

History of the Origin and Development of Meteorological Services in Nigeria

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Abstract

This paper attempts to give an insight to the origin and development of meteorological services in Nigeria. The study traced the origin of meteorological services in the world which started in 300 BCE by the Chinese weather prediction to 1835 when the modern weather forecasting was created by the British. The origin of meteorological services and its gradual development from manual to automated operations in Nigeria started in 1892 as an agricultural station under the then Public Works Department. It was about forty years later that a full-fledged Meteorological Department was established in the country. The Nigerian Meteorological Department started operations in 1937 and became the Nigerian Meteorological Agency a parastatal under the Federal Ministry of Aviation in 2003. The information used in this study was from the archives and also from the interview conducted with some key officers of the Nigerian Meteorological Agency (NIMET). This paper has found out that NIMET has gradually and steadily progressed from being a local to an international meteorological services organization through the consistent procurement of the latest meteorological equipment and partnering with relevant organizations to improve its meteorological services. The paper recommended the establishment of more meteorological stations for effective service delivery and the continuous training of its personnel.

Introduction

Weather conditions have played many roles both in favour of and against the armies in world history. The European Hun Emperor Atilla was construed as “God does not want Rome to be captured” because of a thunderstorm that suddenly occurred of a storm and deafened ears while he was capturing the Rome, however due to those meteorological conditions Atilla abandoned the encirclement. By the ending of the Second World War, there was a stormy, extremely rainy weather in

Normandy. This weather condition was against the Germans, however favouring the running allied forces. Accordingly, the German-Italian bloc was defeated on all fronts in Europe, and on 7 May 1945 it was announced that the war in Europe was over. As the Ottoman Empire entered war with Germany during World War I, the Germans had not ignored the importance of meteorological conditions and established a meteorological observation network in the Ottoman state.¹

The meteorological service in Istanbul started its activity in August 1915, under the name of “Kuvva-i Havaiye Müfettipliği Rasadat-ı Cevviye Müdürlüğü” at Caferağa Mansion in Kuruçeşme. Professor Ludwig Weickmann who was the first manager of the meteorology service has brought sixty German meteorology experts for establishing the organization of meteorology service in the Ottoman state. The related experts were the first members of this meteorology organization. In addition to these German experts, many Turkish officers in the Ottoman Army were selected to work in the meteorology service. Throughout the war, Professor Ludwig Weickmann and his assistant Dr. Erich Obst were the managers of this centre.²

These reserve officers were trained in meteorology at the Ottoman-German General Headquarters in Istanbul. General, Fatin (Gökmen) have given courses at Headquarters. Fatih Gökmen was the founder who changed the Kandilli Observatory to serve as an earthquake research institute. The reserve officers who completed their training started to work at meteorological stations established by the German state. These stations are Edirne, Gallipoli, Izmir, Seydiköy, Zonguldak, Sinop, Ankara, Eskisehir, Konya, Sivas, Diyarbakir, Adana, Brumana, Beirut, Jerusalem and Mosul.³ The modernization of meteorological services in Nigeria has been one of gradual process since then, driven mainly by growing environmental challenges, user requirements and available technical support over the years, as a result of the evolving trend in information and communications technology (ICT). For example, the severe drought of 1969 to 1973 raised significant concerns, which led to the meeting of Heads of Government of the West Africa; subsequent call for better understanding of weather and climate of the region and its variabilities.⁴ Following this call, coupled with the recognition of meteorology as corner piece for nation building, efforts were doubled to improve on the state of the weather observing network of stations in the country; as well as the transformation of the Department of Meteorological Services into a semi-autonomous Agency with a legal framework and corporate headquarters building.

Origin of Meteorological Services

For millennia, people have tried to forecast the weather. In 650 BCE, the Babylonians predicted the weather from cloud patterns as well as astrology. In about 350 BCE, Aristotle described weather patterns. Later, Theophrastus compiled a book on weather forecasting, called the *Book of Signs*. Chinese weather prediction lore extends at least as far back as 300 BCE, which was also around the same time ancient Indian astronomers developed weather-prediction methods.⁵

In 904 CE, Ibn Wahshiyya's Nabatean Agriculture, translated into Arabic from an earlier Aramaic work.⁶ He discussed the weather forecasting of atmospheric

changes and signs from the planetary astral alterations; signs of rain based on observation of the lunar phases; and weather forecasts based on the movement of winds.⁷

Ancient weather forecasting methods usually relied on observed patterns of events, also termed pattern recognition. For example, it might be observed that if the sunset was particularly red, the following day often brought fair weather. This experience accumulated over the generations to produce weather lore. However, not all of these predictions prove reliable, and many of them have since been found not to stand up to rigorous statistical testing.⁸

