

# **WORLD METEOROLOGICAL ORGANIZATION**

## **REPORT OF THE MEETING OF THE COMMISSION FOR BASIC SYSTEMS (CBS) TASK TEAM ON IMPACT OF MULTI-HAZARD PREDICTION AND COMMUNICATION (CBS TT-IMPACT)**

**GENEVA, SWITZERLAND, 16-18 FEBRUARY 2015**



***FINAL REPORT***

## 1. INTRODUCTION

At the extraordinary session of the Commission for Basic Systems (CBS-Ext.(2014), Asunción, Paraguay, September 2014), the Commission requested the Open Programme Area Group on Public Weather Services (OPAG/PWS) and the PWS Programme to work closely and assist Members with implementing impact-based forecasting and warning services through training workshops, and, where possible, pilot projects. In response to this request, the OPAG/PWS established the “CBS Impact of Multi-hazard Prediction and Communication Task Team (TT-IMPACT)”, a Task Team on Impact-based Forecasting, whose purpose was to promote and advance the development and implementation of Multi-hazard Impact-based Forecast and Warning Services by National Meteorological and Hydrological Services (NMHSs) and key partner agencies. This Task Team held its first meeting at the WMO headquarters in Geneva, Switzerland, from 16 to 18 February 2015.

The need to promote impact-based forecasting and warning services in NMHSs was endorsed by the sixty-fifth session of the Executive Council (Geneva, May 2013). The World Meteorological Organization (WMO) regional associations (RAs) also have embraced this approach to service delivery. Similarly, the World Weather Open Science Conference (Montreal, Canada, August 2014) supported the approach.

The TT-IMPACT meeting comprised representatives from a cross-section of stakeholders in impact-based warning service delivery including NMHSs, the health sector, The Global Facility for Disaster Reduction and Recovery (GFDRR)/The World Bank Group, humanitarian agencies (the United Nations Office for the Coordination of Humanitarian Affairs (OCHA)), private consulting service providers, social sciences and communication. The complete “Final List of Participants” is attached as Annex I to this report.

Among the main outcomes of the meeting was the emphasis on a pragmatic approach toward promoting impact-based forecast and warning service delivery in NMHSs. This approach would be characterized by practical implementation activities such as region- or country-specific pilot projects that would be scalable to other countries and regions.

The meeting also recognized that in implementing this approach, it would be necessary to align training requirements with the necessary skills, some of which are new and have therefore not been in the PWS Programme training priorities of WMO Members. Training areas which in the past have not been focused on are for example, change management and leadership. Training, to a great extent, will be guided by the “Competency Framework for PWS Forecasters and Advisors” developed by the PWS Programme.

The meeting also recognized that in implementing the impact-based forecasting, it would be important to apply guidance provided through “The WMO Strategy for Service Delivery and its Implementation Plan” (herein referred to as “the Strategy”), as the Strategy contains tools that could guide the practical implementation of impact-based forecasting. Presentations made at the meeting are accessible through the PWS website (See the Web links table below<sup>1</sup>).

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<sup>1</sup> Table of links to presentations made at the meeting:

<i>Title of Presentation:</i>	<i>Name of Presenter:</i>
<i>Translating weather forecasts into impact-relevant information .....</i>	<i>Dr Baode Chen</i>
<i>ETWCH forecasting systems Flood hazard Modeling .....</i>	<i>Prof. Kevin Horsburgh</i>
<i>Flood hazard Modeling .....</i>	<i>Dr Deepak Vatvani</i>
<i>Dam synchronization and flood releases in the Zambezi River Basin.....</i>	<i>Dr Deepak Vatvani</i>
<i>Public Weather Services (Introduction to Impact-Based Forecasting) .....</i>	<i>Mr Gerald Fleming</i>
<i>User-focus workshop group .....</i>	<i>Mr Gerald Fleming</i>
<i>Science Aspects for TT-IMPACT Plan Development .....</i>	<i>Mr Kenneth Mylne</i>
<i>Preparing for multi-hazard emergencies .....</i>	<i>Prof. Virginia Murray</i>
<i>Impact -Based Warning for Severe Weather Events .....</i>	<i>Mr Peter Muller</i>
<i>QGIS, InaSAFE and OpenStreetMap for Impact .....</i>	<i>Dr Richard James</i>
<i>Impact Forecast and Warning Services – GFDRR and WB activities .....</i>	<i>Dr David Rogers and Dr Vladimir Tsirkunov</i>
<i>How best to develop and receive impact service .....</i>	<i>Ms Sandy Song</i>
<i>The WMO Severe Weather Forecasting Demonstration Project .....</i>	<i>Mr Kenneth Mylne</i>

**2. ORGANIZATION OF THE MEETING**

- 2.1 The Meeting reviewed and adopted the agenda.
- 2.2 The Meeting agreed on its working hours as 0900 to 1700 hours. Appropriate time was allowed for coffee and lunch breaks.

