

The following pages include a collection of inputs from some of the CDP-ET-TDs members, which gathers concrete successful examples and experiences at the national/regional level focusing on the engagement of academics and NMHSs staff on research, research transfer to operation, and application to improved operational delivery. From these valuable examples, potential strategies to further enhance the articulation between these communities can be explored.

Contribution from Prof. Odjugo, Peter Ovuyovwiroye A

RTC Nigeria – RA-I

1. Develop strategies to foster engagement of academic and NMHS staff at the local and regional levels on research and research transfer to operation and application to improved operational delivery:

a. RTC Nigeria has fostered engagement with the academia and NMHS operational staff. The first move was that the Nigerian Meteorological Agency (NiMet)/RTC visited different academic institutions (Universities, Polytechnics, Colleges of Education and Secondary Schools) and Research Institutes in Nigeria to discuss with them the need to foster collaborations in the areas of research and training. This move resulted in the signing of a Memorandum of Understanding between NiMet and many Academic and Research Institutions. NiMet started the implementation of the MoU with the establishment of synoptic weather stations free in Academic and Research Institutions. Presently, 130 synoptic weather stations have been established in Academic and Research Institutions free across Nigeria for the past five years. This has helped them greatly in attaining full accreditation from National accreditation bodies in Nigeria. Staff exchange between RTC and tertiary institutions in Nigeria has been going on over the years in the areas of training and research. Professorial Cadre Lecturers from the Universities are engaged to teach some of the courses (BIP-MT) in collaboration with the RTC Instructors. Such engagements encouraged both the students (BIT-MT) and the RTC Instructors to aim higher in attaining higher degrees and competency in the areas of Meteorology, Climatology, Hydrology and other Atmospheric Sciences. Moreover, the Universities send their Staff to RTC to be trained in different aspects of Meteorology most especially practical and hands-on operations. Again, the Universities, Polytechnics and Colleges of Education do send their Students to RTC for their annual internship/industrial training between 3 and 6 months to strengthen their practical skills and hands-on operations since RTC have a majority of the weather instruments and tools that are lacking in the tertiary institutions.

b. The Nigerian Meteorological Agency (NiMet) also foster engagement with the Secondary Schools as a means of catching them young to read the weather, climate and water-related disciplines like Meteorology, Climatology, Hydrology and Geography, etc, through a programme called “Young Meteorological Ambassadors”. It is an academic Club established in Secondary Schools, domiciled in the Department of Geography of the Schools. In each of the Secondary Schools, a weather Station is established for practical knowledge of weather and climate. NiMet Staff are sent to such schools to teach the Students topics in weather, water, climate and climate change as contained in their curriculum. The students are also engaged in community development in the area of

climate change mitigation and adaptation measures. Every year during the annual Seasonal Climate Prediction (SCP) of the Nigerian Meteorological Agency, the students under the auspices of the 'Young Meteorological Ambassadors' are engaged to stage a drama on any aspect of weather-man-environment relationships. This did not only add colour to the occasion but also send practical knowledge of the importance of weather and climate to man.

c. Only 5 Universities have been offering Meteorology at Graduate and Post Graduate levels in Nigeria for a long time. Since four years ago, RTC has been engaging the Universities that NiMet had MoU with on the need to establish the Department of Meteorology in their Universities. Today, the number has increased to 7 Universities offering Meteorology in Nigeria, at Graduate and Post Graduate levels.

d. RTC Nigeria just concluded the training of BIT-MT and BIP-M of Gambians in Banjul, The Gambia. It was a 4-year training programme whereby the Nigerian Meteorological Agency signed a MoU with the Gambian Meteorology so as to train their Meteorologists in their Country. Instructors were sent from Nigeria to The Gambia to train them at a highly subsidized rate. Moreover, RTC Nigeria is also involved in regional engagement through tuition-free programmes for WMO Fellowships from different countries in Africa. The 2021/2022 academic session for the tuition-free WMO Scholarships will end in December, 2022 and 2022/2023 will commence thereafter. It is a continuous process.

