



Technical Assistance – Implementation of Multi-Hazard Impact-based Forecasting and Early Warning System for the Belize River Watershed Project

TERMS OF REFERENCE

CONSULTANCY SERVICES FOR THE DEVELOPMENT OF A MULTI-HAZARD IMPACT-BASED FORECAST AND EARLY WARNING SYSTEM FOR THE NATIONAL METEOROLOGICAL SERVICE OF BELIZE

1. BACKGROUND

1.01 The initial stages of reducing disaster and climate risk and promoting a culture of disaster resilience lies in the knowledge of the hazards and the physical, social, economic, and environmental vulnerabilities to disasters that communities face, and of the ways in which hazards and vulnerabilities are changing in both the short and long term. These inform actions to be taken to reduce these risks and enhance resilience. The National Meteorological Service of Belize (NMS) is moving towards using multi-hazard impact-based forecast and early warning systems (MH-IBF-EWS) to communicate risks and potential impacts to the public and different sector end users. Through impact-based forecasting, a structured approach for combining hazard, exposure, and vulnerability data is utilised to identify risks and support decision-making, with the ultimate objective of encouraging early action that reduces damage and loss of life and property from natural hazards.

1.02 To move the process forward, the Government of Belize has secured funding from the Caribbean Development Bank to implement the project entitled Implementation of Multi-Hazard Impact-Based Forecast and Early Warning System for the Belize River Watershed. The project is being implemented between 2025 and 2026 with its expected outcome being improved institutional capacity of NMS and National Emergency Management Organization (NEMO) to deliver effectively early warnings and climate services. Key project outputs will include:

- i. Current observation network, modelling and analysis tools upgraded.
- ii. Risk analysis and vulnerability assessment and hazard maps.
- iii. Reliable and operational forecasting and warning system established.
- iv. NMS and NEMO staff EWS capacity improved, and
- v. NMS Climate Analysis Capabilities enhanced.

2. OBJECTIVES

2.01 The main objective of this consultancy is to facilitate the articulation and development of an MH-IBF-EWS framework based on the collective knowledge and experience of the forecasters at the NMS, the staff of the National Emergency Management Organization (NEMO) and other personnel of key stakeholder organizations, and to help put in place a functional MH-IBF-EWS framework and implementation plan.

3. SCOPE OF WORK

3.01 The Consultant will be engaged to develop and implement the MH-IBF-EWS for the Pilot Project, covering the Belize River Watershed and for hazards to be agreed upon with the NMS.

3.02 A methodological framework of impact-based forecasting will be developed and other application components such as PLUVO will be enhanced, and an impact-based forecasting software will be developed/procured and integrated with the SURFACE climate database. The web and mobile app interfaces being developed through the Resilient Rural Belize project with the Ministry of Agriculture, Food Security and Enterprise will be enhanced to incorporate other hazard alerts and warnings apart from drought and pest risk, and a user manual will be produced and published. The mobile app will support the development and implementation of a MH-IBF-EWS by assisting with the dissemination of warning messages.

3.03 More specifically, the consulting firm will report to the Project Coordinator. The team leader will ensure that a reliable and operational forecasting and warning system is established. The main tasks that the consulting firm will perform include:

(a) **Task 1: Inception Activities**

- (i) Convene an Inception Meeting with the NMS and NEMO to discuss the overall exercise and an initial mapping of key stakeholders.
- (ii) Undertake a preliminary desktop review of relevant documents in Belize and the region pertaining to Early Warning Systems, Disaster Risk Management, as well as early deliverables from the project.
- (iii) Based on the above, prepare and submit an Inception Report which include, inter alia, details the methodology/ approach to the assignment and an updated work plan.

(b) **Task 2: Multi-Hazard Impact-Based Forecast and Early Warning System Software/tool installed or designed, and Communication and Dissemination Enhanced**

- (i) Provide on-site assistance to NMS for a period of three months.
- (ii) Identify the required hazard monitoring and early warning services by utilising the information provided by the Risk Assessment and Hazard maps in the pilot area and identify the hazard(s) to be covered.
- (iii) Identify early warning information requirements and systems, procure, or develop impact-based forecasting software, coordinate relevant inputs, and recommend means by which to communicate risks and early warning information to the public for each hazard.
- (iv) Generate local probabilistic weather forecasts for heavy rainfall, strong wind, and extreme heat using numerical weather prediction (NWP) at the local level.
- (v) Establish MH-IBF-EWS supported by a knowledge and decision support system to aid in integrating climate risk information in local

planning and programming to increase the communities' risk reduction efforts and enhance their adaptive capacity.