**3. BACKGROUND TO DISCUSSIONS ON IMPACT-BASED FORECASTING**

- 3.1 The discussions that followed a presentation on the decisions of CBS-Ext.(2014) on the establishment of the Task Team, highlighted a few important points as shown below:
  - a) Some NMHSs continue a traditional approach when dealing with users. One example is the reluctance to use probability, yet most users would understand the concept as many of them employ professionals with scientific background;
  - b) The responsibility of NMHSs is limited to national boundaries, while humanitarian agencies such as OCHA and the United Nations World Food Programme (WFP), as a user group, work on global problems. There are many other issues as well which impede effective partnership and collaboration between NMHSs and the humanitarian agencies. There is an urgent need for dialogue between the two to better understand each other’s requirements, and capabilities to respond to those requirements. The lack of such a dialogue has led to situations whereby those agencies have chosen to turn to private sector service providers or employ their own meteorologists for tailor made information and services;
  - c) Scientific information is available with NMHSs, but often, it does not reach responders or communities at risk in the right format and in a manner that is understandable for Disaster Management (DM) decision-makers and operational responders, as well as communities at risk that can prepare and protect themselves. Interpretation of the scientific analysis and appropriate communication is key;
  - d) For the impact-based forecast and warning services to succeed, specific focus should be directed to assisting and encouraging NMHSs to engage with users. This should be a strong component in capacity building. Developing guidelines in this area was

recommended. One example of a successful engagement is that between the UK Met Office and the health sector;

- e) One of the challenges in adopting impact-based forecast and warning services is around uncertainty and the need to issue warnings while avoiding false alarms; and
- f) NMHSs need to focus on multi-hazard aspects of weather events such as combination of wind and rainfall. This new approach differs from the more traditional one that focuses on one hazard at a time.

3.2 Other presentations addressing different user groups generated discussions which resulted in the following points:

- a) In developing impact-based forecast and warning services, NMHSs need to engage with partners for access to exposure and vulnerability data and information. Some NMHSs may have access to such data but lack skills or capacity to make best use of it. Consequently, capacity in NMHSs needs to be built on making use of this data;
- b) Good forecasts and warnings without information on impacts may not engender appropriate action by a community at risk;
- c) A collection of cases where impact-based forecast and warnings led to effective response by users, as well as those that did not work so well would provide examples for use in training as well as putting forward arguments for advocating impact-based forecast and warning services;
- d) The health community has come to appreciate that they respond better to hazards when they know the likely impacts as opposed to working purely with information on the intensity of a hazard; and
- e) The impact-based forecasting and warning initiative should leverage the opportunity offered by Post-2015 Framework for Disaster Risk Reduction to garner support.

#### **4. REVIEW OF THE “WMO GUIDELINES ON IMPACT-BASED FORECAST AND WARNING SERVICES”**

The meeting reviewed the guidelines (not a technical standards document), being conscious of the fact that these had been approved by CBS and in the final stages of being printed and therefore no major changes could be made to the publication. However, the meeting provided some input from the scientific (technical aspects) and user-focus perspectives, for a future expanded version of the guidelines. The main findings on each perspective are summarized below.

##### **4.1 Scientific perspective**

###### **4.1.1 *Uncertainty***

There is a need to strengthen the sections of the guidelines dealing with uncertainty in order to bring out facts such as: the importance of ensemble forecasting in providing information on model forecast capability, thus increasing the usage of the forecast; the uncertainty emanating from translating hazard to impact, which may increase or decrease uncertainty for a decision; how uncertainty varies with each level of likely hazard impact: a low level of uncertainty in a hazard can lead to a huge uncertainty in impact; and to discuss the uncertainty inherent in the risk matrix.

#### **4.1.2 The Multi-Hazard Early Warning System (MHEWS)**

The draft guidelines need to be strengthened in the part dealing with MHEWS to bring out the following points: definitions of hazards; translation of weather into related hazards; the fact that non-weather hazards may have similar impacts as weather hazards hence the need for developing partnerships between hazards communities; and the effects of interdependency between different hazards, since interdependency could lead to similar or increased impacts.

