Monitoring & Evaluation (M&E) Plan and Impact Statement Form

Objective of the M&E Plan and Impact Statement:

- The M&E Plan and Impact Statement must be designed based on the Technical Assistance Response Plan and must enable the Implementer to complete the Closure Report at the end of the assistance.

Process for filling in the form:

- The Implementer must identify relevant quantitative and qualitative indicators as specified in the Closure Report. A sub-set of indicators to monitor and assess must be chosen among these.
- The Implementer may also identify other specific, measurable, achievable, relevant, and time-bound indicators suitable to monitor Activities, Outputs and anticipated Outcomes from the technical assistance and add to the M&E Plan and Impact Statement.
- During implementation of the TA or FTA, the Implementer must collect all relevant data as described in the Monitoring & Evaluation Plan. Aggregated data on selected indicators as well as an updated version of the Impact Statement will be presented in the Closure Report at the end of the assistance.

Basic Information	
Title of response plan	**Development of Medium- to Long-Range Hydrologic Forecasting System for Ganges-Brahmaputra-Meghna River Basins**
Technical assistance reference number	**2023000003**
Country/ countries	**Bangladesh**
NDE focal point and organisation	Name : Dr. Abdul Hamid Position : Director General Organization : Department of Environment, Ministry of Environment, Forest and Climate Change Email : dg@doe.gov.bd Address : Poribesh Bhaban, E-16, Agargaon, Sher-e Bangla Nagar, Dhaka 1207, Bangladesh
Sector(s) addressed	**Medium- to Long-Range Flood Forecasting**

Technologies supported	**Subseasonal to Seasonal (S2S) forecast data and VIC-River routing model**
Implementation period and total duration	**1 year**
Total budget for implementation	**USD 150,655***
Designer of the response plan	POSTECH, Weatherpia
Implementer of response plan	POSTECH, Weatherpia

*This budget is the estimated cost for the entire Response Plan.

(A) Outputs and Activities as described in the Response Plan	(B) Indicator	(C) Expected results	(D) Method and frequency for data collection	(F) Comments
Output 1: Development of implementation planning and communication documents				
Activity 1.1: Formulation of deliverable documents	Number of documents related to planning and communication developed	• Detailed work plan • Monitoring and evaluation plan • CTCN Impact Description • Closure and Data Collection report	• Deliverable submission / Once for each	
Output 2: Creation of a steering committee, mapping of stakeholders and kick-off meeting				
Activity 2.1: Kick-off meeting	2 material and 1 Kick-off online meeting report	• Material used during the meeting • CTCN response plan • A meeting report for Kick-off meeting (in Korean)	• Deliverable submission / Once for each	Kick-off meeting with the CTCN, NDE, Bangladesh Water Development Board, POSTECH and Weatherpia
Output 3: Construction of 25-km resolution ECMWF S2S hydro-meteorological forecast data using VIC-River Routing model				
Activity 3.1: Construction of past hydrological reanalysis data and S2S weather/hydrological forecast data	Arrangement of forecast data	• Past river discharge data (1950-2022) and forecasted river discharge data	• Reanalysis data from ERA5 and weather forecast data from ECMWF S2S collection • Hydrological forecast data through VIC-River Routing model	ERA5 : The fifth generation ECMWF reanalysis for the global climate and weather for the past 8 decades ECMWF: European Center for Medium range Weather Forecast S2S: Subseasonal to Seasonal

Activity 3.2: Quantitative evaluation of simulated river discharge data by the VIC-River Routing model	Average or range of NSE and KGE values across the three observation points for long-term hydrological forecasts, disaggregated by observation period.	• Enhanced hydrological forecasting model	• Quantitative validation of the long-term hydrological forecast data • Observed daily river discharge data	
Activity 3.3: Verification of historical intra-seasonal and seasonal hydro-meteorological forecast data	Assessment for river discharge forecasts data	• Verification report for the intra-seasonal and seasonal hydro-meteorological forecast data based on ROC curve analysis	• Evaluation of the medium-term (15 days) and long-term (30 days) weather forecast by comparing the ECMWF S2S forecasts with the ERA5 reanalysis data • Assessment based on the ROC curve analysis	ROC: Receiver Operating Characteristic
Output 4: Workshops for technology transfer and strengthening disaster management stakeholder capacities				
Activity 4.1: Workshop for understanding the mid- and long-term flood forecast data (Workshops for technology transfer)	5 online workshop meetings for understanding the mid- and long-term flood forecast data, 1 workshop for technology transfer	• 5 online meeting reports (in Korean) • Tutorial manual for the median- and long-range hydrological forecasting system	• Post-workshop reports • Manual for Bangladesh stakeholders	
Activity 4.2: Capacity building workshop conducted for central and local government disaster management personnel	Capacity building workshop	• Increased climate-change related policy, planning, and disaster management capacity for the central and local government personnel	• Preparation of workshop materials • Survey • Post-workshop report	Ensure that the discussed policies are aligned with the country's direction for climate change adaptation
Activity 4.3: Establish a plan for developing an integrated dissemination system	Deliverables for dissemination system	• Report for developing an integrated dissemination system	• Deliverable submission / Once	
Output 5: Deriving proposal for subsequent project implementation and resource integration				

Activity 5.1: Establishing follow-up project plans for maximizing the effectiveness of TA and ensuring long-term sustainability	Concept Note based on the Technical Assistance Response Plan	• GCF Concept Note for follow-up business	• Deliverable submission at the end of the project / Once	The GCF concept note includes the following sections: a) Project/ programme information b) Indicative cost c) Theory of change diagram, map indicating the project location (optional)

