs, including the Tanzania Red Cross.

The Country Hydromet Diagnostics report has been prepared in cooperation with TMA. The findings in the report have all been discussed and approved by both TMA and DMI. The recommendations in the report reflect DMI observations in conjunction with TMA priorities for improvement. While the rating for each element is based on the standardized indicators list provided by WMO, analysis and recommendations have attempted to take into consideration the overall socio-economic situation of Tanzania and thus what can realistically be expected to be attained, i.e. in terms of sustainable funding, etc.

Chapter 2: Country Hydromet Diagnostics

Element 1: Governance and institutional setting

1.1 Existence of Act or Policy describing the NMHS legal mandate and its scope

The Tanzania Meteorological Authority (TMA) is a public institution under the Ministry of Transport, legally established by the law, namely the Tanzania Meteorological Authority Act No. 2 of 2019, which came into force on 14th June, 2019 through the Government Gazette No. 459 of 2019. The institution is responsible for providing meteorological services, regulating and coordinating of meteorological activities within the United Republic. The Authority is also responsible for issuing warnings and advisories on severe weather events for protection of human life and properties. According to the Act, the functions of TMA are to:

- i. Implement the National climate related policies in relation to weather and climate matters;
- ii. Regulate and coordinate meteorological activities in the United Republic
- iii. Organize and administer efficient networks of surface and upper air stations necessary to establish accurate records of the weather and climatic conditions;
- iv. Provide weather and climate services for the safety of life and property and to various users of meteorological services;
- v. Issue severe weather-related warnings and advisories to ensure that there is a single authoritative voice in this regard;
- vi. Publish weather and climatological summaries, climate status and other interpreted products;
- vii. Observe, collect, process, archive and disseminate meteorological data and related information;
- viii. Cooperate with other institutions and authorities involved in meteorology and related fields in aspects of training, studies, research, environment, climate variability and change;
- ix. To recover cost for meteorological services rendered to ensure service sustainability;
- x. Provide marine meteorological services to shipping, fishing, and other marine activities within the United Republic territorial waters and high sea;
- xi. Provide aeronautical meteorological services, advisory, warnings, products and information and related services to Civil Aviation within the United Republic and other prescribed areas as per regional and international agreements;
- xii. Cooperate with other national and international institutions in search and rescue relating to aviation and maritime accidents by providing relevant weather information;
- xiii. Keep in safe custody all meteorological records and data;
- xiv. Calibrate and fabricate meteorological equipment for internal and external use;
- xv. Ensure that international standards and practices of meteorological services including instrument and equipment installation are maintained;
- xvi. Carry out research, awareness activities, and training in meteorology, climatology and other related fields and to process and analyze climatic data for the purpose of use in socio-economic development planning;
- xvii. Approve and register meteorological stations;
- xviii. Participate in the activities of relevant international organizations, in particular the Organization; and
- xix. Carry out any other function as the Minister may direct.

The functions of TMA outlined in the Act are based on weather and climate, whereas the responsibility of hydrology services falls under the Ministry of Water, where the

Hydrological Advisor to the Permanent Representative of Tanzania with The World Meteorological Organization (WMO) is also based.

Aviation services: TMA is ISO 9001:2015 Certified in Aviation Meteorological Services. TMA provides services to both civil aviation and the Tanzanian Defence by providing observers, forecasters and technicians at both Julius Nyerere International Airport in Dar Es Salaam and national airports.

1.2 Existence of Strategic, Operational and Risk Management plans and their reporting as part of oversight and management.

TMA operations are guided by its vision and mission. The vision of TMA is "A centre of excellence for meteorological services that support all stakeholders to attain national sustainable social, economic development". The mission of TMA is "To ensure quality and reliable meteorological services that meet stakeholders' expectations through provision and regulation of weather and climate services for safety and sustainable social, economic development of Tanzania".

To implement its vision, TMA has a Strategic Plan (2021/22 - 2025/26), which is aligned to the National Five Year Development Plan (FYDP III) 2021/22-2025/26, which has the main objective to contribute to the achievement of goals of the Tanzania Development Vision 2025. The TMA Strategic Plan outlines eight key objectives namely:

- A: HIV/AIDS and Non-communicable Diseases (NCD) Interventions strengthened;
- B: Implementation of National Anti-Corruption Strategies enhanced;
- C: Quality of meteorological services improved;
- D: Quality Assurance and Regulation of meteorological sector players enhanced;
- E: National, Regional and international cooperation in weather and climate services enhanced;
- F: Research and Development on climate and Applied services enhanced;
- G: Financial capacity and resources management and Internal Control Systems of TMA strengthened; and
- H: Capacity to facilitate TMA to discharge its mandates enhanced.

Currently the TMA strategy is not publicly available and it appears that the strategy is regarded mostly as an internal tool. The strategy could be used more proactively to display priorities of TMA, and to engage public, private and international development partners.

Furthermore, TMA is implementing a National Framework for Climate Services (2018-2025) which has seven objectives aligned to the Global Framework for Climate Services and the Tanzania Development Vision 2025. The NFCS was developed and launched in August 2018.

Administratively, management of TMA is headed by the Director General, who is supported by other Directors overseeing various functions; including Forecasting Services, Infrastructure and Technical Services, Research and Applied Meteorology, Corporate Services, meteorological regulations and quality assurance, and the TMA Zanzibar Office.

TMA is divided into eight zones. Each zone comprises several regions and has a Zonal Manager who oversees all meteorological stations within a zone. Furthermore, manned stations are supervised by Heads of Stations who have meteorological and other experts under them to carry out meteorological operations twenty-four hours.

The TMA governing Board oversees progress towards strategic goals, supervises TMA senior management, and ensures adherence to governing laws and procedures. The board

consists of the Chairman, Vice Chairman, five members and the Director General, who functions as the secretary to the board. The Chairman and Vice Chairman of the Board are appointed by the President of the United Republic of Tanzania (URT). The governing Board have well defined duties stipulated in the Tanzanian Meteorological Act. The board has four committees: Governance and technical committee, Audit, Risk and Quality Management Committee, Finance and Planning committee, and National Meteorological Training Centre Committee.

1.3 Government budget allocation consistently covers the needs of the NMHS in terms of its national, regional, and global responsibilities and based, among others, on cost-benefit analysis of the service. Evidence of sufficient staffing to cover core functions

The 2023 annual budget of TMA was 17 million US Dollars. This includes budget for procurement, operation, and maintenance of meteorological infrastructure, employment, and development of human capacity. Being a government institution, the funding source for all TMA operations is through annual government budget allocations.

Of the total budget, the budget for meteorological infrastructure was 5 million US Dollars (including procurement and maintenance of meteorological infrastructure; construction and maintenance of buildings). The government's current initiatives to enhance weather and climate services, managed by the TMA, include the modernization of meteorological infrastructure through the procurement of weather Radars and Automatic Weather Stations, rehabilitation of existing stations and human capacity development. The Government has also invested in improvement of its National Meteorological Training Centre (NMTC) to improve training services for TMA staffs and other trainees from outside TMA.

