

# THE 2014 KARNALI RIVER FLOODS IN WESTERN NEPAL: MAKING COMMUNITY BASED EARLY WARNING SYSTEMS WORK WHEN DATA IS LACKING

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## INTRODUCTION

Implementing Community Based Flood Early Warning System (EWS) in developing countries like Nepal is challenging. Complex topography and geology combined with a sparse network of river and rainfall gauges and little predictive meteorological capacity both nationally and regionally dramatically constrain EWS options. This study provides a synopsis of the hydrological and meteorological conditions that led to flooding in the Karnali River, West Nepal during mid-August 2014, and analyses the effectiveness of flood EWS in the region.

## THE KARNALI RIVER

The Karnali River is a perennial trans-boundary river, originating in the Tibetan Plateau and flowing through the steep mountainous terrain of West Nepal. It is the longest river in Nepal and the total catchment area of the Karnali basin is approximately 45,000 km<sup>2</sup>. The Karnali River exits the Himalaya onto the Indo-Gangetic Plain from a narrow gorge at Chisapani and about one kilometer downstream, the river splits into the Geruwa and Karnali branches, creating an island. About 22 kilometers downstream, after crossing the Nepal-India border, it converges again as the Ghagra.

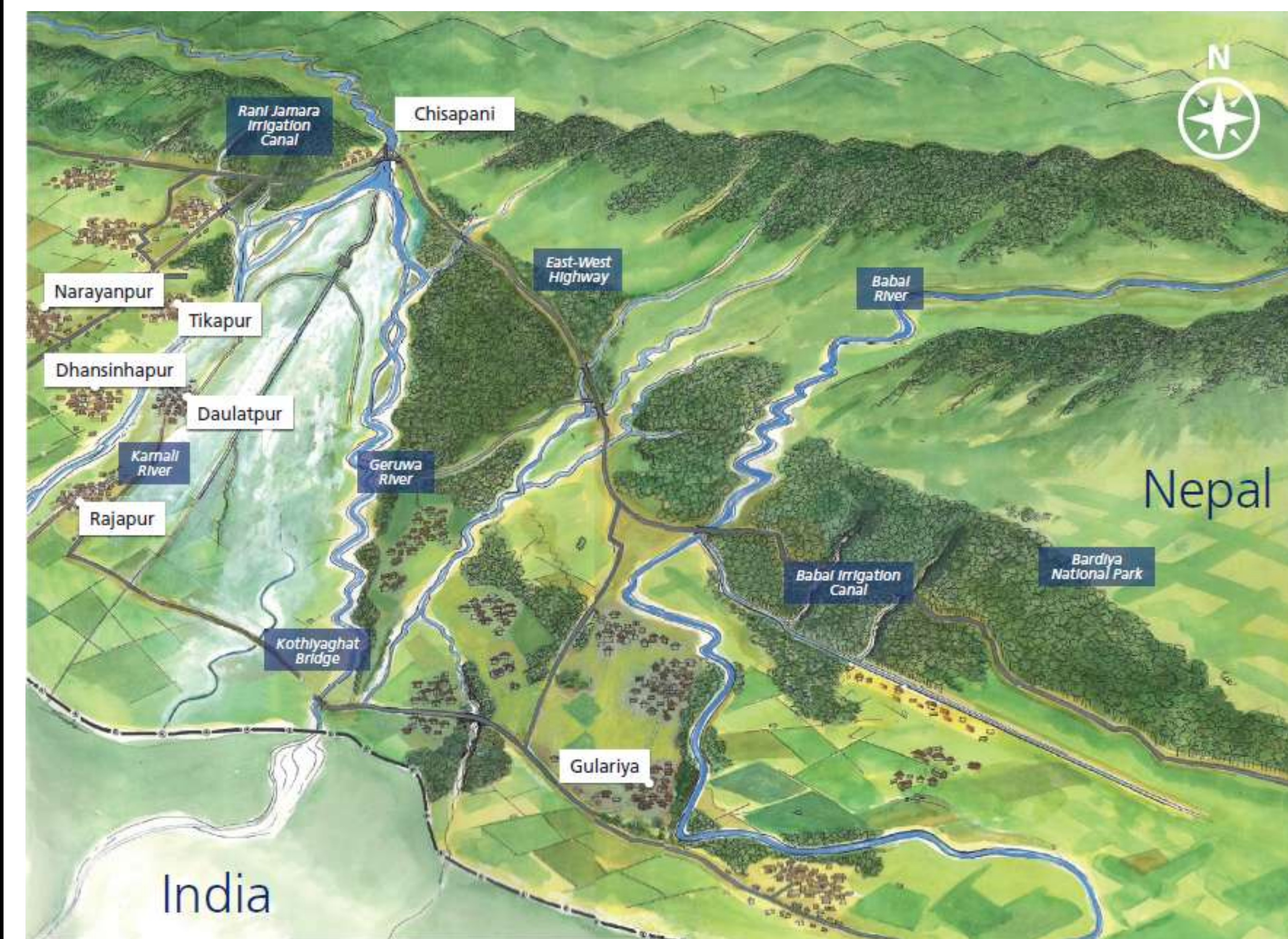
## HYDRO-MET CONDITIONS

On August 14-15, 2014, a large, slow moving weather system deposited record breaking rainfall in the foothills of the Karnali River catchment. Precipitation depths of 200 to 500 mm were recorded over a 24-hour period, which led to rapid rise of river heights. At the Chisapani river gauge station used for the existing EWS, water levels rapidly exceeded the 11 meter danger level. Between 3 to 6 am, water levels rose from 11 to 16.1 meters, well beyond the design height of 15 meters.



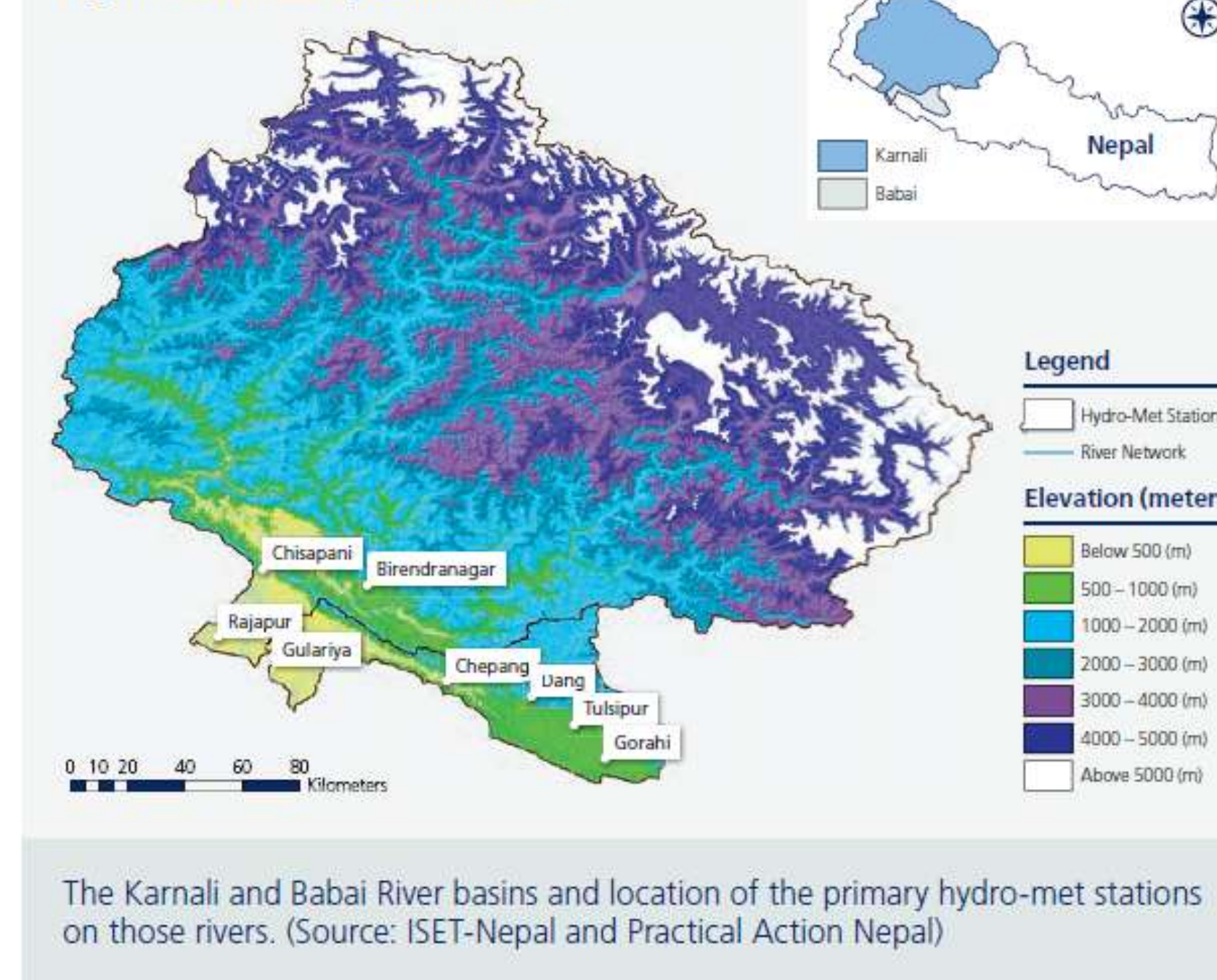
Gauge Station at Chisapani (Credit: Prakash Khadka, CSDR)

