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Geomorphic signature of Paleo-seismic landslides- Studies from parts of the active seismo-tectonic domain of Nagaland, North East India

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Landslide susceptibility studies by the authors; in parts of Paleogene fold belt of Nagaland, located in the active seismotectonic domain of North East India, has identified significant imprints of a number of large paleo- landslides. The geomorphic signatures and morphometric features observed and studied in the south-southwest of Kiruphema village, near Zubza at the northern slope of Lulnadi/Pfukho, near Khuzama village and adjacent to the Khonoma village area of Kohima district, Nagaland are akin to the large paleo landslides initiated elsewhere due to the past seismic shaking. The large dimension, presence of rectilinear to curvilinear relict to reactivated scarp proximal to ridge axis, prominent zone of past mass depletion in the form of stripping of mountain (in the upper reaches), corresponding zone of accumulation in the form of modified gentler slope and a large run out of the released mass, indicated mass wasting related to co-seismic shaking, which might have been further reactivated due to post seismic climatic reasons. The above contentions can be supported with the fact that the area comes under one of the highest seismically active zone [1] [2] having five potential seismic source zones [3] namely i) the Shillong-Mikir Hills massif ii) Bengal basin-Tripura-Mizoram fold belt iii) Himalayan fold thrust belt iv) Belt of schuppen and v) Indo-Burma subduction zone within a radius of 300 km and experienced seismicity of varying magnitude, depth with epicenters within reasonable distance from the site. The same is evident from the fact that between the period 1897 to 2013, the above considered area reported to have 1,684 numbers of historical and instrumental earthquake events having a magnitude of 4M and above of which 607 number have magnitude 5M and above. The estimated rate of exceedance of intensity measure level (PGA) and return period for Kohima area from Probabilistic seismic hazard assessment indicate exceedance of bed rock level PGA in the range of 0.4 to 1g with corresponding return period from 806 years to 5228 years. Analysis of the generated database indicates the probability of at least 48 events in the Holocene period (last 10000 years) in which horizontal component of peak ground acceleration (PGA) might exceeds from 0.4 g to 1g. The identification of geomorphic signatures of Paleo-seismic landslide qualitatively validates the PSHA estimates in respect of the return period for a range of Intensity for the study area. Identification, delineation and detailed attributes of the Paleo landslides preserved in the geologic record of the mountainous terrain of Nagaland are the first significant step in paleoseismic evaluation from paleo-landslide point of view in the active seismo-tectonic domain. The existing seismicity catalogue for higher magnitude earthquake can be upgraded for a longer period through dating of the paleo seismic landslides and for estimation of recurrence relation in respect to large earthquakes (M 5 and above) with greater level of confidence.

The same will be highly beneficial for seismic hazard and risk assessment of the area through estimation of the likelihood time for triggering of societal relevant earthquake.

References:

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