#### **4.2 User-focus perspectives**

##### **4.2.1 Emphasis on Action**

The following points need to be emphasized in the guidelines: in implementing impact-based forecasting in NMHSs; there should be emphasis on the practical aspects rather than treating this subject as an academic exercise; the importance of working at gaining the confidence and commitment of communities at the local level hence the need to listen to, and work with, communities; and the importance of ensuring legislative backing; the need to ensure that impact-based services for public health were covered within the scope of the impact-based service delivery; promotion of the concept of impact-based forecasting among WMO Members should be the starting point of any plans to develop this concept; it is vital to determine who takes ownership and/or responsibility and accountability for impact-based forecasting at the national level; a bridging function should be built into the concept, bringing different actors with a role in the process together; evaluation of outcomes are very important and should be planned for in the impact-based forecasting and warning services project.

#### **5. MOZAMBIQUE PILOT PROJECT**

The meeting supported a pilot project on impact-based forecast and warning services in Mozambique as a proof of concept. It noted that some work towards implementing the Project had already been carried out and that there was a strong sense of ownership for the Project by the main national actors including the country's Meteorological Service (Instituto Nacional de Meteorologia, INAM), National Hydrological Service (National Water Directorate/Regional Water Administration DNA/ARAs) and National Disasters Management Institute (Instituto Nacional de Gestão de Calamidades (INGC) agencies. All agencies were found to be committed to implement the Project. Annex II contains more details of the discussion at the meeting on "The Impact-based forecast and warning services Project for Mozambique".

#### **6. TERMS OF REFERENCE (TOR) OF THE TT-IMPACT**

The TT-IMPACT reviewed and adopted the Terms of Reference (TOR) as agreed to at CBS-Ext.(2014) as contained in Annex III to this report.

#### **7. COORDINATION WITH AND SUPPORT FROM OTHER EFFORTS TO THE IMPACT-BASED FORECASTING INITIATIVE**

The meeting recognized the need to ensure that the impact-based forecast and warning initiative was supported by other efforts that were under implementation by Members. In this regard, the WMO Severe Weather Forecasting Demonstration Project (SWFDP), Flash Flood Guidance System (FFGS), and the WMO Coastal Inundation Forecasting Demonstration Project (CIFDP) were recognized as efforts that had the potential to provide support to the impact-based forecasting initiative.

The meeting also reviewed technical tools that could be deployed in the area of developing hazard impact forecasts and warning services, as they are essential ingredients to the initiative. The tools include mapping and display tools among others. Details of discussions on these tools are provided in section 7.4.

### **7.1 The Severe Weather Forecasting Demonstration Project (SWFDP)**

The SWFDP has the potential to provide primary support to impact-based forecasting in all the regions where the Project has been or is in the process of being implemented. The role of the Regional Specialized Meteorological Centres (RSMCs), which are involved in SWFDP, will need to be enhanced with a view to supporting development of NMHSs towards providing impact-based services. A list of suggested enhancements is included in Annex II to this report.

### **7.2 Flash Flood Guidance System (FFGS)**

The FFGS provides operational forecasters and disaster management agencies with real-time informational guidance products pertaining to the threat of small-scale flash flooding throughout a specified region. The FFGS could be integrated into the SWFDP to the extent of using enhanced digital data sources proposed above to also drive FFGS. This would particularly involve convection-permitting forecast data and use of WMS map layers.

### **7.3 The WMO Coastal Inundation Forecasting Demonstration Project (CIFDP)**

The WMO CIFDP is shared between the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) and the WMO Commission for Hydrology (CHy). Its purpose is to provide coastal communities with safety and socio-economic sustainability (see Annex II for more detailed description of this Project).

### **7.4 Tools to enable hazard impact-based forecasts**

The meeting reviewed the tools that could enable impact-based forecasts. Impact-based forecasts require information on hazard, exposure, and vulnerability. Exposure data could come from for example, OpenStreetMap. OpenStreetMap is an open data mapping tool built by a community of mappers that contribute and maintain data about roads, trails, cafés, railway stations, and much more, all over the world. It emphasizes promoting local knowledge. OpenStreetMap and three open source software tools, GeoNode, QGIS, and InaSAFE, could form the basis for combining forecasts with exposure and vulnerability data to support the development of impact-based forecasts. Annex II to this report provides more information on how these tools could be applied.

## **8. ENGAGEMENT WITH THE EFFORT**

The meeting agreed to participate in the implementation of impact-based forecast and warning services, and to specifically engage in pilot projects such as are planned in China, India, Mozambique, Myanmar and the Pacific region. They agreed that one immediate action that they could engage in is the collection and publication of best practices.

