

NORHED Project on Improving East Africa’s Weather Information Management through the Application of Suitable ICTs

Preliminary Status of the Survey Findings in Tanzania

Table of Contents

1.0 Introduction 2

2.0 Data Management Process..... 3

3.0 Numerical Weather Prediction Activities..... 4

4.0 Current Status and Gaps in Human Resource..... 5

5.0 Key Stakeholders and Target Groups of the Project..... 6

6.0 Challenges 7

7.0 Summary 9

8.0 Research Team..... 9

Meteorology Services in Tanzania

1.0 Introduction

The Tanzania Meteorological Agency (TMA) is situated in Dar-Es-Salaam. It is wholly owned and funded by the government of Tanzania.

Weather Stations in Tanzania

A summary of the types of weather stations that are operated by the TMA and the types of data collected from those weather stations are presented in Table 1 and 2 respectively.

Table 1: Number and Type of Weather Stations operated by TMA

	Type/Purpose	Type: Mode of operation		Total	Frequency
		Manual	Automatic		
1	Synoptic	28	14	42	HOURLY
2	Rainfall				
3	Agromet	13	0	13	
4	Hydromet				
5	Upper Air Stations		1	1	ONE ASCENT PER DAY
6	Satellite Receiver (MSG - 2nd Generation)		1	1	CONTINUOUSLY
7	Weather Radar		1	1	CONTINUOUSLY
8	Other - (specify) ...RETIM SATELLITE RECEIVERS		6	6	CONTINUOUSLY
	Total	41	23	64	

Table 2: Type of Data Collected from the Weather Stations and the Sensors used

	Type of data	Sensors being used
1	Rainfall Amount	Standard Rain Gauges
2	Rainfall Intensity	
3	Humidity	Derived
4	Atmospheric Temperature	Mercury Thermometers
5	Wind Direction	Mechanical Wind Vanes
6	Wind speed	Mechanical Generators
7	Atmospheric Pressure	Digital Barometers
8	Cloud Cover	Visual

9	Soil Temperature	Mercury Thermometers
10	Soil Moisture	
11	Evapo-transpiration	
12	Water Temperature	

The number of weather stations only cover about 60% of the country. More weather stations are needed in the following areas:

- a) Lake Victoria basin,
- b) Western part of Tanzania from Ngara over Kikonko to Kasulu,
- c) Some parts of South-Western Highland,
- d) Central and Southern Coast area encompassing Chunya, Urambo, and Manyoni,
- e) Areas over the Southern Coastal

2.0 Data Management Process

Data from the weather stations is collected by Meteorology technicians and sent to the TMA head office by various means, including: uploading it to a customized system, phone call (landlines), email, post (letter) and SMS. When data is received by at head office, it is compiled from all stations into required format and mapped onto plots and analyzed. Table 3 presents the Techniques used to analyze the data once it is received at TMA head office.

Table3: The Data Management Process

	Technique	Brief description of the technique
1	ENTER RECEIVED DATA ONTO SERVER	Data entered to server from different attached terminals at NMS
2	PRINT DATA	Print data onto hard copy
3	PLOTING	Plot data onto special maps
4	DATA ANALYSIS	Putting isobars through areas of equal pressure
5	WEATHER ANALYSIS	Mapping up weather trends from the analysis and other sources

There are a number of problems encountered during the data processing. These problems and the possible solutions are represented in table 4 below.

	Phase	Problems	Suggested solution
1	Data collection/ capture	Fewer observing & monitoring station. INSUFFICIENT CAPACITY TO FACILITATE AND MOTIVATE VOLUNTARY RAINFALL OBSERVERS	Increase the density of observing & monitoring stations
2	Data Transmission	poor and unreliable communication means	enhance the use of internet/mobile networks to transfer data especially from AWS
3	Data Processing	poor means of data reception and system capacity, limited computational capacity	use efficient data processing tools and software training on data processing
4	Data storage	poor data storage capacity	use data banks for storage
5	Data Analysis	need for enhanced capacity on data analysis including human and computational capacity	Acquire relevant and appropriate modern computing facilities and software. More training on data analysis
6	Report generation	not much customized	customize these reports as much as our new systems can take
7	Information dissemination	some of the intended end users do not either get these information or get them not in real time	dialogue with different network providers, radio operators, TV stations etc

Table 4: Problems faced and their solutions

3.0 Numerical Weather Prediction Activities

The TMA carries out Numerical Weather Prediction using the WRF and COSMO models. Satellite images are used to complement the plotted charts in order to generate forecasts. The data that is obtained is based on the 15km and 5km spatial resolution. But also, atemporal resolution of 48 hrs for the WRF model and 78 hrs for the COSMO model. They cover East Africa (Tanzania, Rwanda, Burundi, Uganda, and Kenya) but can be increased to include South Sudan. For initialization, the WRF Model uses GFS data from NCEP while the COSMO Model uses GME data from DWD, Germany.

4.0 Current Status and Gaps in Human Resource

It was reported that there are over 50 meteorologists in Tanzania. This is not enough for the country but Tanzania's meteorological department is better staffed compared to Uganda. The human resource is fairly skilled but still needs more IT skills and faces challenges as presented in table 5. Table 6 shows the competencies of the meteorological engineers.

