Background

The Langtang valley, ~60 km north of Kathmandu is one of the most intensely researched catchments in the Nepalese Himalayas. Already in the 1950s first investigations were carried out in a small proglacial valley found to be the site of a massive landslide that occurred 104 years ago. The displaced mass encompassed 10–15 billion m³ and is possibly the largest terrestrial land movement in a crystalline environment (Figure 1). The failure likely happened due to a sulfidic mineralized ore structure within a discordant leucogranitic dike that slipped during an earthquake related to the Main Central Thrust (MCT) (Ibetsberger 1996; Weidinger et al. 1996; Schramm et al. 1996).

The upstream area of the valley is today covered by a clean-ice glacier (Yala Glacier), ranging from 5170 – 5300 m asl. and an area of 1.6 km² (Ragettli et al. 2015). The glacier drains partly towards the Lirung glacier further West but mainly into an incised channel towards the South (Dranglung Chu, Figure 2 and 3). Heavy erosion is visible along the valley’s flanks since many years and the valley ends in an alluvial fan covering the entire width of that Langtang valley (Figure 3).

Initial Research Questions

While the Geology has been well determined in the specific area also explaining why the landslide occurred in this particular spot and the petrography of the alluvial fan is documented (Weidinger et al. 2002) it is not clear how the fan has developed and why it did so occurring only in recent years. High resolution imagery from November 1974 and October 2015 and evidence from earlier studies in the late 90s suggests it became reactivated in the late 70s during a flash flood (Schramm et al. 1996) as new fresh deposits become visible. With the recent earthquake in April 2015 that also heavily affected the Langtang area (Karger et al. 2016) the question arises again whether the growth of this fan is predominately driven by

(a)  glacial melt from the Yala glacier
(b)  precipitation over the whole year
(c)  heavy monsoon rains
(d)  minor or major seismic events

Results

The alluvial fan has grown significantly since 1974 but there was no significant change after the earthquake in May 2015 or the subsequent monsoon (Figure 4). More analysis of higher temporal resolution would be necessary for conclusions on seasonal changes driven by heavy monsoon rains.

An initial channel at the top of the fan has since levelled out and deposition is relatively homogenous. This could point to few extreme events (Figure 5). The area gain per year ranges between 10 000 and 30 000 m² however if recent years are an indicator there is a decrease in area gain combined with a slight increase in deposition height.

Rapid local changes like the gain in area between 2010 and 2014 are obvious however seem to be very heterogeneous in time.

The small effect by the earthquake is also substantiated by the very minor changes in erosion in the upstream before and after the event. This does also not change after the following monsoon season (Figure 7).

Selected Literature

Karger, J.; Ragettli, S., Tectonophysics 260 (1996) 85-93; Weidinger, J., Schramm, J., Surenian, R. (1996), On the petrography of the Langtang Fan, Nepal, Tectonophysics. 260 (1996) 95-107; Schramm, J., Petrologic and structural controls on geomorphology of prehistoric Tsergo Ri slope failure, Langtang Himal, Nepal, Geomorphology 26 1998, 105-122. Weidinger, J., Schramm, W., and Ragettli, S. (2015), The alluvial fan covering the Yala Glacier in Langtang, Nepal, was most likely triggered by a high-altitude landslide ca. 10,000 years ago. Weidinger, J. and Ragettli, S. (2013), CRYSTALLINE CORE OF THE HIMALAYA, LANGTANG NATIONAL PARK, CENTRAL NEPAL, 1974-2015: CHRONOLOGY OF TECTONIC EVENTS IN THE LANGTANG HIMALAYA. J. Geophys. Res. 118, 11467-11487. An initial channel at the top of the fan has since levelled out and deposition is relatively homogenous. This could point to few extreme events (Figure 5). The area gain per year ranges between 10 000 and 30 000 m² however if recent years are an indicator there is a decrease in area gain combined with a slight increase in deposition height.

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