It was not until the invention of the electric telegraph in 1835 that the modern age of weather forecasting began.⁹ Before that, the fastest that distant weather reports could travel was around 160 kilometres per day (100 mi/d), but was more typically 60–120 kilometres per day (40–75 mi/day) (whether by land or by sea).¹⁰ By the late 1840s, the telegraph allowed reports of weather conditions from a wide area to be received almost instantaneously allowing forecasts to be made from knowledge of weather conditions further upwind.¹¹

The two men credited with the birth of forecasting as a science were an officer of the Royal Navy, Francis Beaufort and his protégé Robert Fitz Roy. Both were influential men in British naval and governmental circles, and though ridiculed in the press at the time, their work gained scientific credence, was accepted by the Royal Navy, and formed the basis for all of today's weather forecasting knowledge.¹² Beaufort developed the Wind Force Scale and Weather Notation coding, which he was to use in his journals for the remainder of his life. He also promoted the development of reliable tide tables around British shores, and with his friend William Whewell, expanded weather record-keeping at 200 British Coast guard stations.¹³

Robert Fitz Roy was appointed in 1854 as chief of a new department within the Board of Trade to deal with the collection of weather data at sea as a service to mariners. This was the forerunner of the modern Meteorological Office. All ship captains were tasked with collating data on the weather and computing it, with the use of tested instruments that were loaned for this purpose.¹⁴

A storm in 1859 that caused the loss of the Royal Charter inspired Fitz Roy to develop charts to allow predictions to be made, which he called "forecasting the weather", thus coining the term "weather forecast".¹⁵ Fifteen land stations were established to use the telegraph to transmit to him daily reports of weather at set times leading to the first gale warning service. His warning service for shipping was initiated in February 1861, with the use of telegraph communications. The first daily weather forecasts were published in *The Times* in 1861. In the following year a system was introduced of hoisting storm warning cones at the principal ports when a gale was expected.¹⁶ The "Weather Book" which Fitz Roy published in 1863 was far in advance of the scientific opinion of the time.

As the electric telegraph network expanded, allowing for the more rapid dissemination of warnings, a national observational network was developed, which could then be used to provide synoptic analyses. Instruments to continuously record variations in meteorological parameters using photography were supplied

to the observing stations from Kew Observatory – these cameras had been invented by Francis Ronalds in 1845 and his barograph had earlier been used by Fitz Roy.¹⁷ To convey accurate information, it soon became necessary to have a standard vocabulary describing clouds; this was achieved by means of a series of classifications first achieved by Luke Howard in 1802, and standardized in the International Cloud Atlas of 1896.¹⁸

It was not until the 20th century that advances in the understanding of atmospheric physics led to the foundation of modern numerical weather prediction. In 1922, English scientist Lewis Fry Richardson published “Weather Prediction by Numerical Process” after finding notes and derivations he worked on as an ambulance driver in World War I. He described therein how small terms in the prognostic fluid dynamics equations governing atmospheric flow could be neglected, and a finite differencing scheme in time and space could be devised, to allow numerical prediction solutions to be found.¹⁹

Richardson envisioned a large auditorium of thousands of people performing the calculations and passing them to others. However, the sheer number of calculations required was too large to be completed without the use of computers, and the size of the grid and time steps led to unrealistic results in deepening systems.²⁰ It was later found, through numerical analysis, that this was due to numerical instability.²¹ The first computerised weather forecast was performed by a team composed of American meteorologists Jule Charney, Philip Thompson, Larry Gates, and Norwegian meteorologist Ragnar Fjørtoft, applied mathematician John von Neumann, and ENIAC programmer Klara Dan von Neumann. Practical use of numerical weather prediction began in 1955 spurred by the development of programmable electronic computers.²²

The first ever daily weather forecasts were published in *The Times* on August 1, 1861, and the first weather maps were produced later in the same year.²³ In 1911, the Met Office began issuing the first marine weather forecasts via radio transmission. These included gale and storm warnings for areas around Great Britain.²⁴ In the United States, the first public radio forecasts were made in 1925 by Edward B. “E.B.” Rideout, on WEEI, the Edison Electric Illuminating station in Boston. Rideout came from the U.S. Weather Bureau, as did WBZ weather forecaster G. Harold Noyes in 1931.²⁵

