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Enhancing Community Based Early Warning Systems in Nepal with Flood Forecasting Using Local and Global Models

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Operationalising effective Flood Early Warning Systems (EWS) in developing countries like Nepal poses numerous challenges, with complex topography and geology, sparse network of river and rainfall gauging stations and diverse socio-economic conditions. Despite these challenges, simple real-time monitoring based EWSs have been in place for the past decade. A key constraint of these simple systems is the very limited lead time for response - as little as 2-3 hours, especially for rivers originating from steep mountainous catchments. Efforts to increase lead time for early warning are focusing on imbedding forecasts into the existing early warning systems.

In 2016, the Nepal Department of Hydrology and Meteorology (DHM) piloted an operational Probabilistic Flood Forecasting Model in major river basins across Nepal. This comprised a low data approach to forecast water levels, developed jointly through a research/practitioner partnership with Lancaster University and WaterNumbers (UK) and the International NGO Practical Action. Using Data-Based Mechanistic Modelling (DBM) techniques, the model assimilated rainfall and water levels to generate localised hourly flood predictions, which are presented as probabilistic forecasts, increasing lead times from 2-3 hours to 7-8 hours. The Nepal DHM has simultaneously started utilizing forecasts from the Global Flood Awareness System (GLoFAS) that provides streamflow predictions at the global scale based upon distributed hydrological simulations using numerical ensemble weather forecasts from the ECMWF (European Centre for Medium-Range Weather Forecasts).

The aforementioned global and local models have already affected the approach to early warning in Nepal, being operational during the 2016 monsoon in the West Rapti basin in Western Nepal. On 24 July 2016, GLoFAS hydrological forecasts for the West Rapti indicated a sharp rise in river discharge above 1500 m3/sec (equivalent to the river warning level at 5 meters) with 53% probability of exceeding the Medium Level Alert in two days. Rainfall stations upstream of the West Rapti catchment recorded heavy rainfall on 26 July, and localized forecasts from the probabilistic model at 8 am suggested that the water level would cross a pre-determined warning level in the next 3 hours. The Flood Forecasting Section at DHM issued a flood advisory, and disseminated SMS flood alerts to more than 13,000 at-risk people residing along the floodplains. Water levels crossed the danger threshold (5.4 meters) at 11 am, peaking at 8.15 meters at 10 pm. Extension of the warning lead time from probabilistic forecasts was significant in minimising the risk to lives and livelihoods as communities gained extra time to prepare, evacuate and respond. Likewise, longer timescale forecasts from GLoFAS could be potentially linked with no-regret early actions leading to improved preparedness and emergency response.

These forecasting tools have contributed to enhance the effectiveness and efficiency of existing community based systems, increasing the lead time for response. Nevertheless, extensive work is required on appropriate ways to interpret and disseminate probabilistic forecasts having longer (2-14 days) and shorter (3-5 hours) time horizon for operational deployment as there are numerous uncertainties associated with predictions.