## **9. TRAINING**

The meeting recognized that in implementing impact-based forecasting, it would be necessary to align training requirements with the new skill-sets that would be required. Training would therefore, be guided by the required skills set necessary for impact-based forecasting and warning. Training would also be inter-disciplinary and include weather forecasters, public weather services, Disaster Risk Reduction (DRR) Management and community engagement (as defined in the

“Competency Framework for PWS Forecasters and Advisors”). It would also include actors in advisory services, hydrology, health and geophysical science. As delivery of impact-based services will be a new service in many NMHSs, there will be a need to train in ‘change management’ and in ‘leadership’.

## **10. THE PROPOSED TT-IMPACT STRUCTURE**

During the meeting, a structure for Task Team was proposed (see Annex IV to this report). The proposed structure comprises: the IMPACT Advisory Group (IAG) to be formed under the CBS OPAG/PWS; Project Groups; Development partners and donors; and a Resource Network. The composition and Terms of Reference (TOR) of the IMPACT Advisory Group, as well as the expertise required within the Resource Network are provided in Annex IV as well.

Under this proposed structure, the IAG will be a sub-set of TT-IMPACT which will report to OPAG/PWS. The chair of IAG (and TT-IMPACT) will become a member of ICT-PWS OPAG and the chair of OPAG -PWS will report to CBS on behalf of the TT-IMPACT as is done now with expert teams in PWS.

It was agreed that this proposed structure would be presented to the Management Group (MG) of CBS for endorsement.

## **11. CLOSURE OF THE MEETING**

The meeting closed at 1700 hours on Wednesday, 18 February 2015.

**MEETING OF THE COMMISSION FOR BASIC SYSTEMS TASK TEAM ON IMPACT  
OF MULTI-HAZARD PREDICTION AND COMMUNICATION (CBS TT-IMPACT)**

**WMO HEADQUARTERS, GENEVA, SWITZERLAND, 16-18 FEBRUARY 2015**

**LIST OF ANNEXES TO THE FINAL REPORT**

- ANNEX I:** “Final List of Meeting Participants”
- ANNEX II:** “The Impact-Based Forecast and Warning Services Project for Mozambique”
- ANNEX III:** “Terms of Reference (TOR) of the CBS TT-IMPACT”
- ANNEX IV:** “Proposed Structure for the CBS TT-IMPACT”



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## **“THE IMPACT-BASED FORECAST AND WARNING SERVICES PROJECT FOR MOZAMBIQUE”**

### **1. BACKGROUND**

The Commission for Basic systems (CBS) Impact of Multi-hazard Prediction and Communication Task Team (CBS TT-IMPACT) held its first meeting in Geneva, Switzerland, 16–18 February 2015. Among other decisions, the Task Team agreed on participating in the project on impact-based forecasting in Mozambique. The country was found suitable for the project due to the following reasons:

- a) Mozambique is highly vulnerable to a range of hazards particularly floods;
- b) The country’s Meteorological Service, National Hydrological Service and Disaster Risk Management agencies are committed to implement the Project;
- c) These agencies are participating in the Severe Weather Forecasting and Demonstration Project and the Flash Flood Guidance System;
- d) Resources from the World Bank Group and donors are available to implement the Project; and
- e) This is a fitting opportunity to demonstrate substantial contribution to the Post-2015 Framework on Disaster Risk Reduction of the United Nations International Strategy for Disaster Reduction (UNISDR), in which Member countries are calling for capacity building.

### **2. THE STATUS OF THE PROJECT**

The status of the project is as follows:

- a) The Project launch workshop (November 2014), supported by WMO, UK Met Office and Global Facility for Disaster Reduction and Recovery (GFDRR) was successful and confirmed stakeholders commitment to the Project;
- b) Despite weak capacities of participating agencies, the overall picture is encouraging and Mozambique is a promising choice for the Project; and
- c) There is a need to reconcile response to hazards between the Government and the non-governmental organizations (NGOs) on the ground. The INGC uses information from the SWFDP website directly without involving INAM, which is supposed to provide interpretation and advice, while international agencies look for information internationally.

### **3. CONTRIBUTIONS TO THE MOZAMBIQUE PROJECT**

The meeting considered the contributions to the Mozambique Project that could be leveraged from various ongoing projects. It also heard about the tools that were currently available and could be deployed for use in hazard impact forecasts.

### **3.1 Severe Weather Forecasting Demonstration Project ([SWFDP](#))**

The SWFDP strengthens capacities of NMHSs of developing and least developed countries including Small Island Developing States (SIDSs) to deliver improved forecasts and warnings of severe weather. The Project has been established in the Bay of Bengal, Eastern Africa, South Pacific, Southeast Asia and Southern Africa. With the exception of Southern Africa Project, all the other projects are still in demonstration phase.