## FIGURES AND GRAPHS



Schematic of the Karnali Basin in West Nepal (Source: Zurich, 2015)

Figure 2: Landscape schematic



The Karnali and Babai River basins and location of the primary hydro-met stations on those rivers. (Source: ISET-Nepal and Practical Action Nepal)

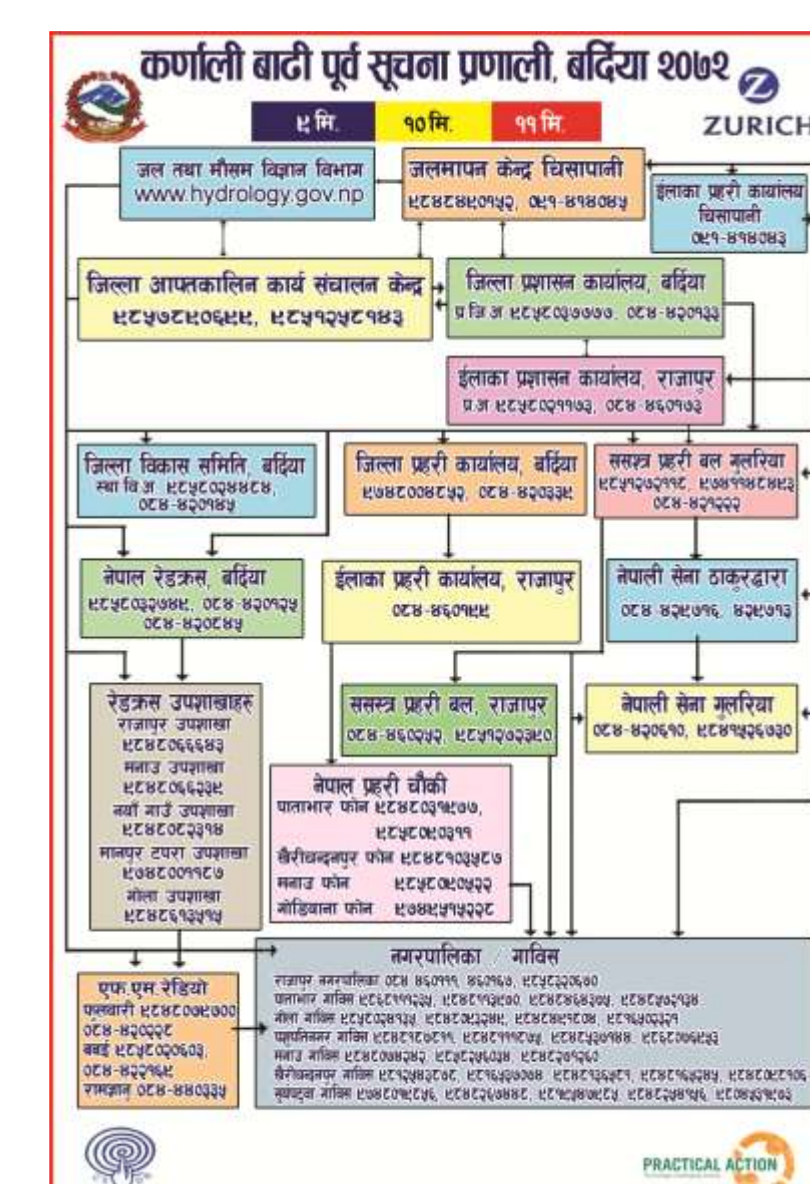
Table 1: Precipitation recorded during 24-hour period

