Effect of Knickpoint Development in Controlling the Stability of the Landslide Dam

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Abstract: This paper studies the stability of landslide dams and development of knickpoints by field investigations and experiments, and analyzing satellite images. The stability of landslide dams depends mainly on the development of step-pool system and stream power of the flood flow. The development degree of step-pool system is represented by a parameter S_p, which was measured with a specially designed instrument. A preservation ratio of landslide dams is defined as the ratio of preserved height after flood scouring to the original height of the dam. For streams with peak flood discharge lower than 30 m^3/s, the preservation ratio is linearly proportional to S_p. For rivers with peak flood discharge higher than 30 m^3/s (30 – 30 000 m^3/s), the minimum S_p value for stable channel increases with the unit stream power p. For a landslide dam with poorly developed step-pool system, S_p is smaller than the minimum value and the outburst flood incises the spillway channel and causes failure of the dam. For preserved landslide dams with sediment deposits in the quake lakes, a knickpoint may be developed if it is stabilized by long-term action of the flow. Large knickpoints can totally change the fluvial processes and river morphology. If hundreds of landslide dams occurred simultaneously on a reach of a mountain river, the potential energy of bank failure and the slope erosion are greatly reduced and sediment yield from the watershed may be reduced nearly to zero. The quake lakes may be preserved for long term and become beautiful landscapes. Streams with long term unfilled quake lakes have good aquatic ecology.

Key words: landslide dams; step-pool system; Knickpoint; river-bed incision; Wenchuan earthquake

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