In order to effectively support the impact-based forecast and warning services project for Mozambique, the SWFDP will need to enhance the role for RSMC, Pretoria (Regional Centre), which supports INAM within the Project. It is already planned to run convection-permitting regional model in Pretoria for southern Africa, and this will be important in assisting the Mozambique Project. However, further enhancement of RSMC Pretoria, along the areas mentioned in paragraph 6.1 (b) to (e) of the report will be necessary. These include:

- a) Provision of digital data for use in impact;
- b) Produce guidance charts as Web Mapping Services (WMS) layers which can be ingested into a mapping tool to overlay with vulnerability fields;
- c) Generation of guidance based on a larger set of thresholds, for Mozambique, to support use of thresholds appropriate to impacts in countries; and
- d) Running translation models to propagate weather into impact-relevant hazards.

It will be necessary to investigate the possibility of securing access to high resolution modeling or ensemble data to enable the routine or event-specific running of a high resolution model or ensemble at convection-permitting scales. This would provide forecasts of heavy convective precipitation and resolved detail of tropical cyclones to drive wave and surge modeling for Mozambique. A global centre could further support the running of local surge/wave models. For this to happen, it would be necessary to develop a funded bilateral development project between Mozambique and a global centre (similar to that recently run between Rwanda and UK Met Office) that supports:

- a) Institutional development of INAM, including management structures, Quality Management System (QMS) culture, etc.;
- b) Training and mentoring of forecasters and PWS Advisers. The UK Met Office Global Guidance Unit (GGU) and training college could provide the training;
- c) Establishment of teleconference dialogue between Pretoria and INAM focusing on impact-based warnings;
- d) Developing relationships with DRCPAs in Mozambique;
- e) Identification of appropriate impact-based thresholds; and
- f) Establishment of effective communication of warnings, including anticipated impacts, to disaster reduction and civil protection agencies (DRCPAs).

The FFGS could be integrated into the SWFDP as is already happening in Southern Africa so it would be easily demonstrated in Mozambique. Enhanced digital data sources proposed above would be used to drive FFGS, particularly convection permitting forecast data and use of WMS map layers.

### **3.2 The WMO Coastal Inundation Forecasting Demonstration Project (CIFDP)**

The CIFDP has great potential to support the Mozambique impact-based forecasting project as it is designed to provide coastal communities with safety and social economic benefits. Under the Project, coastal inundation forecasting and warning systems are developed. The ongoing Sub-Projects are in Bangladesh, the Caribbean, Fiji and Indonesia. Planned Sub-Projects are in Shanghai and South Africa.

- a) The WMO CIFDP differs from SWFDP in that the Project is nationally based as opposed to SWFDP which is regionally based. It functions on the basis of national sub-projects. Whilst acknowledging that the national agreements underlying CIFDP do not easily extend to regional implementations, the technical approach of CIFDP (of bringing together a fit-for-purpose modeling system) is easily adapted to regional implementation;
- b) CIFDP delivers models and tools for forecasting to a country as opposed to SWFDP which delivers guidance products;
- c) Components considered in CIFDP include, as applicable: meteorological forcing, river, wave, surge and tide and inundation. Any of these model elements can be brought into a future application; and
- d) Key success factors of CIFDP are partnership (local and international) and sharing data: It is an essential part of building ownership and hence successful implementation of the Project. All projects are tailored to the exact requirements of the users and are based on extensive user consultation;
- e) Integration of the two projects (CIFDP and SWFDP) would take some time to implement, and should be carried out in a manner that avoids duplication. There should be a link to RSMCs to ensure access to the data so that the same global models are used to drive regional impact models. This can happen on a bilateral basis. From a technical perspective, it is feasible for a CIFDP-style model integration to physically reside at an RSMC and serve out forecasts to users. Naturally, the preferred approach would always be to deliver capacity building and training at national level wherever possible;
- f) The CIFDP is designed in such a way that it would be re-usable or adaptable from one country to another wherever possible; and
- g) The SWFDP, through the respective RSMC, could be involved in providing boundary conditions to CIFDP thus, form the cascading process.

Components considered in CIFDP include meteorological forcing, river, wave, surge and tide and inundation. Any of these model elements can be brought into the Mozambique Project. For example, the key success factors of CIFDP are partnership (local and international) and sharing of data. CIFDP sub-projects are based on extensive user consultation; hence they are bespoke, tailored to the requirements of the users.

### **3.3. Review of existing tools to enable hazard impact forecasts**

#### **3.3.1 The tools**

Impact forecasts require information on hazard, exposure, and vulnerability. Exposure data can come from a variety of sources. One of particular interest for Mozambique is OpenStreetMap. Vulnerability information could simply be based on the number of people, schools, hospitals, etc., that are likely to experience a specific weather impact (e.g., flooding, intense precipitation, extreme heat, etc.). One open data mapping tool, OpenStreetMap, and three open source software tools, GeoNode, QGIS, and InaSAFE, could form the basis for combining forecasts with exposure and vulnerability data to support the development of impact-based forecasts.