- (vi) Define standard operating procedures (SOPs) for the preparation and communication of warnings and advice (technical meetings).
- (vii) Help develop SOPs and any other instruments as necessary (e.g. Memorandum of Understanding) to enable a successful collaborative partnership between NMS, NEMO and other relevant stakeholders.
- (viii) Develop impact-based forecast/warnings protocol from hazard to impact-based using collaborative approaches for the project sites to reduce potential impacts. (Tips issued to vulnerable population to deal with different forecasted hazards and potential impacts).
- (ix) Conduct meetings, table-top simulation exercises and working sessions between NMS, NEMO and other relevant stakeholders for the development of impact, hazard and response matrix tables which are primary to an MH-IBF-EWS system. Develop risk matrix with agreed risk levels and colour codes and accompanying general impact table and general response table for each hazard in collaboration with key national and local stakeholders.
- (x) Put in place an end-to-end MH-IBF-EWS framework and adopt/develop a comprehensive national policy on MH-IBF-EWS to guide the implementation of the framework by national government, local government units and all stakeholders nationwide and include consultation meetings.
- (xi) Conduct test warning exercises between NMS and NEMO and other relevant stakeholders, with a view to make the MH-IBF-EWS framework operational.

(c) **Task 3: Knowledge Sharing**

- (i) Develop a knowledge and decision support system for the implementation of MH-IBF-EWS.
- (ii) Plan and facilitate a follow-up workshop on MH-IBF-EWS providing refresher training on MH-IBF-EWS, including the basic knowledge of MH-IBF-EWS for NMS and NEMO Staff.

(d) **Task 4: Communication and Dissemination Enhanced**

- (i) Conduct an awareness survey to assess the percentage of the target population that is cognisant of the possible consequences and potential extreme weather hazards in their immediate area.
- (ii) Test and validate the impact and response tables of the project sites and plan for public awareness and education activities.

(e) **Task 5: Common Alerting Protocol implemented nationally.**

- (i) Conduct consultations with telecommunication providers (Digi Belize and Smart Belize) and multimedia companies (local media houses) on

message retrieval and dissemination procedures and design a Media Campaign (communications ads, videos etc.) on Common Alerting Protocol and Impact Based Forecasts issued and its messaging and interpretation.

- (ii) Identify and assess which public education and training programs are needed for early warning systems and impact-based forecasts and implement public awareness campaigns. This will require a pre-campaign survey to inform levels of knowledge in communities, access to MH-IBF-EWS information, best media channel, etc.
- (iii) Conduct a survey to assess the percentage of target population receiving alerts and responding favourably after implementation and conduct a simulation exercise using early warning system established and training.

4. QUALIFICATIONS AND EXPERIENCE

4.01 The consulting firm should possess at least the following:

General Experience:

- (a) Minimum five (5) years of experience leading teams on similar national level assignments.

Specific and Regional Experience

- (b) Demonstrated experience of having completed at least five (5) projects in the past 10 years (2016 – 2025) pertaining to MH-IBF-EWS, research, DRM planning, Climate Change Adaptation and Vulnerability Assessment.
- (c) Demonstrated experience of having successfully completed at least three (3) projects in MH-IBF-EWS, meteorology, disaster risk reduction, GIS applications, Earth Observations and related fields in the Caribbean or Central America.
- (d) Evidence of having conducted workshops, trainings, developing frameworks and implementation plans for at least 5 related projects over the past 10 years.
- (e) Excellent communication, analytical, presentation and reporting skills.

KEY EXPERTS

4.02 The team should consist of specialized members as reflected below.

Expert	Academic qualification	Experience
1. Lead Consultant	Minimum of a Master of Science degree in Meteorology, Applied Meteorology, Disaster Risk Management or a related field.	<ul style="list-style-type: none"> a. Minimum of 10 years professional experience pertaining to disaster risk management or Meteorology. b. Demonstrated experience leading teams in the formation of at least two (2) disaster risk management strategy plans and multi-