The governmental budget allocation does not cover TMA's needs in terms of its national, regional, and global responsibilities. Government consistently provides salaries and invests in observation infrastructure. However, TMA continues to face challenges in fulfilling its obligations, incl. provision of sufficient observational coverage given the size of the country, speed of changing observation technology, increasing demand of weather services due to climate change and fulfilling international requirements and obligations such as QMS.

International funding through projects for staff skills development as well as for improving observation infrastructure development has played – and continues to play - a significant role in reducing gaps in capacity.

A few studies have been carried out on the socio-economic value of weather and climate services. Among them a study by Msemo et al (2021) on "The Value of Weather and Climate Information to the Tanzanian Disaster Risk Reduction Sector Using Nonmonetary Approaches". However, little has been done in this area, there is therefore a need for strengthening this aspect. Such studies would display value of services and strengthen communication with government and international development organisations on the benefits of investing in climate and weather services.

1.4 Proportion of staff (availability of in-house, seconded, contracted- out) with adequate training in relevant disciplines, including scientific, technical, and information and communication technologies (ICT). Institutional and policy arrangements in-country to support training needs of NMHS.

As of March 2023 TMA had 526 staff comprising 122 females (23%) and 404 males (77%). The composition of staff is around 400 Meteorological Professionals and 120 supporting staff. TMA has 10 ICT experts, including 3 females, and 13 Meteorological engineers.

According to TMA's own estimates its staffing is at 76% of the optimal number. TMA has submitted a proposal for employment of more Meteorological Engineers by the Government through the Public Service Recruitment Secretariat.

TMA owns and operates the National Meteorological Training Centre (NMTC) located in Kigoma region, in the western part of Tanzania (www.nmtc.ac.tz). NMTC is an academic institution which provides meteorological trainings for WMO Technicians Entry Level (NTA Level 4), WMO Technicians Mid Level (NTA Level 5) and WMO Technicians Senior Level (NTA Level 6). The responsibility of the NMTC is to develop human capacity in the field of meteorology and related geo-sciences within Tanzania and outside, whereby Remote Sensing is among the modules in the Radar Meteorology course. The Training Centre is fully registered and accredited by the National Council for Technical Education (NACTE). It was officially given an international registration in March 2014 with registration number REG/EOS/025. Additionally, The NMTC has established short courses in Remote Sensing including RADAR Meteorology, climate change, agrometeorology, etc. The primary targeted beneficiaries are meteorological personnel from the National Meteorological and Hydrological Services in WMO Regional Association I (Africa) and other organizations carrying out related functions.

Scholars joining NMTC from Tanzania include students graduating from secondary schools, TMA Staff and employees of different organizations, including national defence forces. Scholars graduating from NMTC are employed by TMA depending on the advertised job vacancies. TMA, through the training centre, has a Memorandum of Understanding with the National Institute of Transport for provision of ICT studies.

In the year 2023, a total of 42 meteorological technicians were trained at the college and in 2024 a further 150 is expected to be enrolled. The Government has shown commitment to enhance the NMTC and investments has been made by the Government to renovate and expand the institution to accommodate the needs for meteorological trainings in both Tanzania and neighbouring countries. Existence of the newly established Radar station and the Kigoma Airport Meteorological station provide the NMTC with facilities for practical trainings. Having an international registration, the NMTC has the potential to serve trainees from National Meteorological and Hydrological Services (NMHSs) and other applicants from neighbouring countries.



Figure 1: Some of the building infrastructure of the National Meteorological Training Centre(NMTC). It can be accessed at "<https://www.meteo.go.tz/services/meteorological-training-for-technicians>".

1.5 Experience and track record in implementing internationally funded hydromet projects as well as research an development projects in general.

TMA has a long and proven track record in implementing internationally funded development programmes across the meteorological value chain including:

- Strengthening climate information and early warning systems in Tanzania for climate resilient development and adaptation to climate change (UNDP).
- Enhancing Hydro met Services through Regional Monitoring Innovation Hubs in Africa (WMO/Adaptation Fund)
- FINKERAT – Finish Meteorological Institute, Kenya Meteorological Department, Rwanda Environmental Management Authority, Rwanda Meteorological Agency, Tanzania Meteorological Authority Project (Ministry for Foreign Affairs of Finland)
- GFCS Adaptation Programme in Africa (WMO/NORAD)
- Weather and Climate Information Services (WISER): East Africa 2015-21, (UK MET Office)
- Global Framework For Climate Services (GFCS-2014-2020), which resulted in the establishment and the launch of the National Framework For Climate Services (NFCS 2018 -2025)
- Severe Weather Forecasting Demonstration Project (SWFDP) and the HIGH Impact Weather Lake System (HIGHWAY) which were implemented in the Eastern and Southern Africa regions, including Tanzania.
- A WMO Common Alerting Protocol (CAP) implementation in Africa as means of dissemination of public alerts across Africa
- Capacity building opportunities through WMO Voluntary Cooperation Programme (VCP), through which various Tanzanians have received WMO scholarships for meteorological studies from WMO Regional Training Centers (RTCs), colleges and universities located in WMO Members. The skills and knowledge gained has enhanced the performance of TMA in the delivery of Climate Services.

Summary score and recommendations for Element 1

The legal foundation is solidly anchored in the Meteorological Act of 2019. The Act provides a clear and elaborate description of TMA responsibilities and mandate. TMA has a robust governing structure that both provides oversight of TMA operations and supports TMA's strong relationships within the government. TMA strategic plan is in place and it appears to be used actively by TMA governing body and senior management. TMA should consider making the current strategy public on its website together with other key information documents like the annual institutional report, audit reports, etc.

TMA has formalized partnerships with a range of other government and non-government entities. Through its training academy TMA has a very strong recruitment channel for new staff and for continuous upgrading staff competences within select meteorological subject areas. Government funding provides a solid budget base for TMA but does not sufficiently address all needs.

Maturity Level 4: An effective service but with a few shortcomings related to its mandate, governance, and resourcing and in the process to address the gaps.

Recommendations

- Continue to advocate to the government for sufficient budget allocation.
- Conduct impact studies to provide evidence for the socio-economic value of weather and climate services.
- Make TMA key documents readily available to stakeholders and partners, including development partners to facilitate various uses related to the TMA strategic goals.

Element 2: Effective partnerships to improve service delivery

2.1. Effective partnerships for service delivery in place with other government institutions.

At national level, TMA has partnerships with both government institutions and non-governmental organizations. TMA has collaborations with the Prime Minister's Office (Disaster Management Department - DMD) and other organizations under the National Early Warning System, including Government Ministries, Departments and Agencies (MDAs); UN Agencies; and International NGOs. TMA also collaborates with the Vice Presidents' Office (Department of Environment) on climate change related matters. TMA also cooperates with all Ministries including Ministry of Agriculture, Ministry of Energy, Vice Presidents office, Ministry of Defence, and Ministry of Water where hydrology is anchored.