Table 5: Summary of Technology Specific Skills

No	Technology	People with related training		Rating of the experience with the technology
		Male	Female	
1	Numerical Weather Prediction Models	5	1	Fair
2	Computer Grid Infrastructures			
3	Wireless Sensors	1	-	Good
4	Earth Observation Satellite Data			
5	Information Dissemination Technologies such as mobile phones	2	3	Fair
6	Programming	2	3	Fair
7	Databases		2	
8	Hardware maintenance and Systems Administration		2	
9	Sensor configuration and Network Management	2	4	

The ICT related training requirements that would greatly benefit staff are:

- a) Programming: All NWP models are written in Fortran Language.
- b) Databases: TMA has heaps of data that need to be properly managed including archiving and digitization. The acquired skills will be crucial in enhancing efficiency and effectiveness in data management
- c) Modeling: Data Assimilation and Model Verification. This skill will enable the NWP expert use the observed local data and incorporate in WRF/COSMO Model, which will in-turn improve the initial and boundary condition through data Assimilation and Verify the model output
- d) Hardware Maintenance & Systems Maintenance: Any system to be able to attain its nominal life need properly planned maintenance. Cut off equipment and systems down time due to repair and maintenance hence increase efficiency

- e) Networks Management: Be able to manage different networks of the Agency through proper employment of skill.

Table 6: Human Resource challenges

	Challenge
A	Insufficient staffs
B	Training and capacity building needs
C	Low Salaries
D	Challenging working environment due to lack of TMA owned Central Forecasting Office

5.0 Key Stakeholders and Target Groups of the Project

The major secondary stakeholders of the project are the TMA whose role is to ensure that weather and climate information is provided to the stakeholders. Other stakeholders include the beneficiaries of weather information as shown in Table 7 below:

Table 7: Secondary Stakeholders of Meteorology Services

#	Use	Stakeholders	Purpose & Specific considerations
1	Civil Aviation	Civil aviation, airlines operators	For the safety and efficiency of air transport including flight route plan
2	Agriculture	Ministry of agriculture, universities, extension officers, farmers, decision makers, TMA researchers and the general public	Farm planning and management, crop monitoring & food security, crop modeling and research projects
3	Disaster preparedness	Disaster mgt unit (PMO), red cross, red crescent, international organizations (eg. FEWSNET, WFP, WMO), NGOs, media and the general public	Disaster management: crop performance and early warning, Bad weather phenomenon timing and expected impacts
4	Building and construction	Contractors, planners	Knowing prevailing and expected weather condition on different site and areas

5	Health	Ministry of health	Be able to predict outbreak of weather related diseases,
6	Fishing community	Ministry of livestock and fisheries, TAFIRI, fishermen, media	Know different weather parameters over different water bodies, researchers
7	Energy	Ministry of energy, TANESCO	Facilitate effective planning in energy generation
8	Tourism	Department of Tourism	Weather outlook for tourists
9	Mining	Department of mining	Mining activities planning
10	Water Resource Management	MINISTRY OF WATER,	Plan better use of water, prediction of water catchment

However, some stakeholders are not communicated yet. These are in table8 below.

Table 8: Secondary Stakeholders that are not communicated to

	Stakeholder	Information required	Purpose
1	Marine (shipping lines), small scale fishing	Lakes, oceans weather information	Plan better marine activities, marine safety, fishing activities
2	TANAPA	Weather and historical climatology information	For national parks and others expedition
3	Teaching Institutions	Weather and historical climatology information	Teaching , researchers
4	Government and NGOs in disaster management	Weather information including early warning and advisory on severe weather and extreme events	Planning, resource collection for pending disasters intervention
5	Commercial pastoralists	Weather and historical climatology information	Planning activities

6.0 Challenges

In the implementation of meteorology services in the country, the NMS is faced with several challenges as explained below:

Challenges hindering Large-Scale Deployment of Modern Technologies

The following were cited as the major hindrances to large scale deployment of modern technologies by the Meteorological agency:

- Limited budget
- Lack of (or not enough) trained personnel
- Maintenance challenges
- Lack of locally available spare parts
- Cost: The breakdown of the costs is presented in Table below.

Table 1 Estimates of Acquisition and Maintenance Costs

Cost of Acquisition		Cost in US Dollars
1	Cost of Equipment & Software	Cost of one AWS is approx. 45,000.00 USD inclusive with running software & freight charges
2	Installation Costs	approx. 5,000.00 USD inclusive, DSA for two Engineers, enclosure materials and construction
3	Other costs (please specify) (site survey & inspection cost)	approx. 3,200.00 USD
Maintenance Costs per year		
4	Equipment	Maintenance schedule every 3 month approx. 3,700.00 USD (for AWS)
5	Staff	4
6	Transport	approx. 2000 USD for Local transport
6	Other costs (please specify) Administrative cost	approx. 1,000 USD

Other Challenges experienced by TMA

In addition to the technology specific and communication challenges, the TMA experiences the following general challenges:

- a. Low operating budget
- b. Unhealthy understanding with our main collaborators on the industry ie Civil Aviation, Airport Authorities
- c. lack of TMA Central Forecasting Office
- d. Lack of guiding policies for Network providers, TV operators, Radio operators, and the media in general on their obligation to public services such as weather services
- e. Poor National telecommunication infrastructure

7.0 Summary

The TMA has made huge strides as far as ensuring the use of numerical prediction models and ensuring that there is sufficient human resource and coverage of weather stations. There is still a need for more weather stations and training of the human resource especially in IT skills. With the help of this project and government funding, the TMA is confident it will be able to achieve those goals.

8.0 Research Team

Below are the members of the research team that participated in the survey

	Name	Institution
1	Dr. Amos Nungu	Dar Es Salaam Institute of Technology
2	Dr. Ladislaus Changa	Tanzania Meteorological Agency
3	Mr. Daudi Mboma	Dar Es Salaam Institute of Technology
4	Dr Agnes Kijazi	Tanzania Meteorological Agency
5	Hazla Masoud	Tanzania Meteorological Agency
6	John Mayunga	Tanzania Meteorological Agency
7	Wilberfoce Kikwasi	Tanzania Meteorological Agency
8	Wilbert Timiza	Tanzania Meteorological Agency