Estimation of GLOF & Design Flood for Planning and Design

of HEPs in the Himalayas

Isly Issac¹, Dr N.K.Goel², Dr Wolfgang Schwanghart³

^{1,2}Indian Institute of Technology, Roorkee, India; ³ University of Potsdam, Germany

isly_i@hy.iitr.ac.in

1.Background

IMPORTANCE OF HYDRO-ELECTRIC PROJECTS IN INDIA

- India is 5th in exploitable Hydro-potentia
- Energy security for 1.4 billion
- ✤ Clean and green energy
- Essential development
- Rising energy requirements







2. Objective

- To evaluate the Glacial Lake Outburst flood of the Bajoli-Holi dam
- To estimate the inflow design flood of the Bajoli-Holi dam using the Hydro- meteorological method and to extend the results to similar projects leading to better practices









7. Criteria for Identification of Potentially hazardous Glacial Lakes



3.Dataset

The inventory of glacial lakes for the project catchment is prepared using LANDSAT 8 ETM+, Sentinel and Google Earth Pro.

River cross sections extracted from ALOS DEM of 12.5 m horizontal resolution at an interval of 800 m.

4.Himalayan Energy-Water Nexus & GLOF

In the Himalayas, major rivers originate from glaciers-Indus, Brahmaputra and the Ganges

High Head and narrow valleys

Stagnant glacier ice within the dam

5. Study Area





MIKE 11 model setup for GLOF simulation

Basin	Area	L	Lc	Seq
	(sq.km)	(km)	(km)	(m/km)
Bajoli -Holi	902	52.15	20	43.15

8. Method & Results

Case No.	Initial condition of discharge in River	GLOF peak d/s of Glacial lake (cumec)	GLOF peak at Bajoli Holi HEP (cumec)	Travel time of GLOF wave (minutes)	Glacial lake		
1	MAF	1525	934	21	GL-47(c 15km frc		
2	100-year flood	1525	992	19	listance om dam)		
3	MAF	2147	571	60	GL-52(26.4 k da		
4	100-year flood	2147 952		37	(distance km from am)		
MAF-Mean Annual Flood-52 cumec 100-year return period flood-1157cumec							

9. GLOF Hydrographs at the Project location







Doministic de la companya	Longth 2420 m	Time (minutes)	0 15 30 45 60 75 90 105 120 135 150 165 180 Time (minutes)	30 195 210 225 240 Time (hr)	
Bajoli Holi H.E. project Bajoli Holi H.E. proj		The largest glacial lakes for the project catching GL-47 with a surface area of 14.5 ha and estimated volume of 2.2 MCM and 1.5 MCM resolution located at a distance of 26.4 km and 15 km ups	nent are GL-52 and I 10.6 ha and an Spectively. They are Stream of the dam.	Probable Maximum Flood-8163 cumec The PMF has been generated by following the criteria of selection of inflow design flood for the safety of dam as per IS:11223-1985, the Indian Standard on guidelines for fixing spillway capacity.	
6.Methodology of GLO	F Analysis		10.Conclusion		
 1.Catchment area delineation. 6.GLOF simulation 5.Criticality analysis 4.Approximate volume of the critical glacial lakes estimation 	2. Preparation of Glacial lakes Inventory in the catchment area 3.Potentially dangerous glacial lakes identification	Dam safety is now construction The Indian Himalayan re- even In order to keep pace with por GLOF and Design flood of dam of dams For the Bajoli Holi project observed that GLOF Statutory provisions of free suggested to accommon	sidered an inherent feature in the pla on, maintenance and operation of dan egion is the key in securing green energy r-rising energy demand for India. In GDP growth, India has to develop it tential in the Himalayan regions. both should be analyzed separately for m spillways in the Indian Himalayas for having glacial lakes in their catchmen t, the PMF is 8163 cumec and GLOF is is approximately 12% of the PMF in eeboard with some 10% extra spillwa date the GLOF phenomenon comforta such dams.	anning, design, ms. lergy to meet thets untapped hydro- for computing the for ensuring safety nt.is 992 cumec. It is n this project.ay capacity can be tably for safety of	