Post-Flood Assessment of the 2019 Flooding in the Bagmati River Basin, Nepal

Divas B. Basnyat[1], Dibesh Shrestha[1], Srijana Thapa[1], Shreya Bajimaya[1], Monica Maharjan[1,2], Shankar Shrestha[1], Shashwat Dhungana[1,3,]

[1] Nepal Development Research Institute, Pulchowk, Lalitpur, Kathmandu, Nepal

[2] Department of Environmental and Conservation Science, Murdoch University, Western Australia, 6150

[3] International Water Management Institute (IWMI), Lalitpur, Nepal

1 Introduction

High rainfall in the monsoon season causes regular flooding in Nepal. While the flood hazards may be natural, the risks and damages and losses caused by them are not necessarily just "natural", but often more man-made. Therefore, there is a need for a genesis of each flood event in terms of the hydro-meteorological conditions that caused the flood hazard and the various factors in terms of vulnerability and exposure of the communities, infrastructures and other assets that amplified the damages and losses (risks).

This poster analyses and presents an assessment of the July 2019 flood event in the Bagmati basin in Nepal, with particular focus on four districts, namely Sarlahi and Rautahat districts through which the Bagmati River flows and the two adjacent districts, Bara and Parsa, in the Tarai (southern plains in Nepal) **(Figure 2.1)**.

Lessons that can be learned from the assessment will be useful for designing and preparing flood risk mitigation policies and protective and remedial actions for future flood events. Hydro-meteorological and flood damage and loss data of a number of flood events that occurred since 1993 have been analyzed to compare with that of the July 2019 flood event.

2 Materials and Methods

The methodology followed is a combination of the top-down flood analysis and bottom-up data collection and analysis of flood impacts (damages and losses) **(Figure 2.2).** The flood analysis focused on the temporal and spatial analyses of the rainfall and the flood extent data. The flood damage and loss data were compiled from the available sources. The policy and institutional environment was mapped and analyzed to investigate its influence in flood risk reduction and management.

2.1 Policy and Institutional Framework

Review and analysis of existing international and national policies, legal and regulatory framework, strategies and the dedicated funds that are available for Disaster Risk Reduction and Management (DRRM).

Review of institutional setup that oversees, regulates and manages disaster risks.

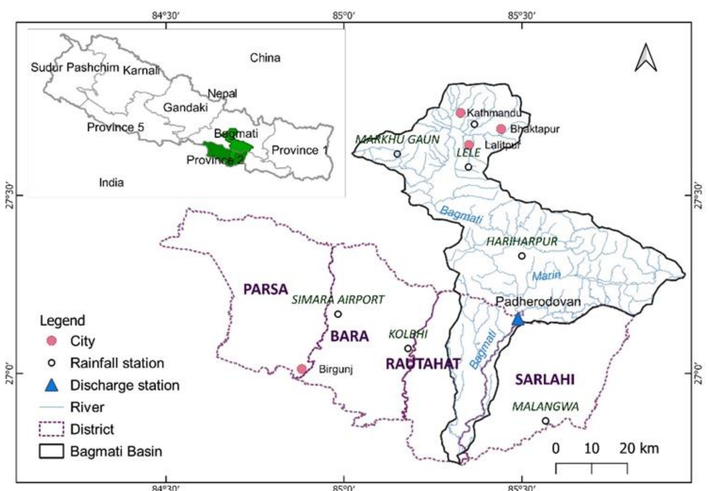


Figure 2.1: Bagmati Basin and Adjacent Terai Districts (Study Area)

2.2 Hydro-meteorological Assessment

The objective of the hydro-meteorological assessment was to understand the nature of hydrological and meteorological conditions during current and historical flood events, and to compare those floods based on the severity and the expected frequencies of occurrences.

2.3 Spatial Assessment of Flood Inundation

Sentinel-1 satellite images were used to analyze the flooded areas during the 2019 floods in Nepal.

The flood extent mapping was carried out using the Google Earth Engine.