##### **a) OpenStreetMap**

OpenStreetMap emphasizes open data and is improved by local efforts. While it is unrealistic to map all of Mozambique in detail, one could generate a set of data on critical buildings. For example, GFDRR supported the development of spatial data on all schools in Mozambique. A similar effort could be used to generate map information on emergency evacuation routes, the location of hospitals, and centers for emergency management. Other global data resources could be used to generate data at selected administrative levels: for example, global population data could be used to generate information on population at the levels at which INAM and INGC operate.

##### **b) GeoNode**

GeoNode is a web-based application and platform for developing geographical information systems (GIS) and for deploying spatial data. It can be extended, modified, and integrated into existing platforms.

- The GeoNode, established by Mozambique, Moz Adapt, was developed by and for INGC, with support from the GFDRR and the World Bank Group;
- The site already hosts a variety of data on exposure and hazards for Mozambique; and
- To ensure continuous access and recovery tools, it could probably be hosted by a cloud provider.

##### **c) QGIS**

The QGIS is a GIS that can be installed on a desktop or web-server. The QGIS supports:

- Numerous vector, raster, and database formats and functionalities; and
- Many Open Geospatial Consortium (OGC) compliant formats/activities.

##### **d) InaSAFE**

InaSAFE is a QGIS plug-in that produces natural hazard impact scenarios for better planning, preparedness and response activities. It provides a simple but rigorous way to combine data from scientists, local governments and communities to provide insights into the likely impacts of future disaster events. The GFDRR has plans to create a web-based version of InaSAFE. This version of InaSAFE should make it possible to use web services to automatically import spatial data, for example, weather forecasts, for display using QGIS and for doing impact assessments using InaSAFE.



It should be noted that GFDRR is supporting Mozambique through a community mapping exercise to support the development of exposure data. It is also supporting a “Hackathon” to develop “apps” for supporting community resilience and disaster response. (A Hackathon is an event in which computer programmers and others involved in software development collaborate intensively on software projects)

### **3.3.2      *How the tools work together***

Impacts are determined through the integration of forecasts with exposure and vulnerability data and functions. This would entail the production (by RSMCs/other agencies) of appropriate products (shapefiles (i.e., geospatial vector data format for GIS software)/raster data/other format, TBD) that can be delivered through a web service. In principle, the forecast data would then be viewed using QGIS that pulls exposure data from a GeoNode. Impacts could be determined using the forecast and exposure data viewed through QGIS via expert opinion or through vulnerability functions implemented using InaSAFE.

## **4.            OTHER POINTS PERTINENT TO THE MOZAMBIQUE PROJECT**

- a)            Within the Project, there is a need to provide for the development of sufficient communication skills within INAM, especially for the service delivery staff who deal with users, including the media. An effective communication strategy would add needed visibility and credibility of INAM. These attributes are very important aspects to an NMHS as tools to attract institutional support and funding from the national treasury;
- b)            It would be beneficial to offer opportunities to the staff of INAM for Masters Degrees or PHDs, aligned to the Project. This would be an effective way of building capacity among young professionals and to ensure a sustainable and progressive future for the Project;
- c)            It would be useful to focus on training regional forecasters who speak directly to the users;
- d)            The Project is bringing together impact forecasting and coastal inundation which resonates well with post-2015 Framework on DRR and would be of interest to many organizations;
- e)            It is vital to build into the Project service delivery to the health sector, among others;
- f)            It is essential to work with local communities. A case study in this area would be beneficial to pursue;
- g)            There will be a need to build or strengthen communication channels (e.g. website) for INAM;
- h)            It would be advantageous to use a past extreme events and demonstrate how these models would perform in predicting it as a way of demonstrating impact-based warnings;
- i)            The Hong Kong Observatory (HKO) is ready to provide a video on extreme weather to Mozambique as part of public education and awareness campaign, for translation into Portuguese.

### “TERMS OF REFERENCE (TOR) OF THE CBS TT-IMPACT”

- 1) Design and develop a plan to assist Members in implementing the “WMO Guidelines on Multi-Hazard, Impact-based Forecast and Warnings Services” (MHIBFWS) using a multi-disciplinary approach within the framework of a Multi-Hazard Early Warning System (MHEWS);
- 2) Identify means to promote the concept of Multi-hazard Impact-based forecasts and warnings among Members;
- 3) Identify competencies and relevant training needs associated with the wider implementation of MHIBFWS.

