HiFlo-DAT

Indian Himalayan Flood Database, for DRR in the Kullu District

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UK-India Education and Research Initiative

1. INTRODUCTION

- ***Key research goal:*** Generate/ analyse a new database of historical flood occurrence and impacts in the Kullu District, India. This will empower future land use & risk assessment by Indian government policy-practice stakeholders. This project provides a direct response to the Asia Regional Plan (2016) in its implementation of the UNISDR Sendai Framework for Disaster Risk Reduction 2015-2030; in particular the 2020 policy target to compile disaster loss data.
- ***This poster:*** Provides a statement on the 'HiFLo-DAT' database project and interim results. Demonstrating the currently underdeveloped record/ understanding of flood risk in high mountain regions.

2. KULLU DISTRICT

- The Kullu Valley (Kullu District, Himachal Pradesh, **Fig. 1**), is dominated by the Beas River watershed (upstream of Pandoh Dam, near Aut: 5278 km^2, 890-6632 m ASL), with a large proportion of runoff from monsoon rain, ice/snowmelt.
- The region experiences a high frequency of hazard process events (earthquakes, floods, slope instability). These impact vulnerable communities and exposed assets; resulting in fatality, disruption, damage and large costs. Recent/ significant floods occurred in September 2018 (**Fig. 2**) and August 2019. Indicating the continuing need for improved DRR policy and practice in the region.
- The spatial extent of 'HiFlo-DAT' is confined to 'Tahsil Kullu' & 'Tahsil Manali', to the north of the Kullu District (**Fig. 3**, red polygon), dominated by the Kullu Valley. This area is selected given it is a long-standing area of settlement, has growing tourism demand and hydro-power construction, resulting in elevated flood risk. It is also the foci of historical records so is advantageous for the compilation/ analysis of meteorological and flood histories.

3. 'HiFlo-DAT' METHOD

- ***Design:*** Founded on bi-lateral workshop consultation (Delhi, 2018), a literature review via SCOPUS and exploration of online databases. These systematically establish best practice in European and global flood/ geomorphic hazard databases in regard to structure, data entry, data verification & analysis. For example: ADRC, AVI, BDHI, Chronology of British Hydrological Events, CNR-IRPI, DFO, DISASTER, EM-DAT, FLASH, GFI, HP-HVRA, HYMEX, INUNGAMA, IPHS, NATHAN, PAGES, PEOPLE, PRESSGAMA, and the Swiss Flood and Landslide damage database.
- ***Database format/ structure:*** An MS-Excel spreadsheet with spatial analysis in ArcGIS, using Census of India (2011) MDDS location codes (as applicable). 'HiFlo-DAT' has 103 categories in 12 groups (**Fig. 4**).
- ***Protocols:*** Govern the careful and systematic team identification, capture and assessment of data sources. Database categories have guidance to achieve a consistent standard of data entry and are fully verified.
- ***Database hosting:*** The final database will be freely available via 'BathSPAdata' and the HPSDMA website. Future updating will also be administered. To maximize application English & Hindi videos & project communiques are planned.

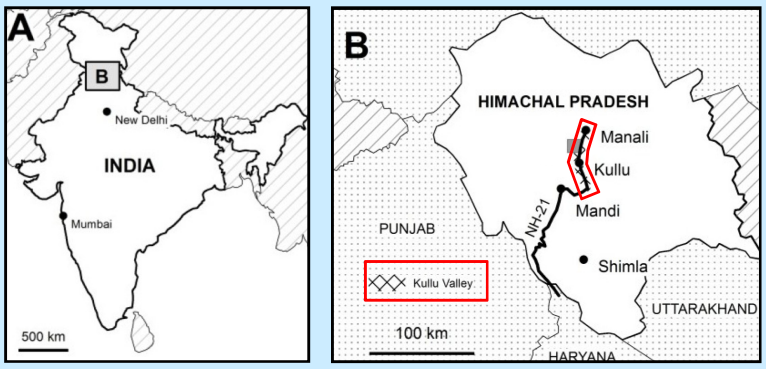

Fig. 1: The Kullu Valley in the Indian Himalaya

Fig. 2: Sept. 2018 flood impacts in Phojal Nalla (near Katrain) bringing significant channel change and destruction of forestry, horticulture, electricity transmission networks, roads, bridges & buildings

