Identification of high risk landslide slopes and disaster management of Hattian Bala and adjacent landslide areas, Azad Kashmir (Pakistan): Applying AHP (Analytic Hierarchical Process) method

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Landslide often occurs under certain topographic and geologic conditions. On the 8th October 2005 a magnitude 7.6 earthquake and subsequent aftershocks for the following months struck the Lesser Himalaya of northern Pakistan devastating the region of Kashmir and parts of Khyber Pakhtoonkhwa. It is estimated that around 87350 people died in Pakistan, of which, 26500 were directly hit by landslides. Within these statistics are the largest single-cause loss of life event triggered by the earthquake; the 68×106 m^3 Hattian Bala rock avalanche that destroyed a village and killed around 1000 peoples.

Based on interpretation of aerial photos of landslide slopes and micro-morphological components that reflect activity of mass movement, a landslide hazard rating system has been developed by application of the Analytic Hierarchical Process (AHP). The AHP method decomposes the process of subjective decisions of people into layers and expresses the process qualitatively**.** This study adopted AHP for landslide hazard assessment by the hierarchical structuring and weighting of the factors that contribute to the reactivation of landslides. Factors and items were determined by brainstorming of experts in geomorphology and landslide investigation works. The first hierarchical level is landslide hazard evaluation. Five geomorphic factors which comprise the second hierarchical level were selected as follows; 1. Distinctiveness of main scarp. 2. Surface feature of landslide body. 3. Position of landslide body on the slope. 4. Position of cracks in the landslide body. 5. Stability conditions of landslide toe. Those correspond to three principle factors; geomorphologic evolution process, landslide activity and destabilizing possibilities. The third hierarchical level consists of the optional items under each geomorphic factor of second level. Factor 5 consists of 5-1 credibility of the landslide toe and 5-2 instability perceived from the sharp end of the landslide toe as level IV.

The final weight coefficient for each item is calculated by multiplying the values of hierarchical level II, III and IV. Hazard levels are classified into hazardous, slightly hazardous, moderate and safe categories, according to the score that accommodates the total weight for each landslide.

Based on this system, a total of 32 deep-seated landslides were identified in the Hattian Bala landslide and its adjacent areas.