The world’s first televised weather forecasts, including the use of weather maps, were experimentally broadcast by the BBC in 1936. This was brought into practice in 1949 after World War II. George Cowling gave the first weather forecast while being televised in front of the map in 1954. In America, experimental television forecasts were made by James C. Fidler in Cincinnati in either 1940 or 1947 on the DuMont Television Network. In the late 1970s and early 80s, John Coleman, the first weatherman on ABC-TV’s *Good Morning America*, pioneered the use of on-screen weather satellite information and computer graphics for television forecasts. Coleman was a co-founder of *The Weather Channel* (TWC) in 1982. TWC is now a 24-hour cable network. Some weather channels have started broadcasting on live broadcasting programs such as YouTube and Periscope to reach more viewers.²⁶

Meteorological Services in Nigeria

The observation and collection of Nigerian meteorological data started in 1892 as an agricultural station under the then Public Works Department. It was about forty years later that a full-fledged Meteorological Department was established in the country. The Nigerian Meteorological Department started operations in 1937 as the main agency responsible for all forms of weather-observations in the country. Several ministries have supervised the Department's activities, including the Ministry of Communications in 1952, Transport in 1953 and the present Ministry of Aviation. The movements of the Department from one Ministry to the other over the years are without doubt, connected with the multi-sectoral relevance of the data they generate.²⁷

Today, there is the Nigerian Meteorological Agency, a parastatal of the Ministry of Aviation. Nevertheless, it was about forty years later before a full-fledged operational Meteorological Services Department was established in the country in 1937 as one of the seven (7) Departments of Colonial Government in Nigeria, to provide essential public services during the British colonial government. It was the sole department responsible for all forms of weather-observations in the country. Although meteorological services in Nigeria started as agricultural station, following the outbreak of World War II in the 1940s, which turned African region, into recruitment ground for support command, meteorology received increasing attention in the aviation sector in West Africa, Nigeria inclusive. All because the airlifting of men and materials during the war, require weather briefing for the pilots to have successful flights.²⁸

The modernization of meteorological services in Nigeria has been one of gradual process since then, driven mainly by growing environmental challenges, user requirements and available technical support over the years, as a result of the evolving trend in information and communications technology (ICT). For example, the severe drought of 1969 to 1973 raised significant concerns, which led to the meeting of Heads of Government of the West Africa; subsequent call for better understanding of weather and climate of the region and its variabilities.²⁹ Following this call, coupled with the recognition of meteorology as corner piece for nation building, efforts were doubled to improve on the state of the weather observing network of stations in the country; as well as the transformation of the Department of Meteorological Services into a semi-autonomous Agency with a legal framework and corporate headquarters building.

Nigerian Meteorological Agency and Establishment of the Legal Framework

With the defunct of the Nigerian Meteorological Services Department and emergence Nigerian Meteorological Agency (NIMET) in June 2003, as a parastatal of then Federal Ministry of Aviation (now Transportation), an Act of the National Assembly (NIMET Establishment Act No. 23 of 2003) was established. The Act of the parliament was to provide legal framework to give impetus to meteorological services in the country. The Agency was set up among other things, to carry out weather 3 observation in Nigeria, as well as collect, process and disseminate all meteorological data and information within and outside the country. Furthermore,

the Agency has the mandate to ensure uniform standard of observations of all meteorological phenomenon in the country, as well as ensure that international standards and practices in meteorological operations are not compromised. Since the inception of the Agency in 2003, NIMET has remained successful in the continued modernization process of meteorological services in the country over the space of 14 years. The drivers of the modernization process inter alia are;

- (i) Strong financial resources base provided by the Federal Government and through internally generated revenue (IGR) of the Agency,
- (ii) Long-term and stepwise developments/investments that are centered at advancing science and technology with verifications and improvements, and
- (iii) Long-term, sustainable human capital development to foster highly educated experts that are capable of handling cutting edge science and technology.

Methods of Data Storage and Dissemination

After the preliminary quality checks on the observed data by the respective station/State/zonal meteorological inspectors, the data are transferred to the Climate Returns Section at Oshodi. Here the data are further subjected to more comprehensive quality checks before transferring them to their final repository in the National Climatological Archives Investigation Section. This section is responsible for storing the data in manuscript forms, kalamazoos, and supplying information on them on demand. It is located at the Meteorological Services Headquarters in Lagos. In addition to the foregoing, a few of the data have been microfilmed, while a substantial amount (particularly those of the synoptic stations) now exist in computerised form.

The data base management software presently used for this is DATAEASE which is employed in the CLICOM (climate computing) system acquired by the Department in 1990. The system was developed by the World Meteorological Organisation (WMO) in 1984 to aid the standardization of the climate data storage and exchange within its member-countries. Data processing/analysis packages like LOTUS and INSTAT are also used at the computer centre. Dissemination of the data/information are in the form of preparation of publications or periodicals, namely:

Monthly Rainfall Summary (from January 1951).

