

Flash Floods in the Himalayas

The Himalayas are one of the youngest mountain ranges on earth and represent a high energy environment very much prone to natural disasters. High relief, steep slopes, complex geological structures with active tectonic processes and continued seismic activities, and a climate characterised by great seasonality in rainfall, all combine to make natural disasters, especially water-induced hazards, common phenomena.

Flash floods are among the more devastating types of hazard as they occur rapidly with little lead time for warning, and transport tremendous amounts of water and debris at high velocity (Fig. 1). Flash floods affect thousands of people in the Himalayan region every year – their lives, homes, and livelihoods – along with expensive infrastructure

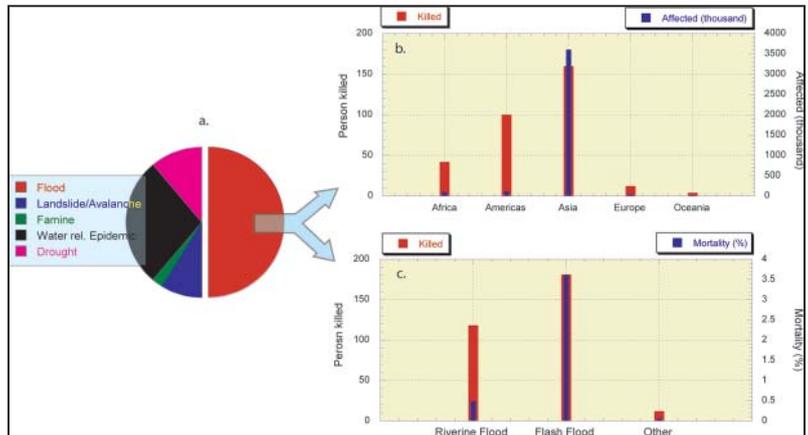


Figure 1: a. types of water-related disasters; b. distribution of water related disasters by continents; c. different types of floods (data source: Jonkman 2005)

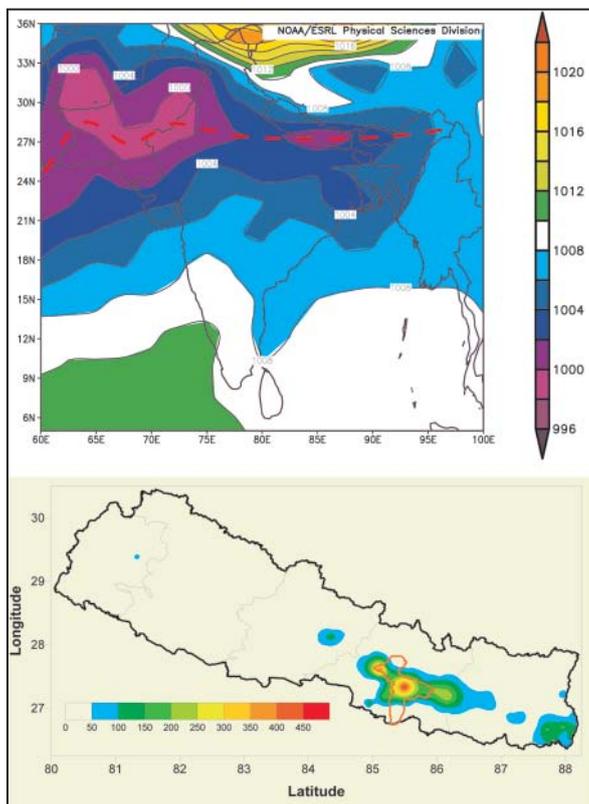


Figure 3: Monsoon trough (top) and precipitation in Nepal (bottom) on 19 July 1993 that caused big flash floods in Central Nepal and huge damage to infrastructure and property (sources: NOAA and DHM)