2.4 Loss and Damage Assessment

Data retrieved from different sources and visualized to discuss loss and damage caused by the flood events and further compared to historical floods.

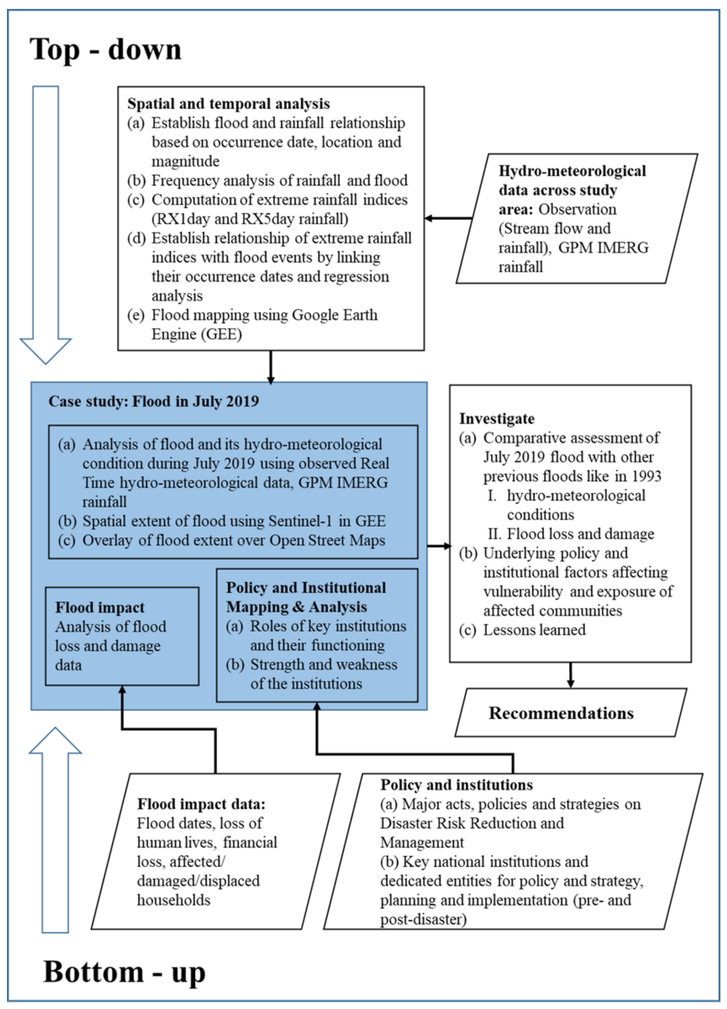


Figure 2.2: Flowchart of Methodology Applied

3 Results and Discussion

3.1 Hydro-meteorological Analysis

The recorded 24-hour maximum rainfall in July 2019, is not the highest recorded in the past. The loss and damages caused during the 2019 flood are not necessarily due to an exceedingly high rainfall and river flow but could be due to other factors (land use change, drainage, etc.)

Table 3.1: Summary of the Hydro-meteorological Analysis

Station	Maximum 24-Hour Rainfall (mm)	Period	Expected Return Peri
Lele Rainfall Station	181.8	12 am, 12 July to 12 am 13 July 2019	10 year
	280	2002	50 years
Kolbhi Rainfall Station	238.2	4 pm, 11 July to 4 pm, 12 July 2019	25 years
	224.6	2007	25 years
Hariharpur Gadi Rainfall Station	262.0	6 pm 11 July to 6 pm 12 July 2019	5 years
	482.2	1993	1000 years
	Maximum Gauge Height (m); Discharge (m^3/s)	**Period**	**Expected Return Peri**
Pandhero Dovan Hydrological Station at Bagmati River (Instantaneous Flood)	9.40m:5,260 m^3/s*	13 July 2019	5 years
	16,000 m^3/s	1993	1000 years