While many of the partnerships have been formalized through MoU's, implementation of the partnerships still needs additional work. One of the main stumbling blocks is limited financial capacity to bring everyone together on a regular basis.

2.2. Effective partnerships in place at the national and international level with the private sector, research centres and academia, including joint research and innovation projects.

TMA has a fairly strong collaboration with research centres and academia, at the national and international levels.

TMA has a partnership with Tanzania Agricultural Research Institutes (TARI) where the 13 agrometeorological stations owned by TMA are housed. The TARIs provide office space for agrometeorological stations and land for installation of meteorological equipment and phenological (crop growth stages and condition) observations. The TARIs benefit from the meteorological observations and the forecasts as key inputs in their agricultural research activities. TMA also collaborates with higher learning institutions such as University of Dar es Salaam, Sokoine University of Agriculture (SUA), Ardhi University and Dar es Salaam Institute of Technology (DIT). For instance, TMA collaborated with SUA in the development of mobile phone based system called FarmSMS which was used to disseminate weather and climate information to farmers and other communities.

Among TMA priorities is to strengthen the existing collaboration with Private Partners through signing of MoUs.

The current TMA Partners from the private sector at national level include commercial farmers such as tea and sisal plantations who own rainfall stations, whereby the observed rainfall data from the stations is sent to TMA for archiving (as required by the Meteorological Act of 2019).

2.3. Effective partnerships in place with international climate and development finance partners.

TMA has worked with both national and international organizations such as the Red Cross, UNDP and World Food Program for several years. At the stakeholder meeting carried out as part of the SOFF Readiness Phase, it was clear that there is potential to expand these partnerships to support the Early Warning for All initiative with a focus on creating value at the latter part of the meteorological value chain.

Tanzania has existing bilateral relationships in weather and climate services with countries in the Eastern and Southern Africa Sub-Regions. The TMA has been providing technical support to some National Meteorological and Hydrological Services (NMHSs) in these sub-regions. Additionally, Tanzania collaborates with neighbouring countries in the Eastern and Southern Africa Sub-Regions through various programs and projects led by organizations such as the World Meteorological Organization (WMO), East African Cooperation (EAC), and South African Development Community (SADC).

These collaborations involve the implementation of projects like the HIGH Impact Weather Lake Systems (HIGHWAY) project, in which TMA provided technical support to the Uganda National Meteorological Authority (UNMA), among others.

Furthermore, Tanzania is currently serving as WMO Regional Specialized Meteorological Centre (RSMC) providing guidance on severe weather for countries around Lake Victoria Basin (Rwanda, Burundi, Kenya and Uganda). Tanzania is also serving as a Regional WIGOS Centre responsible for data availability and quality in the EAC region.

2.4. New or enhanced products, services or dissemination techniques or new uses or applications of existing products and services that culminated from these relationships.

As part of enhancing weather and climate services delivery to the society, TMA has started providing downscaled seasonal forecast at district level for all the districts in the country in all seasons. This has contributed to further improving the accuracy and reliability of the forecasts provided by TMA. Furthermore, TMA has started providing five days rolling Multi-Hazard Impact based forecast for impending weather hazards such as strong wind, large waves and heavy rainfall. The products has demonstrated to be instrumental in mitigating weather related disasters, thus contributing to the implementation of UN Early Warning for All Initiative.

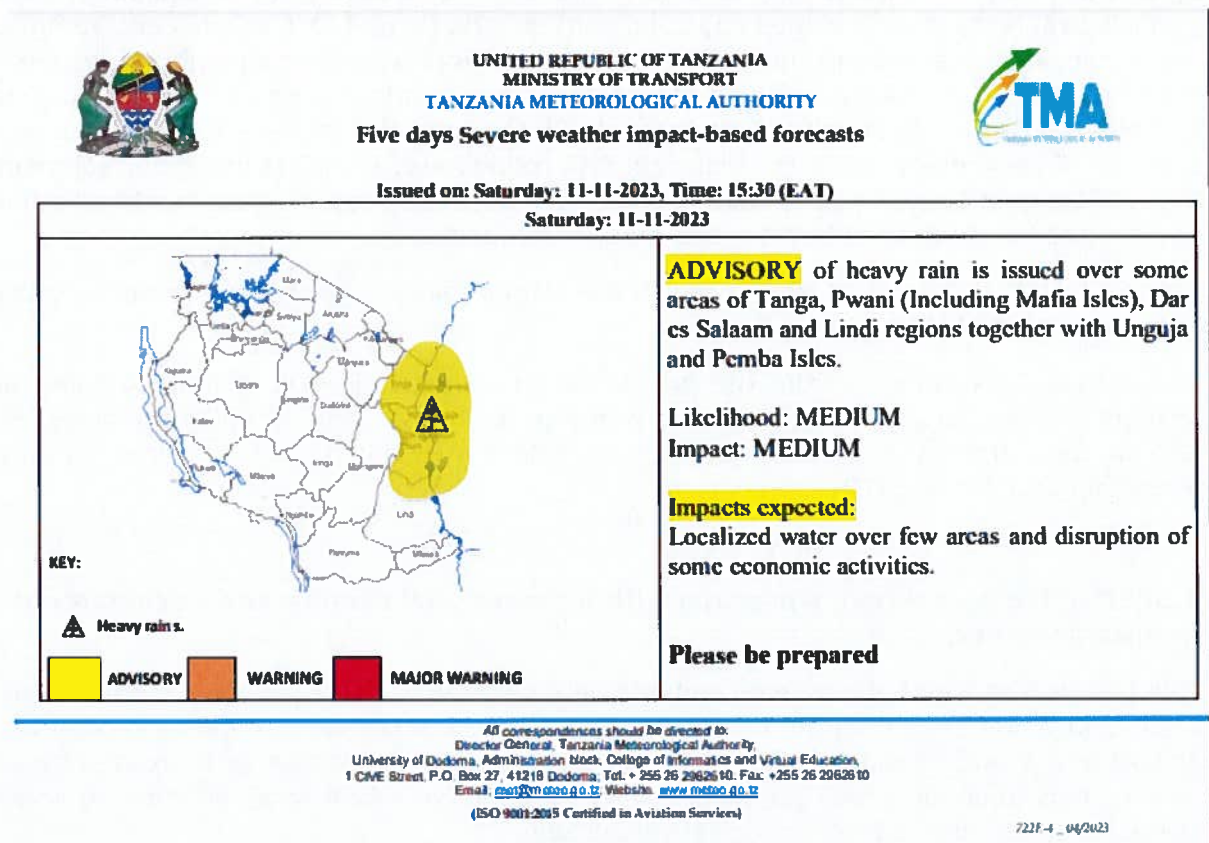


Figure 2: Five days Severe Weather Impact Based Forecast for 12th November, 2023



Figure 3: Observed weather in Dar es Salaam on 12 November, 2023 as reported by Ayo TV

MWELEKEO WA MVUA ZA MSIMU (NOVEMBA, 2023 – APRILI, 2024) KWA WILAYA YA DODOMA
 Umetolewa: 31/10/2023

Taarifa hii inatoa mwelekeo wa mvua za Msimu katika kipindi cha Novemba, 2023 hadi Aprili, 2024; athari na ushauri kwa sekta za kilimo, mifugo na uvuvi katika wilaya ya Dodoma.