e. The research unit of RTC Nigeria established Research groups within the RTC and also in collaboration with Lecturers in the Universities on topical issues that can improve the capacity of the Instructors of the RTC and also enhance the operations of NiMet. RTC organizes monthly seminars whereby an individual or a group presents their research proposals or research findings. Lecturers from the Universities and NiMet Staff from the operational units are engaged both in research and also at the seminars. Such research collaborations have ended in the development of software like Aviatrix, Metease, Meteowiz, NiMet SCP App, among others that are used by RTC and the forecast offices. Most of the research engagements with the universities are published in reputable journals and textbooks. The current ongoing research engagement with the Universities is a research work on "Climate Change Impacts, Vulnerability, Mitigation and Adaptation in Nigeria". This study engaged 14 Lecturers (Experts) from 8 Universities working with the Staff of RTC, Nigeria and the NiMet operational Staff since 2021. The outcome which will be published as reports and textbooks will enhance the capacity and competence of NiMet Staff and will be very useful as a policy document for the Federal Government of Nigeria.

f. Initially, the research unit of RTC which is under the Directorate of Research and training was working independently of the operational research units domiciled in other Directorates of NiMet. So, synergizing the research output between RTC and the operational unit was not easy. But recently, NiMet Management made the coordination of Research from the operational personnel a sole responsibility of the Director of Research and Training. So, The Director of Research and training now coordinates operational staff and RTC Staff alongside those from the Universities and Research Institutes that have joint research with NiMet. The issues emanating from these researches form inputs into the designing and delivery of courses at RTC, adding up to greater efficiency, improved

learning and service delivery at both RTC and the NMHS. This approach, the RTC Nigeria, hope to extend to regional levels.

2. Make recommendations on how to foster systematic contributions from academia towards the enhancement of the research-to-operation continuum which should address approaches to the promotion of capacity development and service capabilities in weather, climate, hydrology and environment at regional levels through the promotion of collaboration and communication between regional centres such as Regional Specialized Centres, Regional Climate Centres, Regional Training Centres (RTCs), WMO

a. The RTCs and/or the NMHS should make collaborative moves with the Universities/Research Institutes in areas of research and training, sign MoU with them and work along the terms of the MoU. The result will be a success story as currently being experienced by RTC, Nigeria.

b. If possible, the RTCs and their NMHS should sponsor or at worst develop collaborative funding for most of their research activities with the academia. With this, the best brains can be brought together to foster researches that can help in operations as done by NiMet.

c. The RTCs should engage/employ those in academia either as adjunct Lecturer, Visiting Scholars, on Leave of Absence or on Sabbatical Leaves, etc. This will give ample time for at least one academic session of those in the academia teaching and making research together with the RTC Staff. NiMet has been engaging the Academia as Adjunct Lecturers and on Leave of Absence to assist the RTC in Research and Training.

d. The RTCs should also extend their engagement of academia to Secondary Schools so as to encourage them early enough to study disciplines like Meteorology, Climatology, Hydrology and other Atmospheric Sciences as currently being done by RTC, Nigeria.

Contribution from Dr. Somenath Dutta

India- RA-II

1. Regarding EC-73 Decision 9, Item: *“Engagement of academic and NMHS staff at the local and regional levels on research and research transfer to operation and application to improved operational delivery”*:

1a. RTCs/TCs run/managed by NMHS may be advised to include research activities (as project work) in their curricula of BIP-M/MT training. In the BIP-M training it can be a miniature of a complete research work and in case of BIP-MT it can be a review of a number of literatures on a given research topic. Academic people from academia and in-house resource persons of NMHS TC/RTCs may jointly supervise these works.

1b. RTCs/TCs may be advised/encouraged to approach Universities/academic institutions for recognising the training for UG/PG degree/Diploma. Resource persons of RTCs/TCs, possessed by the NMS, can be encouraged to enroll them as recognized research guides in the Universities/academic institutions.

At MTI, we run Advanced Meteorological Training Course & Forecasters training course, both are BIP-M compliance. In both courses project work is a compulsory subject. It consists of a report and a presentation to defend. The project work of the trainees of these courses is being supervised jointly by MTI resource persons and scientists from other relevant research institutes.