Note: The Response Plan may contain information useful for the section below. The information in the table below will be used by the CTCN for public communication of the achieved and expected results of the Technical Assistance through the CTCN website www.ctc-n.org and other communication channels. See for example: https://www.ctc-n.org/sites/www.ctc-n.org/files/benin_a_ag_forestry.final_.pdf

Impact Statement	
Challenge	Current deterministic flood forecasts in Bangladesh are often insufficient and medium to long-range forecasts are required for effective planning and management. Even though forecast and warning messages reach national and district-level stakeholders, due to the deficient disseminating capacity, existing flood forecast, and warning are poorly disseminated to flood-prone communities. Even when the forecast reaches the community level, there is often a shortage of expertise to interpret and apply the forecast effectively.
CTCN assistance	• Aim of developing the Medium- to Long-Range Hydrologic Forecasting System for Ganges-Brahmaputra-Meghna River Basins by utilization of VIC-River Routing model • Calculates slope, flow direction, and river order to estimate river discharge, water movement at each grid points • Produce historical river discharge data, medium to long-term forecast data for flood forecast information • Establish an early warning system which could further expand to other regions/countries and support embodiment of adaptation planning
Anticipated impact	• Mitigation of flood and drought risks • Improvement of food security and livelihoods • Core Indicator 2: Anticipated increased economic, health, well-being, infrastructure and built environment, and ecosystems resilience to climate change impacts as a result of technical assistance. “Infrastructure and build environment”, as well as “Health and wellbeing” Is expected to be increased
Anticipated co-benefits from the TA	• Support for climate change adaptation by building resilience against climate change, extreme weather events and changing precipitation patterns • Enhanced water and food security by contributing clean water resource management and food production
Gender aspects of the TA	• Providing disaster knowledge for both men and women: This project offers knowledge on early warning systems and disaster response to both men and women, aiming to improve natural disaster responses and rescue more people in advance, benefiting the entire population.

	• Empowering women in disaster decision-making: The public awareness developed through this project will ensure that women, as well as men, are actively involved in making decisions and taking necessary actions during disaster responses. • Enhancing rescue interventions for vulnerable groups: The effectiveness of early warning systems and disaster response will particularly benefit women, especially those responsible for protecting the elderly and children, thereby reducing casualties during floods.
Anticipated contribution to NDC	• Median- and long-term (over 10 days) flood and floodgate predictions become possible, the forecasting, risk assessment capacity of local community can be increased, and thus the adaptation and preparation to flood disaster would be possible, based on the knowledge acquired by the technology. • By producing gridded data with a resolution of 9-km, it is possible to produce forecast data for all areas of Bangladesh, overcoming existing spatial limitations. • Through this project, early warning systems based on the data acquired by the presented technology could be implemented and structured in network with other collected data, to ensure a strong alert system within the covered area • Enhancement of the meteorological data collection and availability through this project, a key factor in the realization of the NDC goal • Contribution to water resource management, specified in the Bangladesh NDC, and food security improvement, by promoting sustainable agriculture
The narrative story	Bangladesh is highly susceptible to floods with approximately 20-30% of the country experiences flooding, which can escalate to 70% during catastrophic floods. This recurrent flooding could lead to loss of life, disruption of livelihoods, and significant damage to crops, livestock, and infrastructure. Over recent decades, factors such as climate change, population growth, and human activity on floodplains have made floods more frequent and severe, and the frequency and severeness of these natural disasters would worsen due to the climate change in upcoming years. With its flat topography and location at the confluence of the Ganges-Brahmaputra-Meghna river basin, Bangladesh faces challenges in forecasting floods through structural measures. The flood management approach has shifted since the early 2000s, emphasizing the use of non-structural solutions like flood forecasting and early warning systems. However, the forecasting capacity is often insufficient for long-term predictions and disaster scenarios. Early warning capacities to communities also lack development and there is often a shortage of expertise to effectively interpret and apply the forecast. The medium- to long-term hydrological forecasting system presented through this project can overcome existing temporal-spatial limitations by simulating river discharge not only at regional scale but also for the entire Ganges-Brahmaputra-Meghna River basins.
Contribution to SDGs	**SDG 2.** (End hunger, achieve food security and improved nutrition, and promote sustainable agriculture) The TA will have the ancillary benefit of promoting sustainable agriculture by collecting necessary meteorological data and forecasting river discharge, which, when disseminated to the people of Bangladesh, including farmers, can help mitigate the impact of hydrological disasters. **SDG 6.** (Ensure availability and sustainable management of water and sanitation for all)

	Using the acquired data, agricultural management can provide advice to emergency response teams before the flood season. This can be achieved as an ancillary benefit stemming from the data-driven system. **SDG 11.** (Make cities and human settlements inclusive, safe, resilient and sustainable) The forecasted medium to long-term river discharge data will be used for disaster preparedness measures, thus minimizing the damage to densely populated cities and enabling them to become more resilient and sustainable. **SDG 13.** (Take urgent action to combat climate change and its impacts) The TA will seek to ensure the flow of information from the urban centers to the rural communities where the information is quite thin. It will supply scientific based information on drought and other climate related disasters over a distributed network that is owned and managed by local communities (13.1 – Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries) The VIC-River Routing model, utilizing forecast data openly provided by ECMWF, enables the prediction of river discharge. This can be utilized in national policies, strategies, and plans related to measures and prevention of damages from droughts and floods caused by climate change. It holds the potential to minimize the impact of natural disasters on the people of Bangladesh (13.2 – Integrate climate change measures into national policies, strategies and planning)
Reference to knowledge products	None