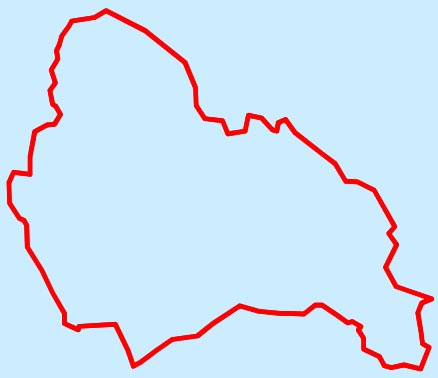

Image redacted for public version.
See: Census of India (2011) District Census Handbook, Kullu, Village and Town Directory, Government of India, page 5

http://www.censusindia.gov.in/2011census/dchb/0204_PART_A_DCHB_KULLU.pdf

Fig. 3: Kullu District- 'HiFlo-DAT' area highlighted (Census of India, 2011)

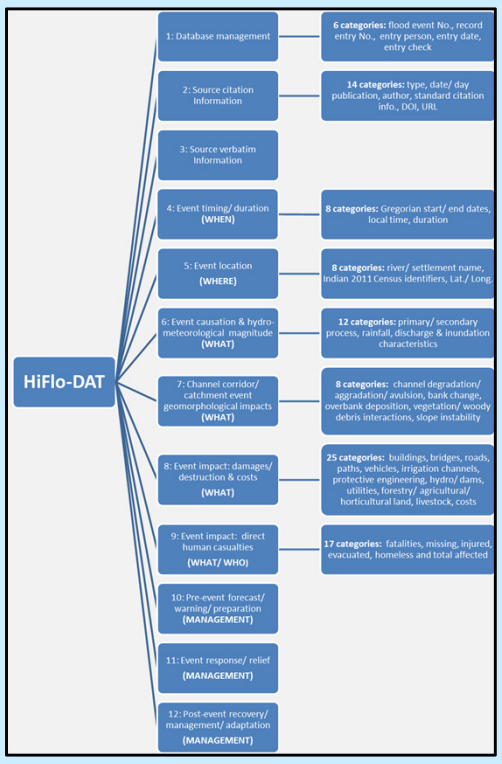

Fig. 4: Synopsis of the 'HiFlo-DAT' database architecture

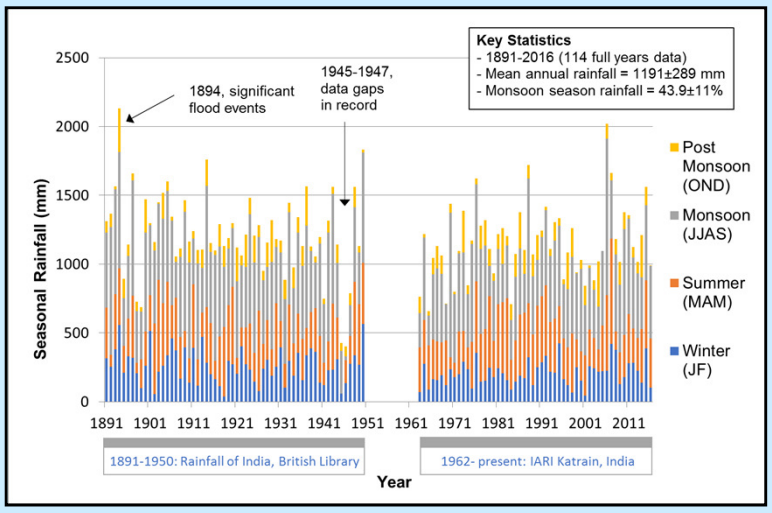

Fig. 5: Rainfall at Naggar Farm, derived from daily data, Jan. 1891 to May 2017 (Altitude: c. 1660 m ASL; Lat. 32° 06' 9.41" N Long. 77 ° 09' 0.65" E; rain day thrown back to 0800 [pre 1949], 0830 [1949-50], 0900 IST [IARI], Seasons follow IMD conventions)

4. DATA SOURCES

- Span the period 1835- 2019 (185 years).
- Long-term information via English language Indian newspapers. These are national/ regional publications (**Tab. 1**).
- Supplemented by a diverse collection of additional materials (e.g. books, reports, diaries, hydro-meteorological data) compiled from:

(1) Indian Government (e.g. Directorate of Energy, DDMA, HPSDMA, GBPNIHESD, Himurja, IARI, IMD)
(2) Libraries (British Library, Chandigarh Library, Gladstone Library, HPU Library, IIAS Library (Indian Institute of Advanced Studies)- Shimla, Kullu Library, NMML-Delhi, Ratan Tata Library- Delhi)
(3) Archives (American Alpine Club [USA], HP State, National Archive India, Punjab State, RGS-IBG)
(4) Private/ family archives (Chetwode, Donald, IRMT-Naggar, PAHAR [USA], Pagoda Press, Tribune Office)
(5) Academic publications & existing global database entries.