Monthly Weather Report (from January 1949).

Annual Summary of Observations (from 1949).

Agro-Meteorological Bulletins (from August 1962).

Additional materials are published from time to time in two series of occasional publications:

Meteorological Notes.

Technical Notes.

The Development of Meteorological Services in Nigeria

Nigerian Meteorological Agency (NIMET) is posed to be a World Class provider of Weather and Climate services for safety and sustainable national socio-economic development and also to observe Nigerian Weather and Climate and provide Meteorological, Hydrological and Oceanographic services in support of National needs and international obligations. The key mandate of the Agency is observing, analyzing, timely and accurate reporting of weather and climate information for socio-economic development and safety of lives and property. These are the operational structure for effective service delivery:

- i. The Corporate Headquarters in Abuja is located at the National Weather Forecasting and Climate Research Centre Abuja
- ii. National Weather Forecasting and Climate Research Centre, Abuja
- iii. Fabrication workshop at NiMet Complex, Oshodi.
- iv. WMO Regional Training Centre, Oshodi Lagos
- v. 6 Zonal offices (Enugu, Ibadan, Kaduna, Kano, Maiduguri and Port Harcourt)
- vi. 1 Central Forecast Office, Abuja
- vii. 4 Independent Forecast Offices (Abuja, Ikeja, Kano and Port Harcourt)
- viii. 54 Synoptic Stations spread all over Nigeria
- ix. Instrument Calibration Laboratory, Abuja
- x. 1 Agro-meteorological Experimental Farm (Oshodi, Lagos)
- xi. 8 Upper Air Stations (Abuja, Enugu, Lagos, Kano and Maiduguri, Jos, Calabar and Yola)
- xii. 30 Automatic Weather Stations (Received additional 37 by TAHMO)
- xiii. 12 Marine Stations, Calabar, Eket, Niomr and Koko (operational). Eastmole, Aiyetoro, Warri, Onne, PH Wharf, Apapa, Bonny, Forcados.
- xiv. 6 Radar stations (Abuja, Port Harcourt [Operational], Yola, Maiduguri, Kano and Lagos)
- xv. 4 Air Quality and Ozone monitoring station (Abuja, Lagos, Enugu, Kano)

Key Innovations and Initiatives

The Agency has developed over time to become a World class meteorological agency. These are some of the innovations achieved:

- i. Technology To improve the capacity to track hazardous weather system, provide early warning system to pilots and the general public and provide accurate and timely weather forecast, the Agency procured and installed 6 Doppler Weather Radar
- ii. The Nigerian Meteorological Agency (NIMET) is equipped with EUMETSAT ground receivers at the main forecast offices
- iii. The installation of Low Level Windshear Alert System (LLWAS) at Lagos, Kano, Port Harcourt and Calabar and other Airports. The Low Level Windshear Alert System (LLWAS) measures wind speed and direction at remote sensor station sites situated around an airport and can generate warnings when wind shear or micro-bust conditions are detected The LLWAS assists pilots during critical times when they must determine whether to attempt to land or take off in hazardous weather conditions.

- iv. Upper Air Weather Measurements. The Nigerian Meteorological Agency presently operates a network of eight upper air stations across the country. These are located at Abuja, Calabar, Enugu, Jos, Kano, Lagos, Maiduguri and Yola. Upper Air Sounding (or Observation) is used for measuring weather parameters at different altitudes in the atmosphere. It uses a set of sensors, known as radiosonde, attached to a hydrogen-filled balloon and released into the atmosphere.
- v. The Thunderstorm and Lightning detector device detects electrical discharges associated with lightning within a 200 nautical mile radius of the system.
- vi. Integrated AWODS installed in 14 locations Key Innovations & Initiatives: Technology It measures cloud height, cloud base, runway horizontal visibility, wind speed, wind direction, temperature, pressure, precipitation, humidity, radiation, thunder and lightning. Presently, NIMET Provide daily Weather Forecasting Services to Liberia and Sierra Leone under our Technical Assistance Program.
- vii. The Data Management, Information and Communication Technology (ICT) Unit designed to enhance data collection, processing, storage and application for product generation in the different areas of meteorology. Data Management Infrastructure. The Data Management Center receives real time numerical and satellite data for processing, archiving and dissemination to various end users.
- viii. NIMET also has a data buoy anchored off Lagos coast. Hourly marine weather data obtained from these stations are built into the production of daily marine forecasts.
- ix. NIMET has complied with best practices by certifying its aeronautical meteorological services : ISO 9001:2015 certified (the first African Country to have achieved that) NiMet is remodeling the fabrication and calibration laboratory in readiness for ISO : 17025 certification
- x. NIMET, recently signed an MoU with a Dutch Consortium- TAHMO for the installation of a robust network of 1000 AWOS in Nigeria for hydrometeorological monitoring. Under this partnership, the Agency, on 8th October, 2017 received 37 Units at no cost to the Nigerian Government. These Units are being immediately installed across the country (34 in universities) to significantly increase the density of NIMET's observatories and quality of services.
- xi. During the last Africa Hydromet Forum in Addis Ababa, 12th-15th September, 2017 NIMET signed a Memorandum of Understanding (MoU) With an Austrian Partner- UBIMET, with the core aim to establish a long-term commercial partnership between the Parties for the purposes to enhance and tailor the quantity and quality of weather services and products for end-customers in Nigeria and NIMET's areas of responsibility. As part of this collaboration, UBIMET is currently installing 8 Lightning Detection System across the country to help monitor and issue Early Warning Systems (EWS) for extreme weather events.