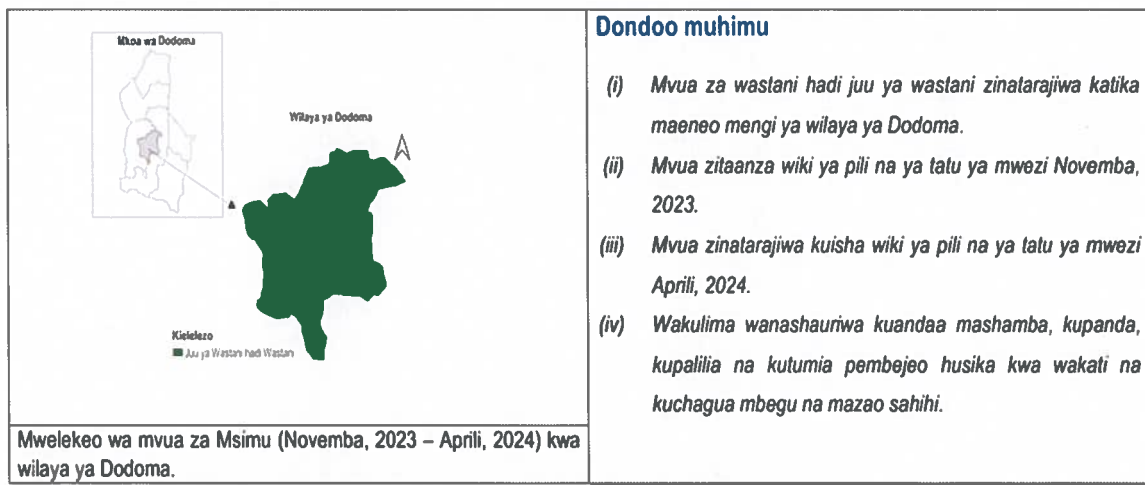


Figure 4: Downscaled seasonal forecast for Dodoma Urban district: Forecast for November 2023 to April 2024 season.

Summary score, recommendations, and comments for Element 2

TMA has a long range of partnerships with both government and non-government partners. MoUs are in place for several partners, and a formal platform for cooperation has been well-developed. The operationalization of the partnerships is at times challenged by limited funding for coordination unless it has been funded through projects.

The partnerships with private sector appear to be an area that could be expanded further, which is also on the radar of TMA.

TMA has a long track record of implementing Hydromet development projects. They are a proactive and vocal partner, and it appears that internationally funded projects are used to support the strategic and long-term development of TMA.

TMA also plays a significant regional role, providing support to other Met services in Eastern/Southern Africa

Maturity Level 4: Effective partnerships with equal status in most relationships and approaching relevant funding opportunities in a coordinated manner.

Recommendations:

- Continue to expand partnerships with the private sector.

Element 3: Observational infrastructure

3.1. Average horizontal resolution in km of both synoptic surface and upper-air observations, including compliance with the Global Basic Observing Network (GBON) regulations.

TMA operates surface observing network consisting of 27 manned synoptic weather stations and 41 Automatic Weather Stations (AWSs), one (1) Upper Air station located at Julius Nyerere International Airport and three (3) weather radars installed in Dar es Salaam, Mwanza and Mtwara. The upper air station performs daily ascent at 1200 GMT. Moreover, two (2) other weather radars have been installed in Mbeya and Kigoma. In addition, the procurement of two (2) additional weather radars is complete (to make a total of seven (7) weather radars network in the country), and now at the manufacturing stage. Upon completion they will be installed at Dodoma and Kilimanjaro. Currently, TMA is installing five (5) lightning detectors that will cover the entire Lake Victoria region. TMA also operates 13 Agro-meteorological stations located at Agricultural Research Institutes. TMA is continuing with the installation of 60 Automatic Rainfall Stations and 5 Meteorological Instruments for Aviation, procured recently. The procurement of High Frequency Marine radar network to enhance observation and monitoring of weather conditions in the Indian Ocean has been completed and now at the manufacturing stage. Moreover, the process of construction of National Meteorological Calibration laboratory has begun. The laboratory will be equipped with a wind tunnel (for anemometers calibration), temperature, pressure, humidity and radiation calibration equipment.

Several of the current AWS stations are at the end of their lifetime and needs upgrading or replacing. The United Republic of Tanzania Government (URT) has initiated improvement of eleven (11) stations and procurement of one upper air station. At present Tanzania is not compliant with GBON regulations. In order to become GBON compliant Tanzania would need 27 fully functional surface-based stations and 5 upper air stations. The SOFF National Contribution Plan for Tanzania and the subsequent Funding Request outlines to path towards ensuring GBON compliance.

The WMO OSCAR Surface database is not up to date and the information on number of stations, active stations and reporting frequency is currently not accurate. TMA has staff with capacity to conduct this task, but needs to develop a plan for regular updating including designating a focal point for ensuring the task.

3.2. Additional observations used for now-casting and specialized purposes.

Station operations include weather observations and data transmission to the TMA headquarters at synoptic hours (after every 3 hours). The real time observations from manned stations are sent at the Central Forecasting Office (CFO), communication section after every three (3) hours through email and telephones as backup. Received observations at CFO are then manually submitted to the Automatic Message Switching System (AMSS) for international exchange through the Global Telecommunication System (GTS). Weather parameters observed at stations are also sent through email and hardcopies to the climate data section for long term storage.

3.3. Standard Operating Practices in place for the deployment, maintenance, calibrations and quality assurance of the observational network.

The TMA organizational set up for maintenance of both surface based and upper air stations are based on a decentralized approach. TMA has divided Tanzania into eight cluster zones. Each zone is manned with a residential engineer who will oversee maintenance in his/her zone of operation. Additional engineers are based at TMA HQ in Dodoma with the capacity to provide support to the zones. Each cluster has a regional

head office which also contains a warehouse. Spare parts and reserve equipment are stored at the warehouse of each cluster zone head office.

Furthermore, TMA has a calibration laboratory, which is used to calibrate TMA observation equipment. TMA is also in the process of expanding the calibration laboratory to make it support National Meteorological and Hydrological Services (NMHSs) of neighbouring countries in the region including in EAC and SADC subregions. Such calibration laboratory can also support calibration of equipment for NMHSs of neighbouring countries implementing SOFF projects. Additionally, TMA has a fabrication workshop for some of weather observation equipment. The workshop can also be equipped to manufacture equipment for NMHSs of other neighbouring countries in the region, for which TMA is already providing technical support.

3.4 Implementation of sustainable newer approaches to observations.

TMA has embarked in the use of Radar technology. The radars complement the network of AWS's and the manual synoptic stations. TMA has also embarked on the use of automatic rain gauges which require limited human intervention.