Deliverables under each of these TOR are to be defined by the Team and reported to the Commission for Basic Systems (CBS= Management Group (MG) by the Chair of Open Programme Area Group on Public Weather Services (OPAG/PWS) and the Chair of the CBS Task Team on Impact of Multi-hazard Prediction and Communication (TT-IMPACT).

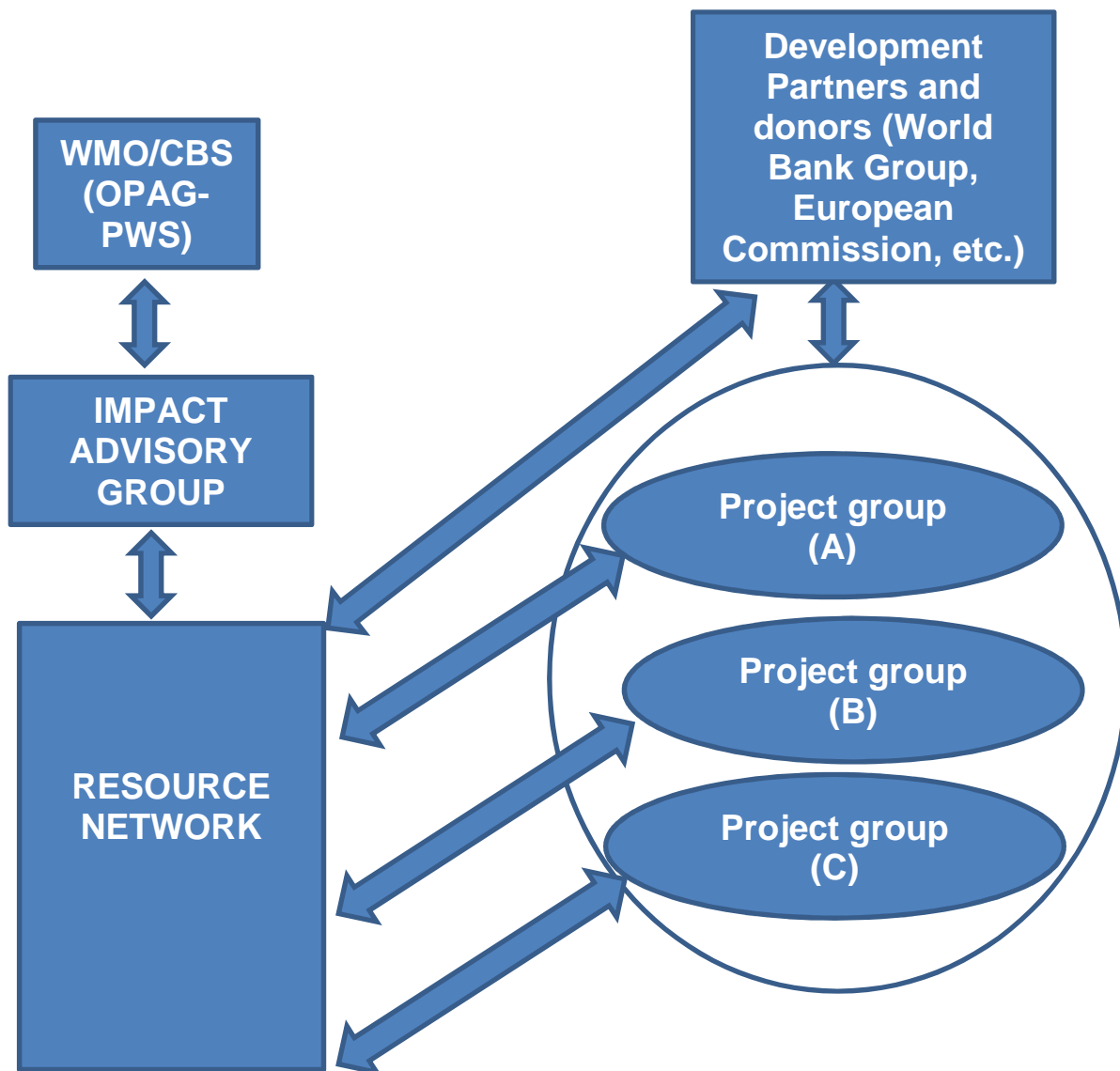
#### **In Scope:**

- i.) Establishing requirements for the development of modelling, technology and capacities to support the provision of Multi-Hazard Impact-Based Forecast and Warnings Services (MHIBFWS);
- ii.) Establishing requirements to monitor and capture information and data on impacts with a view to evaluating the quality of MHIBFWS;
- iii.) Researching and suggesting options for integrating MHIBFWS with existing service delivery initiatives such as the WMO Coastal Inundation Forecasting Demonstration Project (CIFDP) and the Severe Weather Forecasting and Demonstration Project (SWFDP);
- iv.) In addition to Disaster Risk Reduction (DRR) and emergency operations, identifying the benefit of MHIBFWS to other social and economic sectors, e.g., water resources, health;
- v.) Natural hazards that fall under the responsibility of National Meteorological and Hydrological Services (NMHSs) or related agencies (e.g., hydro-meteorological and geophysical in origin);
- vi.) Communication aspects related to MHIBFWS, especially with regard to mobilizing actions required for DRR;
- vii.) The possible impacts of climate projections, seasonal and sub-seasonal forecasts in enhancing the application of climate and weather services in a seamless manner;
- viii.) Making recommendations to the OPAG Chair and CBS MG in regard to establishing a sustainable approach to the work of the TT; and
- ix.) Exploring funding mechanisms for the sustainability of the initiative and allowing future developments.

**Out of Scope:**

- i.) Aeronautical Meteorology; and
- ii.) Chemical and Nuclear accidents and similar man-made hazards.

**“PROPOSED STRUCTURE FOR THE CBS TT-IMPACT”**



**1. THE STRUCTURE OF TT-IMPACT FOR DEVELOPMENT AND DELIVERY OF PROJECTS**

The proposed structure of the TT-IMPACT will comprise the: IMPACT Advisory Group (to be formed under the Commission for Basic Systems (CBS) Open Programme Area Group (OPAG) on Public Weather Services (PWS)); Project Groups; the development partners such as GFDRR/World Bank Group and donors; and a Resource Network.

### **1.1. The IMPACT Advisory Group (IAG)**

The IAG will be a sub-set of TT-IMPACT, which will report to the OPAG/PWS. The Chair of the IAG (and TT-IMPACT) will become a member of ICT-PWS OPAG and the Chair of OPAG/PWS will report to CBS on behalf of the TT-IMPACT as is done now with PWS Expert Teams (ETs).