Station	Rainfall (mm)	Station	Rainfall (mm)
Rajapur	233	Belghundi, Dang	346
Birendranagar	423	Chepang	326
Nepalgunj	184	Talipur	299
Gorahi	298	Chisapani	493

Source: DHM, <http://www.mfd.gov.np/content?id=77> \*Rainfall ending at 8:45 am

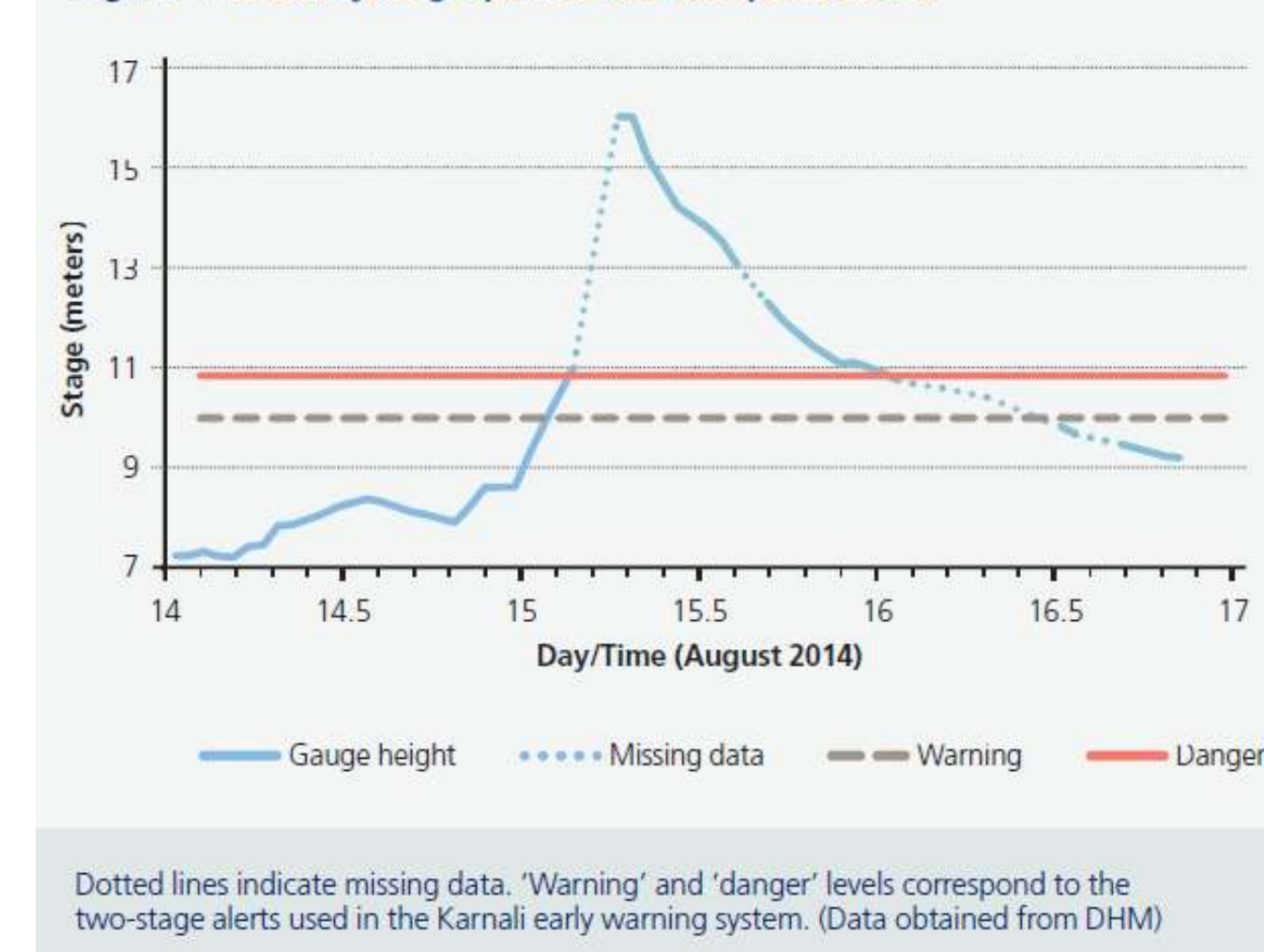


Gauge Reader at the Chisapani Station

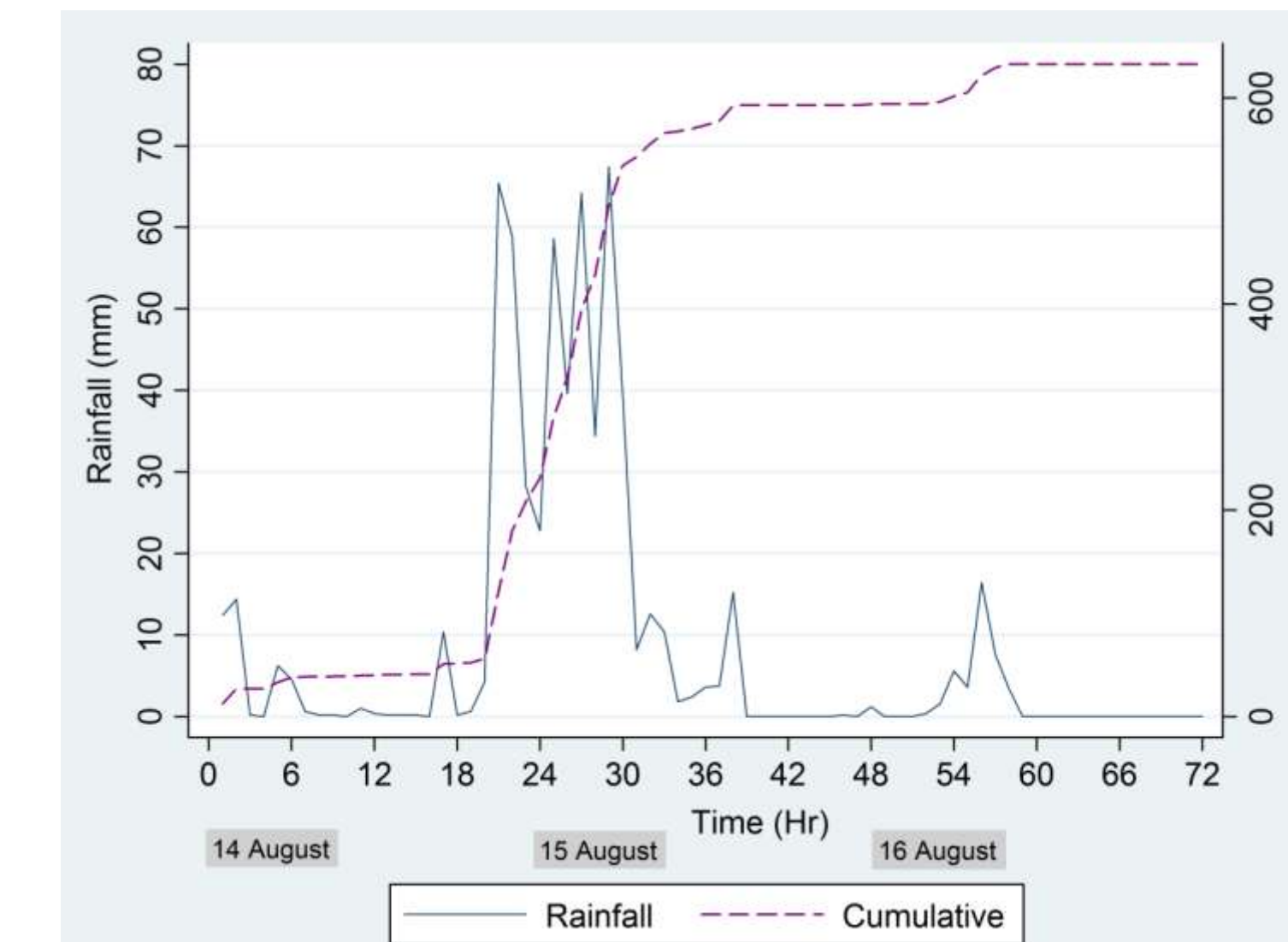


Communication Channel for CBEWS

Figure 4: Flood hydrograph for the Chisapani station



Flood Hydrograph at Chisapani for August 14-16



Hourly Rainfall at Chisapani for August 14-16

## COMMUNITY BASED FLOOD EARLY WARNING SYSTEMS

The Chisapani gauge on the Karnali River is the backbone of the community-based early warning systems (CBEWS) for this region. CBEWS is based upon working closely with the gauge reader from the Department of Hydrology and Meteorology (DHM) and linking communities and relevant stakeholders. Gauge readers are provided with a cell phone and are trained to record gauge data and transmit flood warnings to communities, districts, and national-level agencies via a communication channel.