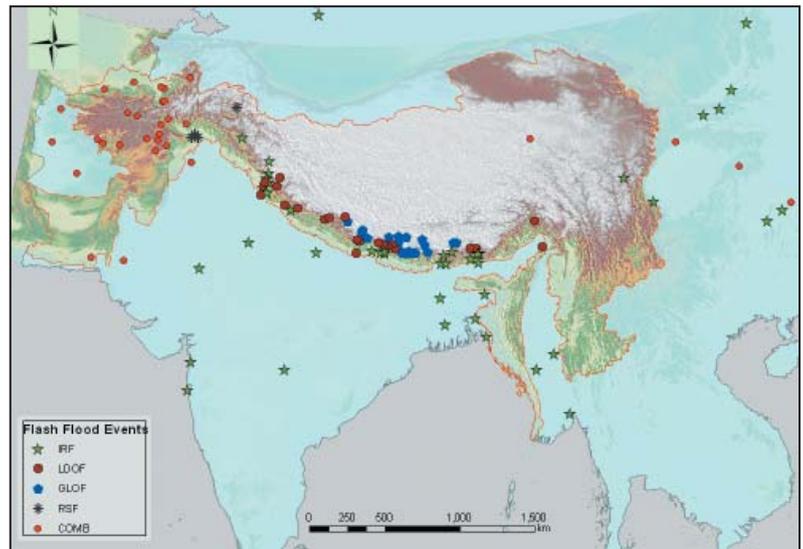


Figure 2: Different types of flash floods in the HKH region

There are several different types of flash flood. The most common include intense rainfall floods (IRF); glacial lake outburst floods (GLOFs), landslide dam outburst floods (LDOF), and flash floods caused by rapid snowmelt (RSM) and ice (Fig. 2). Failure of dams and other hydraulic structures can also lead to flash floods.

Intense rainfall

Intense rainfall is the most common cause of flash floods in the Himalayan region. These events may last from several minutes to several days. Such events may happen anywhere but are more common to mountain catchments. The main meteorological phenomenon causing intense rainfalls in the region are cloudbursts, stationarity of monsoon trough (Fig. 3) and monsoon depressions.



Figure 4: A landslide dam in central Nepal (left), Tsatichu landslide dam (top-right) and lake formed by Tsatichhu dam (bottom-right) in Bhutan (source: WECS 1987; Dunning 2006)



Figure 5: Tsho Rolpa glacial lake (top) and outburst of Tam Pokhari glacial lake (bottom), Nepal (photos: J. Ullal, S. Dwibedi)

Landslide dam outburst

Debris from a landslide can temporarily block the flow of a river creating a reservoir in the upstream reach (Fig. 4). The landslide dam can breach due to overtopping and cause huge floods known as landslide dam outburst floods (LDOF).

Glacial lake outburst

The glaciers in the Himalayas are mostly retreating, and as they retreat lakes can form from melt water held in by the now exposed terminal moraine acting as a dam. If the dam breaks the water can be released suddenly resulting in a glacial lake outburst flood (Fig. 5).

Impact of climate change

Intense rainfall floods and landslide dam outburst floods are directly related to the hydrometeorological conditions and likely to be affected by climate change. Climate models project an increase in monsoon precipitation in the region. Similarly the frequency and magnitude of extreme rainfall events are also anticipated to. GLOFs are related to glacial retreat which in turn is mainly due to climatic warming. It is therefore very likely that flash floods due to intense rainfall, landslide dam outbursts, and glacial lake outbursts will increase in the future.

ICIMOD initiatives

While the region is highly exposed to flash flood hazards, due to poor socioeconomic condition the vulnerability is also high. In general the capacity to manage the risk of flash floods is low. ICIMOD has undertaken several initiatives targeted towards mitigation of the impact of flash floods including development of an inventory of glaciers and glacial lakes for a part of the Hindu Kush-Himalayan region; an international workshop on flash floods in Lhasa, PR China; capacity building for flash flood risk management; and satellite rainfall estimation. ICIMOD will continue to work in flash flood management in the region particularly in raising awareness towards flash floods, increasing capacity to manage the risk, and linking flash floods risk management with climate change adaptation.

References

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