### **1.2. Proposed Terms of Reference (TOR) for the IAG**

- a) Create, implement and manage a network of interdisciplinary expertise to support multi hazard, impact-based service developments and subsequent implementation;
- b) Review, prioritize and approve project proposals being assigned to the Advisory Group. For each project, the Advisory Group will ensure funding is appropriately identified with appropriate plans in place to monitor and control costs, skills and resource usage, and to account for these to funders;
- c) Provide guidance to Humanitarian Agencies (HAs), NMHSs and non-governmental organizations (NGOs) on the most appropriate/relevant weather, climate, multi- hazard and impact-based information, and also the advisory capability in impact-based information, to meet the needs of the HA and responder community;
- d) Help identify most appropriate partners to provide advice and information (possibly based around Regional Specialized Meteorological Centre (RSMCs)) and maintaining WMO's regional to national cascade philosophy;
- e) Provide linkage between HAs/NGOs and Project Groups on the requirements for capacity development/new science and resilience plans for rebuild;
- f) Set the strategic direction of the Advisory Group; and
- g) Promote and raise the visibility of the joint work and relationship arrangements within all participating organizations.

### **1.3. Membership**

The proposed Membership of the group will be as follows:

- a) Chair;
- b) Advisory Group Secretary;
- c) WMO representative;
- d) Global Facility for Disaster Reduction and Recovery (GFDRR)/World Bank Group representative;
- e) User representation (e.g., (the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA), or its equivalent);
- f) Communication/social science representative;
- g) Interdisciplinary scientist representative; and

h) Programme/Project Manager (TBC).

#### **1.4. Frequency of Meetings**

Meetings of the Advisory Group will be held once a year, with the possibility of an extra meeting, if required, and video conference and teleconference, when required.

#### **1.5. Standing Agenda**

- 1) Review actions and minutes of last meeting
- 2) Review progress to meet main deliverables of the programme of work
- 3) Review Balanced Score Card (programme metrics)
- 4) Future demands on resource and managing interdisciplinary network
- 5) Communications
- 6) Any Other Business (AOB)
- 7) Date of next meeting

#### **1.6. Expertise within the Resource Network**

The expertise to be sought for the Resource Network will include the following areas:

- Meteorology (weather and climate);
- Modelling: Numerical Weather Prediction/Ensemble Prediction System (NWP/EPS);
- Oceanography;
- Hydrology;
- Geophysical Sciences;
- Mapping: Global Information System (GIS);
- Social Science;
- Communications; and
- Disaster Risk Management (DRM).