IMPROVING FLOOD EARLY WARNING LEAD TIME IN NEPAL

Using Probabilistic Forecasting for Better Preparedness

- Practical Action has improved flood early warning across Nepal, through development, piloting, and scaling up of a low data approach to increasing early warning.
- The model has potentially increased the lead time of early warnings from 2 to 7 hours
- Provide information on graphics communicate the likelihood of water levels reaching warning and danger levels.
- The system has been replicated across Nepal, enhancing early warning for vulnerable communities.

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Summary
Flood early warning systems based on real-time monitoring of water levels leave communities with little time to respond to flood warnings. A new approach introduces probabilistic forecasting, providing information about the likelihood of flooding and resulting in an additional five hours of early warning. This increased lead time means that families gain crucial hours to get to safety and act to protect themselves, their homes and their livelihoods.

Background
The lower Karnali basin in western Nepal is vulnerable to sudden onset floods. Practical Action has been working with communities in the Karnali floodplains for the past decade, working in partnership with the Nepal Department of Hydrology and Meteorology (DHM), to develop a simple, low-tech, community-focused early warning system. This real-time monitoring system measures water levels upstream at the Chisapani gorge (Figure 1). When the water level crosses predetermined thresholds, the early warning system triggers a warning for downstream communities. This simple system provides 2–3 hours of flood early warning to vulnerable communities.

Constraints
Despite the success of this simple approach, the effectiveness of the system is constrained by the limited lead time for early warning (approx. 2–3 hours), especially for rivers originating from steep, mountainous catchments. This makes it difficult for warning messages to reach all at-risk groups, and evacuation is challenging, particularly for vulnerable groups such as disabled people, pregnant women, the elderly, and children. The current type of system, reliant on real-time water measurements upstream, is also vulnerable to failure, as in the case of the 2014 flood when the system failed in the adjacent Babai basin, particularly due to lack of access to the upstream measurement site during hazardous conditions. The current short lead time is also best suited for saving lives, but gives limited opportunity to save moveable assets, livestock, and livelihood tools.
Challenge

The challenge, therefore, was how to increase the lead time for early warning. Any new approach would need to have low data requirements (river flow and rainfall data is limited in the Karnali basin) and be simple, low cost, and easy to maintain. Practical Action worked closely with Dr Paul Smith to develop an improved approach to extend the early warning lead time. The previous system communicated a simple ‘warning’ or ‘evacuate’ message, which can only be delivered late (once there is close to certainty of flooding occurring). The new probabilistic forecast communicates the likelihood of flooding as a percentage, providing earlier and more nuanced information on the likelihood of flooding.

New approach

A new approach was piloted with the DHM in 2015-16, which provides an additional 5 hours of early warning (taking the early warning lead time from the current 2–3 hours to 7–8 hours). Figure 1 shows an example forecast at the time of the last major flood event (produced by the model at 23.00 on 14 August 2014). It shows forecast rising water levels for the next 5 hours, using blue colouring to demonstrate the range of possibilities. The line in black has been added to show the actual water level at each time (note the close alignment of the reality with the forecast). On the right, two easy-to-read visuals are provided, showing the probability that water levels will reach warning levels (top) and dangers levels (bottom) in the next 5 hours.

The example shows a very high probability of reaching warning levels in the near future, and a high probability of reaching danger levels in 5 hours’ time.

Replication and impact

Initial successes in Karnali basin led the DHM to adopt the model and roll it out to all major river basins across Nepal in 2016. This includes large river basins such as the Narayani and Koshi, along with smaller basins, such as Kankai, Babai, and West Rapti. Initial results indicate that the model provides an additional lead time of 3–5 hours for larger basins and around 1–3 hours for smaller basins.

The probabilistic model has already affected the approach to early warning in Nepal, and was applied during the 2016 monsoon in western Nepal. When rainfall stations upstream of the West Rapti catchment recorded heavy rainfall on 26 July, localized forecasts from the probabilistic model at 8 a.m. suggested that the water level would cross a predetermined warning level in the next 3 hours. The Flood Forecasting Section at DHM issued a flood advisory, and sent SMS flood alerts to more than 13,000 at-risk people residing along the floodplains. Water levels did cross the danger threshold (5.4 metres) at 11 a.m., peaking at 8.15 m at 10 p.m. The longer warning lead time from probabilistic forecasts was significant in minimizing the risk to lives and livelihoods as communities gained extra time to prepare, evacuate, and respond.

About Practical Action

Practical Action uses technology to challenge poverty by building the capabilities of poor people, improving their access to technical options and knowledge. We work internationally from regional offices around the world.

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Further information

Further details on this new model and on the operation of the early warning system in Nepal are available in Smith et al. (2017) The Journal of Natural Hazards and Earth System Sciences. The article is available for download at: www.nat-hazards-earth-syst-sci.net/17/423/2017/ contact us to learn about incorporating rainfall forecasts into the model to further enhance lead time and communicating more sophisticated forecasts to communities.

Practical Action is a member of the Zurich Flood Resilience Programme, a multi-sectoral alliance focusing on helping communities in developed and developing countries strengthen their resilience to flood risk.

References


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