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Glacier Dynamics and Outburst Flood Potential from the Imja and Thulagi Glacier-Lake Systems (Nepal)

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Thulagi and Imja lakes are, according to ICIMOD, among Nepal's most dangerous glacier lakes, i.e. most likely to cause death and destruction in case of a glacier lake outburst flood (GLOF). Imja Lake and the associated Imja and Lhoste-Shar glaciers have been intensively studied; Thulagi Glacier and its lake are much less studied. Collectively, we have undertaken a series of increasingly thorough bathymetric and land surveys and satellite remote sensing analyses of Imja Lake and its glacier setting. We are analyzing several expeditions' data to build a detailed assessment of the glacier and lake to better establish the dynamical evolution of the system and its future GLOF potential. Our most recent, most complete bathymetric survey of Imja Lake has revealed a much greater volume (75,200,000 cubic meters) and maximum depth (149.8 m) than found before.

Our analysis suggests that not all possible Imja GLOF scenarios would result in devastation. Some moraine melt-through or down-cutting mechanisms— perhaps induced by extreme monsoon precipitation or an earthquake— could generate outbursts lasting from 10,000-100,000 seconds ("slow GLOFs"), thus limiting peak flows and downstream damage. The potential damage from a slow GLOF from Imja Lake— even if there is a large total volume— is lessened by the relatively low peak discharge and because the major villages downstream from Imja Lake are situated just outside of and above a deep, broad outwash and debris-flow channel system. Imja and other glaciers in the area have built a large fan, now deeply trenched, which is able to accommodate the peak discharges of potential slow GLOFs, such that Dingboche and other villages would be spared. However, local geomorphology also bears evidence of "fast GLOFs," such as may be issued by a tsunami, which could be initiated by a large mass movement into Imja Lake and which might override and damage the end moraine in <100 seconds. Dingboche and other villages are vulnerable to such a "fast GLOF."

Thulagi lake, on the other hand, exhibits a much larger hazard potential even from slow GLOFs simply because downstream developments— particularly Tal village— are established on the lowest part of the floodplain of an outwash channel system, and there is a lack of deep channel entrenchment. We will present some details of both glacier-lake systems from our recent bathymetric and satellite remote sensing of glacier behavior and the characteristics of downstream developments to explain why the two lakes pose different likelihoods of causing downstream devastation. Neither system is safe, but the hazards differ.