Starting with the onset of intense rainfall during August 14, 2015 the Chisapani gauge reader was in regular communication with downstream stakeholders and communities. At 1 a.m. the river rose to over 10 meters, triggering an 'amber' alert. The flood conditions worsened and within two hours the river had risen to above 11 meters, triggering a 'red' alert, with water levels still rising. The automatic gauge station at Chisapani stopped working at 2am on 15th August and manual readings were not possible between 3am and 6am, as the trail to the gauge station became blocked by landslides and torrents. Since the gauge reader provided downstream communities with timely information regarding rising water level, people just had enough time to move to safe places with their livestock and key assets. Though households still lost substantial assets, without the EWS, floodwaters would have caught communities completely unaware and damage would almost certainly have been much worse.

## LESSONS LEARNT

Despite the complications associated with access to the Chisapani gauge and failure of the telemetry system to transmit real time data, EWS was instrumental in saving both lives and livestock during 2014 floods. Since, the current CBEWS is reliant on a single node - both the gauge reader and the station need to have alternative methods of communication to make the system more robust and reliable. Also, relevant stakeholders at the district need to be made aware regarding the implications of the flood warnings. However, the urgent need is to move from observation to forecast based EWS, ideally coupled with hydrological and meteorological models that would provide flood estimates well in advance to vulnerable communities.

## REFERENCES

MacClune, K., Venkateswaran, K., Dixit, K. M., Yadav, S., Maharjan, R., Dugar, S. (2015). Urgent case for recovery: what we can learn from the August 2014 Karnali River floods in Nepal. Zurich, Switzerland: Zurich Insurance Company Ltd.

Zurich (2015). Risk Nexus: Urgent case for recovery: what we can learn from the August 2014 Karnali River floods in Nepal.

As part of Zurich's flood resilience program, the post event review capability (PERC) provides research and independent reviews of large flood events. It seeks to answer questions related to aspects of flood resilience, flood risk management and catastrophe intervention. It looks at what has worked well (identifying best practices) and opportunities for further improvements. The study was conducted by ISET-International, ISET Nepal, Practical Action and Zurich.