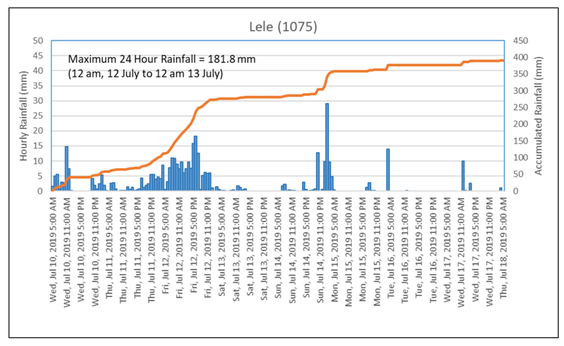
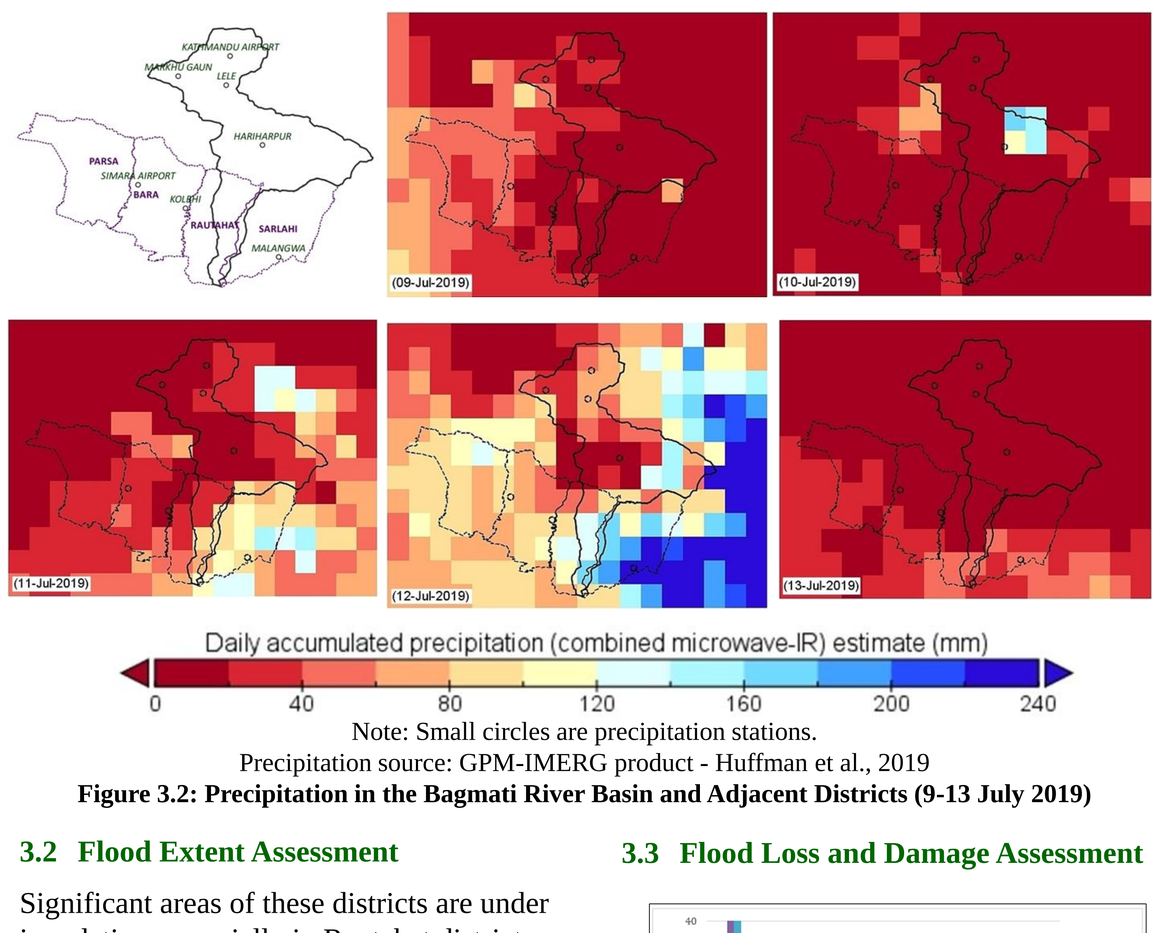


Figure 3.1: Hourly Maximum Rainfall at Lele



Note: Small circles are precipitation stations.