TMA seeks to fully automate the data transmission system from stations to TMA Central Forecasting Office and international exchange through the Global Tele-communication System. This automation has been proposed in the Systematic Observation Financing Facility (SOFF) project. TMA is also in the processing of implementing the WMO Integrated Global Observing System (WMO) in line with the Tanzania Meteorological Authority Act No. 2 of 2019 whereby, TMA has the mandate to register and regulate all meteorological stations operating in the United Republic of Tanzania and archive all the data from the stations.

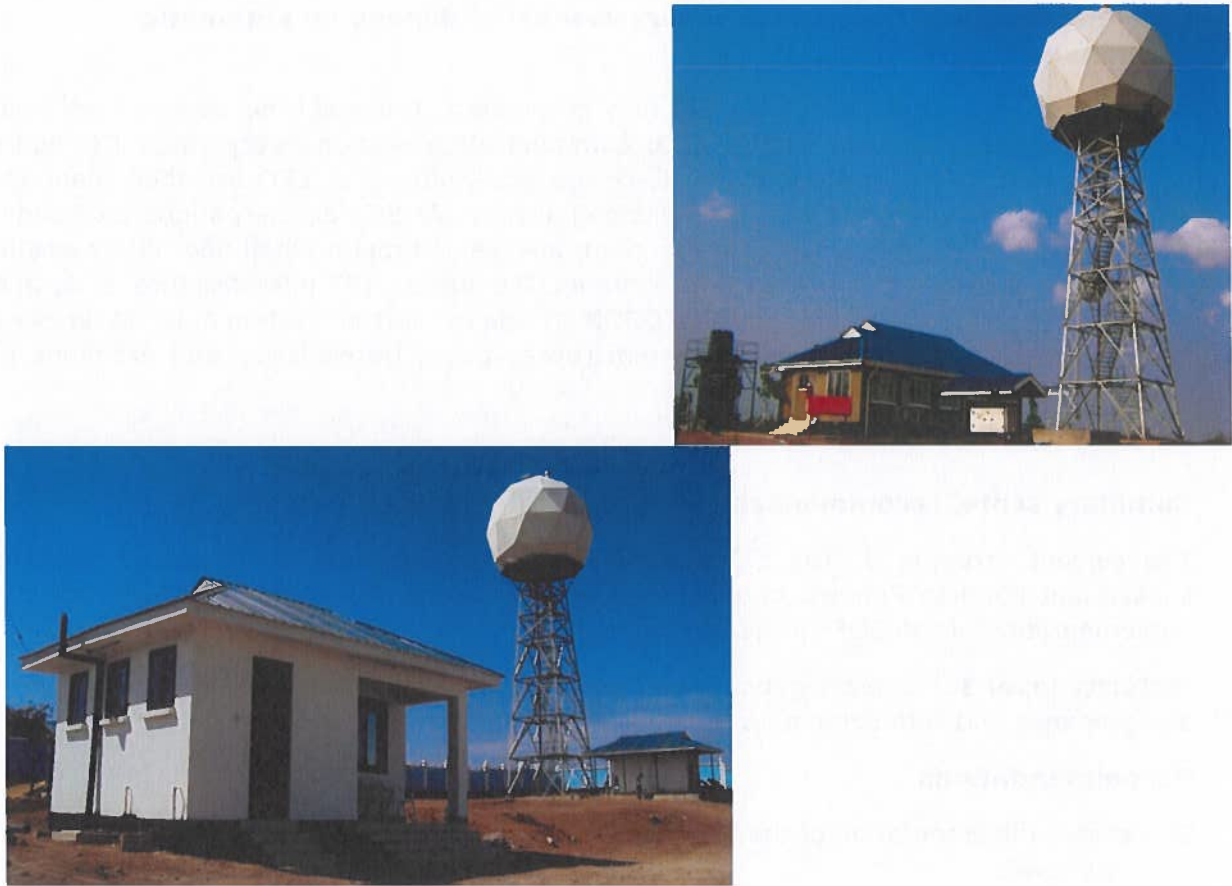


Fig. 4: Weather Radar stations at Mwanza and Dar es Salaam



Fig.5: Weather Radar station at Mtwara

3.5. Percentage of the surface observations that depend on automatic techniques.

However, most of the stations are not fully automated. The real time observations from manned stations are sent at the CFO, communication section every three (3) hours through email, GPRS and telephone. Received observations at CFO are then manually submitted to the Automatic Message Switching System (AMSS) for international exchange. Weather parameters observed at stations are also sent through email and hardcopies to the climate data section for long term storage. The current ICT infrastructure is old and outdated. To efficiently comply with the GBON criteria the current system must be renewed and upgraded to a fully automatic system (observation, transmission and exchange of meteorological information and data).

Summary score, recommendations, and comments for Element 3

The current score is 3. The SOFF National Contribution Plan for Tanzania and the subsequent Funding Request outlines the path to ensure GBON compliance. Successful implementation of the SOFF project could increase the score to 4.

Maturity level 3: Moderate network with some gaps with respect to WMO regulations and guidance and with some data quality issues.

Recommendations

Successful implementation of the SOFF project is the primary pathway to increasing the maturity level.

Element 4: Data and product sharing and policies

4.1. Percentage of GBON compliance – for how many prescribed surface and upper-air stations are observations exchanged internationally. Usage of regional WIGOS centres.

Of the surface stations operated, only two stations (AWSs) are GBON compliant sharing data on hourly basis. However, this has not been updated in OSCAR Surface. For the purpose of data exchange regionally and internationally, TMA uses the Global Telecommunication System (GTS), and in-house developed tools such as the "Digital Meteorological Data Observatory (DMO)"; "Meteorological Aviation Information System (MAIS)"; "Meteorological Marine Information System (MMIS)" and the "Meteorological Message Exchanging System (MES)".

4.2. A formal policy and practice for the free and open sharing of observational data.

It has not been possible to locate a formal policy for sharing of data. It is recommended that TMA develops such policy and make it publicly available on its website.

TMA provides data services to support data users including construction companies and research work. The data services are provided by the Data section based on the data policy that guides the data services for all data clients. The direction of TMA is to provide products instead of raw data. WMO recommends the provision of open data and experiences show that service provision is not always a profitable business. TMA should consider conducting an in-depth analysis of the business case for its service provision. This will enable TMA to get an in-depth understanding of the market and the potential profitability of service provision vs. provision of open data.

4.3. Main data and products received from external sources in a national, regional and global context, such as model and satellite data.

In addition to the NWP data products generated locally at TMA using the Weather Research & Forecasting Model (WRF), TMA accesses model products from regional and Global Centres including RSMC Pretoria, EUMETSAT, UK-Met Office, ECMWF, and NOAA.