5. RESULTS

- ***Naggar rainfall 1891- 2017*** **(first time compiled)** (**Fig. 5**) reveals notable intra- and inter annual variability over 114 full years. Detailed analysis is pending verification of some anomalous daily data entries (especially after 1962) and review of wider site meta-data. Planned analyses include: consideration of long-term trends, role of wetter winter/ summer seasons, monsoon season variability, daily rainfall value and flood episode relationships (accepting Naggar may be distant from the flood location, and thunderstorms are very localised).

- ***Kullu flood history*****:** The 'HiFlo-DAT' database is a work in progress. Initial observations suggest:

(1) Flood events frequently occur during monsoon months (JJAS), but not exclusively
(2) Rainfall (persistent and thunderstorm) is a common flood trigger; but causation also includes recorded LLOFs, earthquakes and hydro-power plant issues
(3) Years with high-magnitude &/or repeated flood events so far include: 1846, 1875, 1894, 1994, 1995, 2018. For 1894 (wettest year on instrumental record) detailed accounts of elevated winter precipitation, snow avalanches and landslides exist. Larger events with broader footprints (e.g. 1894, 1905 Kangra earthquake, 1995, 2018) brought significant geomorphic change and societal impact
(4) Apparent hotspot flood locations include: Upper Beas north of Manali, Phojal Nalla (opposite Naggar), Sarvari Nalla (Kullu) and the Parvati River
(5) Since 1830, recorded floods occur in at least 13 of 19 decades. With a step change in occurrence or newspaper reporting since the 1990s.

Newspaper	Timespan Reviewed *(Total Years)*	Search Months	Output Format	Output Holdings	Number of Files
Indian Express (Delhi & Chandigarh editions)	1954-2017 Delhi 1977-2010 Chandigarh (are webpages after) *(64 Delhi)*	All	.JPEG, keyword search of Delhi database in Panchkula	Filtered at capture	36
The Times of India	1838-2005 (are webpages after) *(168)*	All	.PDF keyword search of ProQuest database at British Library		90
The Tribune	1881-2016 (are webpages after) *(136)*	All	.PDF keyword search of Digital Smart Archive in Chandigarh		513 (from 95,385 in Feb. 2016)
Civil & Military Gazette	1876-1914 1947-1949 *(42)*	JJAS (Monsoon), except 1894 (Jan-Oct)	.PDF, microfilm outputs at British Library	Unfiltered at capture	14,832 + 1725 (1894) (individual pages) 2626 (multi-page compilations)
	1915-1938 1947-1949 1956-1963 *(35)*	JJAS	.JPEG, microfilm outputs at Nehru Memorial Museum & Library (NMML) in Delhi		11,441 + Part of NMML aggregated collection of 88,306 pages
Delhi Gazette	1837-1845 1847-1856 1859 1877-1889 *(33)*	JJAS	.PDF, microfilm outputs at British Library		Part of British Library aggregated collection of c. 27,000 pages
Englishman Newspaper	1894 (are other unsearched holdings) *(1)*	MJJAS	.JPEG, microfilm outputs at NMML		Part of NMML aggregated collection
Mofussilite (1 of 3 publications subsumed by CMG)	1845 1847-1875 *(30)*	JJAS	.PDF, microfilm outputs at British Library		Part of British Library aggregated collection
The Friend of India/ Statesman	1835-1882 *(48)*	JJAS	.PDF, microfilm outputs at British Library		Part of British Library aggregated collection
	1883-1899 1915-1927 (are unsearched holdings 1928 onwards) *(30)*	JJAS	.JPEG, microfilm outputs at NMML		Part of NMML aggregated collection

Tab. 1: Newspaper archives captured for 'HiFlo-DAT' (excludes listing of fragmentary holdings from other publications)

6. CONCLUSIONS

- The spatial occurrence and temporal frequency of recorded flood impacts are far more extensive than currently detailed in the Himachal Pradesh State HVRA (Hazard Vulnerability Risk Analysis Atlas). This demonstrates the critical importance of systematically reviewing historical accounts to inform future flood risk management/ disaster resilience
- Database construction is an intensive endeavor. It may be applied to other districts in the Indian Himalaya, with ongoing digitization of archive materials and significant resource investment.

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Project Website

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