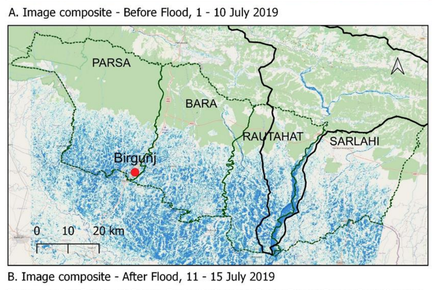
Precipitation source: GPM-IMERG product - Huffman et al., 2019

Figure 3.2: Precipitation in the Bagmati River Basin and Adjacent Districts (9-13 July 2019)

3.2 Flood Extent Assessment

Significant areas of these districts are under inundation, especially in Rautahat district

A. Image composite - Before Flood, 1 - 10 July 2019



B. Image composite - After Flood, 11 - 15 July 2019

Prepared using Sentinel-1 C-band Synthetic Aperture Radar Ground Image Collection and overlayed over Open Street Map in QGIS

3.3 Flood Loss and Damage Assessment

Figure 3.3: Flooding and Inundation Extent in lower Bagmati Basin during July 2019 flood

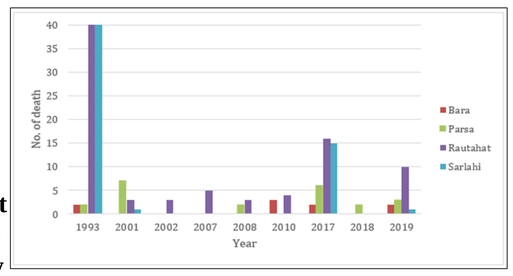
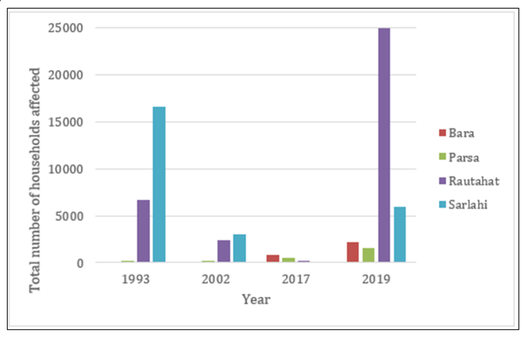


Figure 3.4: Total Number of Deaths and Affected Households due to Flood in Different Years



4 Conclusions and Recommendations

- The findings of the study recommend (a) systematic and enhanced coordination among sectoral agencies and stakeholders for effective implementation plans for DRRM, (b) technical capacity building of local government bodies to prepare and act effective in pre and post flood phases, and (c) regular update and maintenance of the Disaster Management Information System (DMIS) to further enhance coordination and efficiency of disaster management efforts.
- Strong linkages of floods with extreme rainfall conditions were observed. It is seen that even rainfall and flood events occurring in 1 in 5 years or 1 in 10 years are causing substantial damage and loss. These make the communities and infrastructures more vulnerable and exposed to floods.
- The risks (losses and damages) have increased, more due to increased vulnerability and exposure of the communities and infrastructures to man-made attributes than by increased frequency and magnitude of the hydro-meteorological hazards.
- Extreme events (such as RX1day and RX5day rainfall) are expected to increase in the future as a result of climate changes, and hence flood events are also expected to increase. Improved policy and institutional instruments, and proper land use and infrastructure planning are thus required considering recurrent flood hazards in the basin.

Acknowledgement:

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Reference: Divas Bahadur Basnyat, Dibesh Shrestha, Srijana Thapa, Shreya Bajimaya, Monica Maharjan, Shankar Shrestha, and Shashwat Dhungana (2020). Post-Flood Assessment of the 2019 Flooding in the Bagmati River Basin, Nepal. Journal of Development Innovations, 4(1): 20-47. https://www.karmaquest.org/journal/index.php/ILGDI/article/view/67

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