Summary score, recommendations, and comments for Element 4

TMA has taken significant steps in recent years to upgrade its observation network from manual to automated stations. The work is not finished, and significant gaps remain in terms of optimizing internal data flows. TMA should also work to adopt/communicate the organizations data flow policy as well as creating a structure that ensures regular update of OSCAR Surface. It is expected that the SOFF project will address some of these challenges, and TMA could in a few years very well increase its current maturity level rating.

Maturity Level 2: A limited amount of GBON compliant data is shared internationally. The existing data sharing policies or practices or the existing infrastructure severely hamper two-way data sharing.

Recommendations

- Update OSCAR Surface and develop a plan for regular updates.
- Articulate data sharing aspects in the TMA data policy.
- Conduct a cost benefit analysis of business case for service provision, such as open data availability.

Element 5: Numerical model and forecasting tool application

5.1. Model and remote sensed products form the primary source for products across the different forecasting timescales.

TMA has made significant strides in the realm of Numerical Weather Prediction (NWP), boasting a dedicated NWP branch within its organizational structure. Currently, the NWP branch comprises five personnel tasked with generating NWP products daily, with plans to expand the team to enhance both the quality and quantity of these products. Additionally, TMA has six interns from the University of Dar es Salaam, with occasional involvement of postgraduate students for practical training in NWP. The Authority utilizes a variety of NWP products sourced externally from institutes worldwide, alongside in-house products generated by the WRF model. While global-scale products like GFS, IRI, ECMWF, Meteo-France, UK Met Office are commonly employed, regional-scale products from Kenya's Nairobi RMSC are also utilized. In-house products mainly stem from the WRF model, with the COSMO model, previously used for high-resolution NWP, now discontinued.

For remote sensing products, TMA relies on EUMETSAT satellite imagery and radars, among others, which are particularly beneficial for nowcasting. Consequently, TMA delivers a spectrum of weather forecasts, ranging from short to medium-range, extending to seasonal forecasts during specific periods of the year.

5.2. a) Models run internally (and sustainably), b) Data assimilation and verification performed, c) appropriateness of horizontal and vertical resolution.

TMA's NWP framework operates with products generated for two domains: the primary domain and the inner domain (nest). The primary domain spans a 36km by 36km horizontal resolution, covering most of Africa, while the inner domain, with a 12km by 12km grid resolution, focuses specifically on Tanzania. These predictions are facilitated by the WRF model, updated twice daily, with plans underway to generate products at higher resolution for improved suitability to Tanzania's profile. Automation of the NWP product generation process is also on TMA's agenda to streamline operations with minimal human intervention.

While data assimilation is currently absent at TMA, it stands as a priority for future integration. Model verification processes, however, are effectively conducted for weather forecasts and seasonal predictions, although enhancements utilizing modern techniques are planned for the future. A notable challenge lies in the availability of global products which come as images not raw data, limiting comprehensive model verification using statistical approaches.

5.3. Probabilistic forecasts produced and, if so, based on ensemble predictions.

TMA demonstrates robust capabilities in post-processing NWP, with skilled personnel adept at post-processing NWP products and data analysis. While ensemble prediction system (EPS) products are sourced from international institutes, TMA's own WRF model products are not yet equipped for ensemble prediction. However, plans are underway to develop such capabilities. TMA forecasters access probabilistic forecast products from international institutes like ECMWF, primarily in image format, limiting further exploration or modification. These probabilistic forecasts predominantly serve seasonal predictions, with rainfall forecasts occasionally issued with probability indicators.

Summary score, recommendations, and comments for Element 5

Maturity Level 3: Prediction primarily based on model guidance from external and limited internal sources (without data assimilation) and remote sensed products in the form of maps, figures, and digital data, covering nowcasting, short, and medium forecast time ranges.

Recommendation

- Train staff in data assimilation, verification, and post-processing methods of NWP models.

Element 6: Warning and advisory services

6.1. Warning and alert service cover 24/7.

As an integral component of Tanzania's early warning system (EWS), TMA makes systematic observation of the weather systems, provides weather forecasts to the general public and socio-economic sectors; and disseminates the information through various channels. Forecasts provided by TMA include daily weather forecasts (24 hours), five days Multi-Hazard Impact Based Forecasts, dekadal forecasts, monthly forecasts, seasonal forecasts (national level and downscaled forecasts at district level and, severe weather warnings). Tailor made products include Agrometeorological bulletins, and products for energy, mining, and water sectors. TMA also prepares and publishes the "Annual National Statements on the Status of the climate", each year to support climate change adaptation planning and interventions

The services provided for specific socio-economic sectors include:

- Meteorological services for Aviation sector;
- Meteorological Services for transportation sector and construction industry;
- Meteorological Services for construction industry;
- Meteorological services for Agriculture;
- Marine Meteorological Service;
- Meteorological service for defense;
- Climatological and climate change services (Climatological analyses and Annual National Statements on the Status of the climate);

Furthermore, TMA delivers Multi-Hazard Early Warning (MHEW) services, by issuing Five days impact-based forecast in anticipation of extreme weather events. These warnings are disseminated through various channels, including television, newspapers, radios, TMA website, TMA online TMA, and social media (WhatsApp groups, Twitter, Instagram, YouTube and Facebook). The forecasts contribute to the EWS, outlining potential weather hazards such as roughs or heavy rainfall, which may lead to flooding. The EWS's effectiveness benefits from the involvement of the Prime Minister's office, expediting the dissemination process. Collaboration with local governments and end-users ensures timely interventions based on forecasted weather hazards. However, the challenge that constrain effectiveness in the impact-based forecasting is availability of vulnerability data from the vulnerable communities, which is key input in the development of impact-based forecasting. In that regard, opportunities for enhancement remain, particularly in optimizing the EWS and MHEWS to cater for the most vulnerable communities.

6.2. Hydrometeorological hazards for which forecasting and warning capacity is available and whether feedback and lessons learned are included to improve warnings.

TMA possesses both the technical and human capacity to forecast and issue warnings for various extreme weather events, collaborating with stakeholders to tailor climate services to end-users' needs. Feedback mechanisms facilitate continuous improvement, albeit with recognition of existing challenges such as limited mobile phone-based warnings and rural accessibility constraints. Efforts to expand the station network across the country are ongoing, aiming to enhance forecast quality.

Collaboration with stakeholders is strengthened through tangible actions, backed by Memorandums of Understanding (MOUs) with entities such as the Red Cross, UNDP, and agricultural departments. Further MOUs, including those with the Ministry of Defence, are in progress, fostering comprehensive disaster preparedness.

6.3. Common alerting procedures in place based on impact-based services and scenarios taking hazard, exposure and vulnerability information into account and with registered alerting authorities.

TMA adopts the WMO Common Alert Protocol (CAP) EWS software, facilitating effective dissemination of alerts to registered alert authorities. While the platform demonstrates efficacy, ongoing improvements are essential to ensure timely warnings, including the registration and training of additional alert authorities.

Summary score, recommendations, and comments for Element 6

Maturity Level 3: "Weather-related warning service with modest public reach and informal engagement with relevant institutions, including disaster management agencies."

