Ministry of Energy Water Resources and Irrigation
Department of Hydrology and Meteorology

Priority River Basins Flood Risk Management Project
Project Implementation Unit
Babarmahal, Kathmandu, Nepal

Proposal for Consulting Service

Numerical Weather Prediction Expert
(Individual Consultant)
PRBFRMP/PIU/DHM/NWP/CS-05

Project Implementation Unit (PIU)
DHM
June 2025

INTRODUCTION

1.   Priority River Basins Flood Risk Management Project jointly undertaken by the Asian Development Bank (ADB) and the Government of Nepal, focuses on enhancing community resilience in the flood-prone Terai Region. The project emphasizes six river basins: Mohana-Khutia, East Rapti, Lakhandehi, Bakraha, Mawa-Ratuwa, and West Rapti, implementing a Flood Forecasting and Early Warning System (FFEWS). The system is procured through the supplier Ms. NARI Group Corporation, China and implemented by Project Implementing Unit (PIU), PRBFRMP under Department of Hydrology and Meteorology (DHM). This system integrates real-time data from rain gauges and river stations, complemented by Numerical Weather Prediction (NWP) forecasts such as WRF, ECMWF, GEFS and NCMRWF. Extending the FFEWS to small catchments to address flashy floods, the project aims to develop an impact-based early warning system, improving the region's preparedness and response capabilities, thereby reducing the adverse effects of floods in the Terai region.

PIU-DHM with its limited strength is not in a position to develop a numerical weather prediction model for these works and therefore intends to hire a Numerical Weather Prediction Expert to assist DHM in providing technical support for developing a model and feed into FFEWS. Hence this proposal is submitted for hiring hydraulic modeler as an individual consultant, under package CS-04.

OBJECTIVES

The primary objective of this intermittent consultancy assignment is to provide comprehensive technical support to DHM for developing a numerical weather prediction model to feed into the FFEWS.

DETAILED SCOPE OF WORK

The scope of work will include

  i)   Develop and generate medium-range (3 to 7 days) multi-model/multi-physics Ensemble forecasting systems for flood early warning with hourly/3hourly/6hourly output.
  ii) Assist in operationalizing 7-day weather forecasts for DHM generated in WRF.
  iii) Guiding, Monitoring and Evaluating downscaling of ECMWF, GEFS, NCMRWF, WRF and other similar numerical weather prediction model to the supplier.
  iv) Monitor and guide capacity building activities for DHM flood engineers and managers regarding NWP.
  v)   Collaborate closely with DHM staff, the international FFEWS Expert, other national Experts and the Supplier.

DETAILED TASKS AND/OR EXPECTED OUTPUT

The main tasks related to the position shall be, but not limited to:

  1. **Development Monitoring:**

o   Regularly report the development of the NWP model and identify gaps in deliverables required by FFEWS TOR Section 6 of DHM.

2. **Global Forecast Assessment:**
   o   Evaluate global forecast outputs for operational use as initial conditions for the NWP model for the five river basins and assess the quality of these outputs.
   o   Guiding, Monitoring and Evaluating the downscaling of global NWP to project area scale for ECMWF, GEFS, NCMRWF, WRF and other similar NWP products suitable for project.
   o   Develop 3-7day weather forecast with output of 1-3 km spatial scale and hourly/3hourly/6hourly timescale.

3. **Model Setup Support:**
   o   Assist in setting up a modeling system using the open-source Weather Research and Forecasting (WRF) Model.
   o   Ensure the model includes multiple choices of physical parametrization schemes suitable for both "convection permitting" (1-3 km grid-size) and "synoptic scale" (6-9 km grid-size or larger) modes.
   o   Include parametrization schemes for processes like radiation, turbulence, cloud microphysics, convection, surface, and soil processes.

4. **Model Execution Monitoring:**
   o   Oversee the supplier's execution of the WRF model to downscale global forecast outputs and produce multi-model multi-physics ensemble precipitation probability forecasts at 1-3 km grid size.

5. **High-Resolution Domain Configuration:**
   o   Monitor the establishment of a double-nesting model and configure high-resolution domains for project basins and surrounding areas.

6. **Sensitivity Testing:**
   o   Supervise sensitivity tests suitable for the project area with different initial conditions and micro-physics options in WRF modeling.

7. **Forecast Evaluation:**
   o   Evaluate forecasts using statistical verification methods and refine processes to improve accuracy in collaboration with DHM.

8. **Training and Capacity Building:**
   o   Supervise the creation of automated visualization tools and ensure seamless integration with model runs.
   o   Conduct detailed training in NWP model setup, running, and troubleshooting for selected DHM hydrological and meteorological forecasters and IT staff.

9. **System Recommendations:**

   O   Recommend system requirements and operational frameworks for upgrading DHM's High-Performance Computing (HPC) system for 7-day weather forecasts

MINIMUM QUALIFICATION REQUIREMENTS:

- Master's degree (Ph.D. preferred) in meteorology, atmospheric sciences, applied mathematics, or a related field.
- At least 5 years of relevant professional experience in planning, designing, and commissioning NWP systems, with demonstrated experience in data mining, downscaling methodologies, applying statistical analysis, numerical modeling, machine learning techniques, and large-scale computing platforms.
- At least 5 years of specific experience in meteorological modeling, particularly in dynamical downscaling of precipitation events leading to potential flood events, state-of-the-art data assimilation techniques, and ensemble forecasting.
- Proven experience in designing and implementing NWP systems using the WRF model.

- Proficiency in Linux/UNIX operating systems and programming languages (Fortran, C/C++, Python, or R).
- Strong communication skills in English.

Duty Station shall be Kathmandu.

PROPOSED CONSULTANTS

For the tasks outlined above, it is proposed to engage one Numerical Weather prediction Expert on individual basis. The consultant shall be engaged for 5.0 months on intermittent basis staggered over a period of 12 months tentatively from October 2025 to September 2026.

KEY DELIVERABLES

- **Inception Report:**
    - Detailed work plan and methodology with timesheet plan and output evaluation indicators.
- **Technical Note on Data Assessment:**
    - Comprehensive assessment of global forecast outputs and boundary data for NWP model evaluation.
- **Technical Note on Model Setup:**
    - Detailed WRF model setup and development.
- **Phase 1 Report:**
    - Model development, sensitivity analysis, probabilistic precipitation product, and verification results.
- **Technical Note on Trainings Conducted:**
    - Documentation of training sessions, including feedback and suggestions.
- **Technical Note on DHM HPC Upgrade Recommendations:**
    - System requirements and operational framework for a high-resolution 7-day forecast.
- **Phase 2 Report:**

    - Consolidated final report with project outcomes and recommendations

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