		<p>hazard impact-based early warning systems and managing complex, multi-disciplinary climate resilience and disaster risk assessment projects.</p> <p>c. Demonstrated skills in project planning, institutional and capacity development, and stakeholder facilitation, coupled with technical understanding gained through a career working in supporting meteorological and hydrological services and disaster management sector.</p>
2. Disaster and Climate Risk Management Expert	Minimum of a master's degree in environmental management, Climate Science or Disaster Risk Management, or a related field.	<p>a. Minimum of 7 years of experience providing technical advice in the development and implementation of policies and programmes in disaster risk reduction, disaster response and recovery, climate change adaptation or closely related fields.</p> <p>b. Proven experience in integrating disaster risk reduction (DRR) and climate change adaptation into infrastructure and development planning.</p> <p>c. Extensive experience in risk reduction and resilience building, including in risk assessments, early warning systems, preparedness initiatives, capacity building for national governments and other key stakeholders, mainstreaming risk reduction into development planning, and developing recovery and risk reduction plans and programmes.</p> <p>d. Experience of working on at least three (3) similar assignments in the Caribbean or Global South where it was necessary to work directly with governments and development partners.</p>
3. Weather and Climate Forecasting Expert	Minimum of a Master of Science degree in Meteorology, Climatology, Hydrology or Atmospheric Science.	<p>a. At least seven (7) years of experience in weather and climate forecasting, including experience with weather and climate models and data analysis.</p> <p>b. Proficiency in data analysis software, statistical modelling, and other relevant statistical tools</p> <p>c. Experience in the assessment of climate change impact and knowledge on climate risks and their modelling</p> <p>d. Relevant experience in developing tools for MH-IBF-EWS and climate.</p>
4. Impact-based Forecasting Early Warning	Master's degree in meteorology, hydrology,	<p>a. At least 10 years of experience in the areas of disaster risk assessment, early warning systems, hydrometeorological monitoring</p>

Systems Expert	environmental engineering, or related fields to hydrometeorological monitoring.	<p>and service provision, anticipatory action or disaster prevention.</p> <ul style="list-style-type: none"> b. Proficiency in meteorological prediction, hazard modelling, and data analysis is crucial for developing accurate forecasts and warnings. c. Understanding the various indicators that can predict the occurrence and impact of weather-related hazards is essential. d. Familiarity with decision support systems, thresholds, and probabilistic forecasts is necessary for making informed decisions during emergencies. e. Ability to work with various stakeholders and partners to create comprehensive early warning systems is important.
5. Stakeholder Engagement and Communication / Policy Expert	Minimum of a bachelor's in communications, Public Relations, Environmental Policy, or a closely related field.	<ul style="list-style-type: none"> a. 7 years of experience in convening and organizing multi-stakeholder engagement, facilitating public consultations and producing high-quality knowledge and policy products. b. Demonstrable experience of having prepared at least two awareness strategies related to MH-IBF-EWS or similar areas. c. Experience of leading or contributing to managing or creating coordination mechanisms at a strategic level for disaster risk reduction or early warning and action initiatives in a developing country is required. d. Direct work experience with at least one major government institution or international organization working on early warning/early action or disaster risk reduction/ risk knowledge is desirable. e. Proven track record working with government agencies, local communities, and development partners to communicate disaster risk and climate resilience strategies.

5. REPORTING AND DELIVERABLES

5.01 An inception meeting between the consulting firm and key personnel at the NMS and NEMO and other key agencies will be conducted to clarify the scope of the work and expected deliverable. Further consultations will be conducted particularly with NMS prior to preparing the Inception Report. The consulting firm will prepare the following deliverables as part of this assignment:

Deliverable/Report	Expected Timeline
a. Inception Report detailing the approach to be used in the execution of the Consultancy as well as a detailed work implementation plan.	Two (2) weeks after signing of the contract.
b. An outline of the MH-IBF-EWS Framework, including an Implementation Plan of MH- IBF-EWS at NMS, which should be compliant with World Meteorological Organization guidelines, and comprise inter alia the proposed method and resources to be utilised.	Two (2) months after signing of the contract.
c. Report on the operationalization of the MH-IBF-EWS Framework and Implementation Plan. Report should, inter-alia, also document lessons learnt and make recommendations for sustaining and scaling up the project in other parts of Belize.	Five (5) months after signing of the contract
d. Report on well-designed and facilitated training workshop. <ul style="list-style-type: none"> • Preparation of workshop training materials, delivery of training and preparation of a report summarizing the outcomes of the workshop. 	Six (6) months after signing of the contract
e. Report on Public Awareness	Seven (7) months after signing of the contract
f. Report on Common Alerting Protocol and EWS messages inclusive of results of survey to determine percentage of target population receiving alerts and responding favourably.	Eight (8) months after signing of the contract

5.02 All deliverables are to be submitted to the Project Coordinator via email in both Word and PDF versions.

6. DURATION

6.01 The level of effort required for this assignment is estimated at 200 consultancy days. The NMS will provide office accommodation, equipment and appropriate administrative support to the Consultant while in country.

7. LANGUAGE

7.01 All reports and other deliverables produced under this assignment shall be in English.

8. ADMINISTRATIVE INFORMATION

8.01 Contracting authority: The contract will be issued by the Ministry of Economic Transformation, Belize on behalf of the National Meteorological Service (NMS) of Belize. As such, the consultant will liaise directly with the Project Coordinator, who is based at the NMS.