2. Regarding EC-73 Decision 9, Item: *“Review and update the current competency frameworks”*:

In India, the India Meteorological Department is the NMS. Its operational/scientific/technical personnel are mainly recruited in two channels, viz., at the staff cadre and at the officer cadres. Staff cadre people after being recruited undergo a training, viz., Integrated Meteorological Training Course, a BIP-MT compliance course. After successfully completing this training, these people work as Scientific Assistant, Aeronautical Met Observer, etc. After 10-15 years, as per organizational-cum-career progression requirement, they are being deputed for undergoing forecasters training course. Departmental people, being about 50+ years aged, find it difficult in clearing the compulsory training examinations, even though they are fine in the classroom discussion. Considering these difficulties, we may think of suggesting WMO to advise RTCs/TCs of NMHS to plan for alternative mode of training evaluation of the trainees, at least for elderly trainee with a regionally decided critical age.

Contribution from Dr. Carla Gulizia

Argentina, RA-III

1. “PREVENIR A 5-year project for the development of a flash flood early warning system in Argentina”. An early warning system will be developed including efficient communication tools such as a cell phone app and a web-portal. The system will be optimized and tested over two highly populated basins in Argentina. These two basins also present challenges with respect to monitoring, hydrometeorological modeling and social vulnerability. It consolidates a partnership including many institutions from Argentina and Japan are involved (in Argentina: Foreign Affairs Ministry, National Water Institute, National Meteorological Service (SMN), National Council for Scientific and Technological Research (CONICET). In Japan: RIKEN Center for Computational Science, Osaka University, ICHARM, Japan Meteorological Agency).

The ongoing initiatives related to forecast and warnings of flash floods events at the National Met. Service in Argentina (SMN) in cooperation with other relevant partners at national and regional levels have contributed to get at the stage for the collaboration between the institutions involved in the PREVENIR project including Japan colleagues.

The SMN Strategic Plan (2020-2023) considers, as its main priorities, the reduction of the societal consequences of high impact weather events and improvement of emergency management decision making by sharing meteorological information timely and effectively. This priority is aligned with the PREVENIR project goals. Besides, another priority of the SMN is to increase added value of meteorological information to benefit productivity and societal wellness.

PREVENIR also starts at a stage in which SMN has been already working for a while to improving its capacity in terms of infrastructure. For example, a project funded by the Ministry of Defense and the Ministry of Science and Technology in Argentina, in collaboration with personnel from the Research Centre of the Sea and the Atmosphere and University of Buenos Aires with the SMN, allowed the acquisition of the first supercomputer used at SMN for a short range of numerical weather prediction and the implementation of the first high-resolution ensemble-based numerical forecast system.

Finally, PREVENIR is based on the co-design of the forecast and warning system of flash floods events. The project aims to improve the precision and effectiveness of flash flood events warnings and to establish channels for the efficient communication of these warnings to different users.

PREVENIR among other working packages (WP) includes “professional and scientific capacity building on urban hydro-meteorological forecasting”. The activities of this WP will include scientific training, collection of good practices, capacity development to forecasters at the nowcasting offices, particularly with the objective of how to deliver hydrological meteorological forecasts. In line with the latter, capacity development on articulating language, practices, culture between hydrological and meteorological communities will also be developed along the project.

2. A second project which engages both the operational and academic community that has recently kicked off is PronoMAr Forecasting the Argentinean Sea. The main

objective is the development and implementation of an operational ocean forecasting system system for the management and sustainable exploitation of marine resources: This project proposes the creation of an institutional network of science, technology and innovation organizations that will develop, implement, and provide support and continuity to a state-of-the-art sea level system for sea level and wave forecasting, in co-production with the National Meteorological Service (SMN). About 30 researchers and technicians from the institutions involved participate in PronoMAr.