In recognition of the need to step-down SRP vital information to grass root end users in the country, NIMET in collaboration with MARKETS II, a USAID funded project, organized an EA training of trainers across the country as part of the Agency's mandate to contribute to the Federal Government Agenda on reviving Agriculture for maximizing output and achieving food security and robust economic development. The SRP step down workshops took place in 18 States during the 2017 Growing Season. NIMET, in October, 2017 signed an MoU with the West African Service Centre on Climate Change Adaptive Land Use-WASCAL to increase observation stations density as well as developing refined tailor made weather/climate services in the country. Fallout of this noble collaboration, West African Science Service Center on Climate Change and Adapted Land Use (WASCAL) has donated 10 number AWOS (Automatic Weather Stations) which are to be integrated in the NIMET's existing observatories for improved services.

The overall spirit and objective of the MoU was to reach an agreement that brings mutual commercial benefit to both Kukua and NIMET. In addition, this Agreement brings benefit to Nigeria as a whole through both economies and societies. In pursuance of this collaboration the parties agree on the following Key Principles:

- a. Kukua and NIMET will collaborate for the enhancement of weather information across Nigeria.
- b. Automatic Weather Stations will be installed at telecom tower sites and maintained under the responsibility of Kukua and NIMET.
- c. NIMET will be a designated provider of ISO Standard Certifications regarding instrument precision and data. Despite the current giant stride to increase the number of observation stations across the country, due to the vast landmass of Nigeria, the number of these stations are grossly inadequate to address the challenges of climate variability and change. In light of the aforementioned, NIMET is collaborating with the 34 Universities to install and maintain standard weather observation stations across the length and breadth of the country. The data to be co-generated and co-shared for research and development in the Country.

The Agency is in collaboration with other Partners

- i. International Institute Of Tropical Agriculture (IITA): Climate Smart Agricultural Practices
- ii. International Fund for Agriculture (IFAD)-CASP Project On Climate Smart Agriculture and Farmers Associations Across The Country
- iii. Federal Ministry Of Agriculture
- iv. Institute of Agricultural Research, ABU, Zaria, Agricultural Insurance Organizations and Companies and Other Community Based Organizations/ Non-Governmental Organizations interested in Weather/Climate Services. The Nigerian Meteorological Agency (NIMET) have commenced the process of rescuing and digitizing its weather observational data stored in paper form. The data records spans for over a hundred years in some

stations. The National archive is located in Lagos (former headquarters of NIMET) and to some extent, is in relatively good condition. Unfortunately, many archives are in poor condition and not well organized and managed. The Nigeria Meteorological Agency has the responsibilities of securing this endangered national resource and is therefore looking for the best data rescue and digitization methods, including the most modern equipment that will be most effective and efficient to adopt in this rescue project³⁰.

Conclusion

NIMET evolved from colonial public service department which started in 1887 to a modern day technology driven weather service provider. Although NIMET is a parastatal under the Federal Ministry of Transportation(Aviation), the services provided by the Agency cut across other critical sectors of the economy such as Agriculture, Water Resources, Environment, Transport, Health, Defence, Tourism, Marine and so many other sectors. NIMET has witnessed massive infrastructural investment resulting to seamless service, accurate forecasting and real time reportage of weather information.

NIMET is driving towards a new paradigm of sustainability through partnerships for the purpose of increasing the Agency's IGR and reducing dependence on Government funding. NIMET has complied with best practices by certifying its aeronautical meteorological services: ISO 9001:2015 certified and is remodeling the fabrication and calibration laboratory in readiness for ISO 17025 certification.

Notes

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