Recommendations

- i. Enhance availability of vulnerability data to support Impact Based Forecasting;
- ii. Develop a strategic approach, including continuous cross-sectoral engagement for development of comprehensive Multi-hazard Early Warning System.
- iii. Proactively engage with government and development partners and international finance institutions to advocate for funding for EW4ALL in Tanzania.

Element 7: Contribution to Climate Services

7.1. Where relevant, contribution to climate services according to the established capacity for the provision of climate services.

TMA plays a pivotal role in climate services provision, offering tailored climate reports and collaborating with regional counterparts to enhance climate service capacity. TMA's contribution to climate services is quite high and many end users are using this service. TMA launched the NFCS a while ago and now the framework is in the process of being used, although not fully operational. The Authority, as part of its role as a provider of climate services provides every year a report on the State of Climate in Tanzania. TMA is also using its expertise in climate service provision to capacitate other countries in the region. Some sectors of the economy are receiving climate services from TMA tailor-made according to their needs, e.g. agriculture.

Summary score, recommendations, and comments for Element 7

Maturity Level 3: Essential capacity for Climate Services Provision.

Recommendations

- i. Monitor the implementation of the Ensure operationalization of National Framework for Climate Services (NFCS 2018 -2025) and make necessary reviews, considering also that the NFCS is close to the end of its time frame.
- ii. Strengthen observation network to provide improved data on the unique topographical/Orographic features of Tanzania considering also the large size of the country

Element 8: Contribution to hydrology

8.1. Where relevant, standard products such as quantitative precipitation estimation and forecasts are produced on a routine basis according to the requirements of the hydrological community.

The functions of TMA outlined in the Act are based on weather and climate, whereas the responsibility of hydrology services falls under the Ministry of Water where the Hydrological Advisor to the Permanent Representative of Tanzania with The World Meteorological Organization (WMO) is also based.

TMA has only recently established a hydromet section. It is currently manned by two staff. It is a wish for TMA to strengthen this section in order to provide more and enhanced services on hydrology.

The Hydromet section is responsible for generation of specific information and products to support hydrological functions such as rainfall intensities. Through the MoU, TMA provides technical support for the personnel working on weather stations owned by the Ministry of Water as well as calibration and maintenance of the stations. The Act requires all meteorological operators including the Ministry of Water to send the meteorological data to TMA as a National Data Bank for archival.

8.2. SOPs in place to formalize the relation between Met Service and Hydrology Agency, showing evidence that the whole value chain is addressed.

TMA has a Memorandum of Understanding (MoU) for collaboration with The Ministry of Water.

For the cooperation with Ministry of Water a joint action plan has also been developed. A cross ministerial task team consisting of 3 representatives from Ministry of Water Resources and three staff from TMA ensures implementation of the action plan. The Task team issues quarterly reports on implementation of the action plan.

The Authority also supported the Ministry of Water and 9 Water Basins Authorities in establishing a Quality Management System that strengthened management of water resources in Tanzania.

TMA has implemented a Quality Management System (QMS) for aeronautical meteorological services, which has received the certification ISO 9001:2015 certification. QMS helps to ensure working procedures are followed and executed effectively. This has improved TMA services and trust by stakeholders and partners.

8.3. Data sharing agreements (between local and national agencies, and across international borders as required) on hydrological data in place or under development.

The Tanzania Meteorological Authority Act No. 2 of 2019 mandates TMA to provide weather services, to coordinate and regulate meteorological activities in the United Republic of Tanzania. This include sharing of the data, whereby all the stakeholders owning or operating meteorological stations must be registered by TMA and share observational data to TMA, which is the National Data bank. TMA archives the data and shares real data through the Global Telecommunication System and WIS 2.0. Stations from stakeholders currently sharing data to TMA include stations owned by the Ministry of Water, Ministry of Agriculture and Large farmers who own mostly rainfall stations.

8.4 Joint projects/initiatives with hydrological community designed to build hydrometeorological cooperation.

There is an incipient formalized collaboration via the recently established hydromet unit at TMA and the established SOP and MoU between partners. They are currently in the process of developing joint projects together.

Summary score, recommendations, and comments for Element 8

The cooperation with the hydrological agency under the Ministry of Water is solid. The MoU and SOPs form the foundations, while the establishment of a joint task force supports operationalization of the cooperation.

TMA appears to still have limited capacity to provide tailor made support, but it is working on strengthening its hydromet section.

There is a constructive and mutual engagement to strengthen the collaborations and the partners are engaging in developing joint project proposals.

Maturity Level 3: There is a moderately well-functioning relationship between the meteorological, hydrological and water resources communities but considerable room for formalizing the relationship and SOPs.

Recommendations

- i. Raise more awareness to stakeholders on compliance to the Tanzania Meteorological Authority Act No. 2 of 2019.
- ii. Expand the Hydromet Section to ensure capacity to provision of tailor made support to the hydrology.

Element 9: Product dissemination and outreach

9.1. Channels used for user-centred communication and ability to support those channels (for example, does the NMHS operate its own television, video or audio production facilities? Does it effectively use cutting-edge techniques?).

TMA provides weather forecasts to the general public and socio-economic sectors. Forecasts provided by TMA include daily weather forecasts (24 hours), five days Multi-Hazard Impact Based Forecasts, decadal forecasts, monthly forecasts, seasonal forecasts (national level and downscaled forecasts at district level and severe weather warnings). Tailor made products include Agrometeorological bulletins, and products for the energy, mining, and water sectors. TMA also prepares and publishes the "Annual National Statements on the Status of the climate", each year to support climate change adaptation planning and interventions.

The services provided for specific socio-economic sectors include:

- Meteorological services for aviation sector;
- Meteorological services for transportation sector and construction industry;
- Meteorological services for construction industry;
- Meteorological services for agriculture;
- Marine meteorological service;
- Meteorological service for defense;
- Climatological and climate change services (climatological analyses and Annual National Statements on the Status of the climate);

TMA has its own weather studio for production of audio and video weather forecasts products for dissemination to the public. TMA has a strong collaboration with various media houses (television and radios across the country) who broadcast TMA produced weather and climate information to the general public. TMA also uses ICT systems innovated by TMA staff including Marine Meteorological Information Services (MMIS) for dissemination of marine weather services, and Meteorological Aviation Information System (MAIS) for dissemination of aeronautical meteorological services. Furthermore, weather information is disseminated through social media (WhatsApp groups, Twitter, Instagram, YouTube and Facebook).

Other major means of dissemination of TMA services include TMA websites, portals, mobile phones, display systems, newspapers.

9.2. Education and awareness initiatives in place.

For specialized meteorological education TMA owns and operates the National Meteorological Training Centre, which provides meteorological studies for NTA Level IV, V and VI and specialized short courses.

TMA carries out awareness activities to stakeholders through various platforms including radio and television programmes, exhibitions, forums, stakeholders meetings and outreach programmes. The aspects covered in awareness activities include services provided by TMA, application of weather and climate information, importance of integrating weather and climate information in planning and decision making, Tanzania Meteorological Authority Act. No. 2 of 2019 and climate change education.