Contribution from Prof. Dwikorita Karnawati

Indonesia - RA-V

1. BMKG experience in linking research with operational (strategy):

1. a. Ina NWP (Indonesia Numerical Weather Prediction)

Ina NWP is a local Numerical Weather prediction model that was developed by the researchers of BMKG Research and Development center. Monthly forums have been conducted to discuss the progress and update of the model among researchers, forecasters and academicians. The model has been customized for short-range and daily forecasts. Our forecasters found that it is very useful in helping them produce short term forecast including hourly, daily and weekly forecasts.

1.b. Coastal Inundation Forecasting System (CIFS)

It was started in 2013 as Indonesia planned to develop CIFS with the assistance of WMO through the Coastal Inundation Forecasting Demonstration Project. In national level, BMKG collaborate with the Center for Research and Development of Water Resources of the State Minister of Public Works and Public Housing (PUSAIR), the Directorate of Coastal Utilization of the Ministry of Maritime and Fisheries Affairs (KKP), the Preparedness Directorate of the Indonesian National Board for Disaster Management (BNPB), and the Center for Geodesy Control Nets and Geodynamics at the Indonesia Geospatial Information Agency (BIG). At the local level, as the implementation of this system is in two cities, therefore we collaborate with the local government of Jakarta and Semarang. CIFS has been implemented operationally in 2019 especially for the Jakarta region.

1.c. Dengue Fever Early Warning System

BMKG has developed the Dengue Fever Early Warning System from 2018 with collaboration with researchers, academics, and climatologists. BMKG together with the Jakarta Health Service and the Bandung Institute of Technology (ITB) collaborated to develop a climate-based early warning model for the spread of dengue fever. This system provides predictions of the incidence of dengue fever (per 100,000 of population) for the next three months and predictions of humidity (RH) available for the next five months. The humidity prediction map (relative humidity, RH) shows the probability of RH suitability for the dengue vector. The higher the probability, the higher the possibility of RH supporting the growth of the *Aedes Aegypti* mosquito which then results in an increase in the population infected with dengue fever. Right now, we are developing the same system in other regions.

2. Collaboration between RTC Indonesia and Philippines (Pagasa)

2.a. Training course on Impact-based forecast

Impact-based forecast (IBF) has been identified as a high priority by the WMO members to increase the relevance and utility of their NMHSs forecasts and warnings. Impact-forecasts emphasize what a hazard will do rather than what a hazard will be.

Implemented in BMKG since March 2019, this system is very suitable for countries that has a complexity in various aspects from topography to socio-culture, which varying the disaster impact in each region. Impact Based Forecast implementation needs human resources who have capabilities and competencies on how to operate equipment, to process data, to analyze and ensure its dissemination for public and stakeholder. Research takes a role in the development of the method in the risk and impact analysis.

In IBF training, participants are expected to be able to explain the concept of IBF and its implementation by showing best practices in Indonesia, and share material gained with the other colleagues in their countries and to be able to start planning the implementation of IBF in their countries. Some events were conducted namely: the IBF Course for RA-V Countries (7-8 December 2020), International Training on IBF for ASEAN (5 - 17 April), The IBF Course BMKG - Pagasa the Philippines (26 to 28 April 2021), with total number of participants is more than 100 participants, from more than 20 countries involved.

2.b. Training course on Ocean Forecast System

BMKG has started the development of the Ocean Forecast System in the Indonesian Sea, and in 2017 it was officially introduced as the BMKG Ocean Forecasts (OFS) System. The OFS provides crucial information on ocean circulation, sea temperature, ocean waves, ocean current, salinity and sea level in terms of provision of marine weather information and services. The training improves participant's competency in understanding ocean models and their skill to visualize and utilize OFS outputs as well as. This online training would be the Indonesia Specialized Training Center (OTGA-IOC) contribution in supporting Ocean Observation and Services (OOS) Programs. The next level of the OFS utilization is to understand coastal resilience in order to be able to mitigate the disaster risk. This course brings advanced practical and analytical knowledge of the OFS to approach and analyze coastal resilience, and then mitigate the disaster risk, during the extreme event, in particular. So far there were 2 OFS trainings conducted: The OFS Training Course (9-20 August 2022) and The OFS Coastal Resilience and Disaster Risk (15 August - 2 September 2022) with a total number of participants around 100 participants, from more than 20 countries.