The importance of education and awareness to the stakeholders has also been emphasized in the National Climate Change Response Strategy (2022-2026), National Disaster Management Strategy (2022-2027), National Framework for Climate Services (NFCS 2015 -2025) and TMA Strategic Plan 2021/ 2022 - 2025/26.

9.3. Special measures in place to reach marginalized communities and indigenous people.

TMA organizes outreach activities to raise awareness on the services provided by TMA and their applications, and to gather views on user requirements. TMA also implemented awareness activities through implementation of projects supported by Development Partners. TMA also has an initiative to engage communities and integrate science and indigenous knowledge in weather forecasting by organizing village meetings with Indigenous Knowledge Experts at village level. This is still a research work, not operational yet. However, there is a need to raise awareness to various stakeholders on the importance of using weather and climate services in planning of their activities so that they can get full benefits of weather and climate services.

Summary score, recommendations, and comments for Element 9

Maturity Level 3: A moderately effective communication and dissemination strategy and practices are in place, based only on in-house capabilities and supported by user-friendly website.

Recommendation

Continue efforts to raise awareness targeting the most vulnerable populations, including rural populations who do not use or have unlimited access to social media.

Element 10: Use and national value of products and services

10.1 Formalized platform to engage with users in order to co-design improved services.

Services and products provided by TMA are to a reasonable degree co-designed through operational platforms for engagement of stakeholders ranging from socio-economic sectors, decision makers, intermediaries to end-users. Among the operational platforms are the National Climate Outlook Fora (NCOF), which are normally organized in the process of preparation of seasonal forecast. The NCOFs are organized for each season which involves presentations of prepared forecasts of a particular season prepared by TMA followed by break out session to prepare impacts for each socio-economic sector and users based on the presented forecast. The stakeholders' inputs (likely impacts and advisories) are incorporated in the final seasonal forecast statements to be disseminated to the communities. Presentations of scientific forecasts are preceded by feedback from selected sectors. Participants of the Fora include representatives from Sector Ministries, Local Government Authorities, Civil Society Organizations, Media Houses and representatives of End Users. The role of stakeholders in the forum is to prepare impact statements and advisories for each category of users and sectors based on the expected weather indicated in forecast. Stakeholders also present their feedback on the previous forecasts and perspectives, including the package and language of the forecast statement (bulletin). The main challenge is budgetary constraints to ensure that wider audience is represented in the National Climate Outlook Fora, including gender representation.

Furthermore, TMA organizes a meeting as part of seasonal forecast preparation that targets only media houses to ensure they communicate effectively the intended key messages. Participants from media houses also share their feedbacks and views on best practices and areas for further improvement.

TMA also organizes outreach activities to engage intermediaries (such as extension workers) on services provided by TMA and gather views on areas of improvement. Another platform used by TMA is the Annual Nanenane Exhibition for farmers, which involves showcasing weather and climate services provided to the farming communities.

10.2 Independent user satisfaction surveys are conducted, and the results used to inform service improvement.

Feedback about users' satisfaction on services provided by TMA are provided during National Climate Outlook Fora and other platforms such as the Nanenane Agricultural Exhibitions. TMA has a Marketing and public relations Unit which organizes community outreach activities and coordinates questionnaires to gather users' feedback and views on aspects that require further improvement.

10.3 Quality management processes that satisfy key user needs and support continuous improvement.

In compliance with international and national requirements, TMA has a Directorate of meteorological regulations and quality assurance which is specific for overseeing regulation and quality assurance aspects of meteorological activities and services provided by TMA. In the area of quality assurance, TMA is implementing Quality Management Systems with a Quality Policy Statement of Tanzania Meteorological Authority, which states that:

"We, TMA employees are dedicated to provide quality meteorological products and services which meet or exceed customers' expectations and comply with agreed national and international requirements through continual improvement of our processes".

Quarterly QMS status meetings are organised to continuously assess and address QMS related issues.

The Authority attained ISO certification in aeronautical meteorological services since 2011. The Authority continued to maintain the certificate in the sequential international audit exercises. TMA continued to implement Quality Management System (QMS) for Aeronautical Meteorological Services and was re-audited for ISO 9001:2015 certification in January 2024 through an intensive online external QMS audit exercise and successfully maintained the ISO certification in provision of Aeronautical Meteorological Services.

TMA has also assisted other countries in implementing a quality management system. The Authority has further continued with its implementation of a quality management system for marine weather services and the audit report from the IMO Safety Audit Scheme (IMSAS) conducted in 2019 shows that TMA complies with international standards and increased their country score.

Summary score, recommendations, and comments for Element 10

Summary

Services and products provided by TMA are to a reasonable degree co-designed through operational platforms for engagement of stakeholders. Feedback about users' satisfaction on services is collected mainly through stakeholder meetings. There appear to be a range of venues where TMA engage with stakeholders and users. Feedback could possibly be enhanced further by systematizing data collection.

QMS is a priority area for TMA and there appears to be robust QMS structures in place to ensure monitoring and follow up on Quality Management related issues.

Maturity Level 3: Services development draws on regular dialogue with major stakeholders.

Recommendations

- i. Ensure wider representation of Stakeholders in the National Climate Outlook Fora, including gender representation.

For TMA to improve the rating in this category they should initiate activities to systematize data collection from stakeholders and users through survey data. TMA is active in engaging in dialogue with its users and key stakeholders of meteorological services. There appear to be both structured annual stakeholder events and ongoing, more informal, stakeholder meetings. It is not clear how data driven the user feedback is. Structured data collection could further enhance TMA understanding of user needs and be used to demonstrate continued value and relevance of TMA activities.

Annex 1 Consultations

The CHD for Tanzania was developed as part of the SOFF Readiness Phase.

During the CHD development DMI made three visits to Tanzania.

- May 2023: 11 day field visit as part of the SOFF Readiness phase
 - o Briefings with TMA senior Management
 - o Field Visits to TMA stations and zone offices
 - o Ongoing dialogue with TMA SOFF team
 - o Meetings with Tanzania District Officials
 - o Meeting with civil aviation representatives
 - o Meetings with UNDP, WFP, Danish Embassy
 - o Meeting with TMA Governing Board
 - o Workshop with TMA to share and discuss initial findings of mission
 - o Debriefing and analysis of findings with TMA Acting Director General
- September 2023
 - o Development of National Contribution Plan
 - o Analysis of key Tanzanian policies and strategic documents
 - o NCP and CHD Stakeholder workshop with TMA partners and service users
 - Various Ministries
 - Agricultural/Farmers organizations
 - Tanzania Red Cross, local NGO's
- February 2024
 - o Work session with TMA SOFF team on Finalization of CHD
 - o Verification interviews with TMA staff
 - o Discussion with TMA Acting Director General on maturity levels and recommendations
- DMI and TMA has held a large number of online consultations
- DMI has benefitted from online meetings with the SOFF secretariat and the WMO CHD unit during the development of the CHD for Tanzania