CORRESPONDENCE

Cairns as Hurdles for Lichenometric Studies on Himalayan Glaciers

Kapil Bisht, Shashi Upadhyay and Yogesh Joshi*

[1]Centre for Biodiversity Conservation and Management, G. B. Pant National Institute of Himalayan Environment and Sustainable Development, Kosi-Katarmal, Almora -2 63 643, India

***E-mail:** dryogeshcalo@gmail.com*

The Himalaya is not only a natural heritage but also the spiritual paradise for the Hindus and a pantheon for other religions. In Himalaya the glaciers and snow capped mountain peaks are not just heaps of ice but the source of inspiration for mankind. They are associated with the cultural and spiritual believes of mankind. Many of the glaciers and mountain peaks are named after the names of gods/goddesses/ local deities and are considered sacred. They are not just water towers; they are the places where everyone wants to pilgrimage for one's mental peace while some others trek over the mountains to test their physical potential. They are the heavenly places devoid of man made things. In recent decades under the influence of global warming the glaciers worldwide have attracted attention of the scientific community (Haeberli et al., 1996). The scientists worldwide are concerned about the rapid recession of glaciers. The Himalayan mountain system that consists of the largest concentration of ice outside the Polar Regions has attracted attention from across the world (Bahuguna et al., 2014). The high mountains of South Asia covering the Hindu Kush, Karakoram and Himalaya (HKH) belt have been described as the "Water Tower of Asia" (Viviroli et al., 2007; Immerzeel et al., 2010) due to their important role in feeding the major rivers of South Asia. Several studies conducted on Himalayan glaciers have revealed rapid recession (Chaujar, 2009; Bahuguna et al., 2014; Kulkarni and Karyakarte, 2014; Wiltshire, 2014; Bisht, 2018; Bisht et al., 2018a,b). In many of the Himalayan glacial moraines and at the base of high mountain peaks one can find several cairns (stone towers), built by putting stones one above the other (Fig.1). During the religious visit to these regions, visitors perform a cultural practice of building cairns. People pick up the stones from moraines and carry them to the snout or base of the mountain peak. They build cairns as an offering to the deity as well as to symbolize their presence at that place.

Lichenometry a commonly used dating technique which is very popular among geologists and lichenologists to date glacier moraines; requires the stones to be stayed at the places where they were actually exposed after the retreat of glacier. Building of cairns creates a problem for the researchers because the stones consisting lichens get shifted from their actual position of exposure; in this case if any researcher measures the diameter of lichens and measures the distance of the stone from the snout the results can give wrong information about the age of the exposure of that stone and hence the age of the lichen as well. For instance if a researcher measures the diameter of a lichen species on a stone at 100 m distance from the snout, and thereafter if some visitor picks up that stone and puts it at the snout, the researcher can consider that the actual location of the stone was at the snout, although it was exposed 100 m away from the snout, in this case the measurements can mislead the researcher and the dating will be inaccurate. This also becomes a problem for the future measurements. Researchers have to find ways to tackle this problem otherwise the lichenometric studies will not provide the accurate dating when applied on Himalayan glaciers. The issue of cairns can be resolved to some extent by marking the geo-coordinates of that point on the stone surface (but the marking should be long

Fig.1. Cairns on moraines of Adi Kailash Glacier of Uttarakhand

lasting and should be water proof). This may help in relocating the stone surface in future surveys by hand held GPS. It is recommended to focus on bigger boulders while sampling the lichen species, but it is always not possible that one can find the biggest thallus on the bigger boulder only, however, sometimes the bigger lichen thalli can be found on small stones. In some regions the moraines consist only gravel and soil, lacking big boulders. In this case it is reasonable to measure a larger number of lichen thalli for minimizing sampling errors. The plot size for sampling lichen species on Himalayan glacial moraines may vary for each glacier. This is because the moraine conditions are different for different regions. In some regions the glacial moraines are spread over a large geographical area and are devoid of any kind of vegetation including lichens to a considerable distance from the snout, while in some other areas the moraines are smaller and consist of vegetation very nearer to the glacial snout. In this case it is not possible to suggest a standard plot size for lichen sampling. The plot size should be bigger enough to at least contain the representative individuals of all the lichen species growing on that particular moraine.

Acknowledgements: Authors are grateful to Dr. Ranbeer S. Rawal, Director, G. B. Pant National Institute of Himalayan Environment and Sustainable Development, Kosi-Katarmal, Almora and Nodal person KSLCDI - India for providing financial assistance under Kailash Sacred Landscape Conservation and Development Initiative (KSLCDI) facilitated by International Centre for Integrated Mountain Development (ICIMOD).

References

Bahuguna, I.M., Rathore, B.P., Brahmbhatt, R., Sharma, M., Dhar, S., Randhawa, S.S., Kumar, K., Romshoo, S., Shah, R.D., Ganjoo, R.K. and Ajai (2014) Are the Himalayan glaciers retreating? Curr. Sci., v.106(7), pp.1008-1013.

Bisht, K. (2018) Impact of climate change on glaciers of Kumaun Himalaya: a lichenometric approach. PhD Thesis, Kumaun University, Nainital, pp.170.

Bisht, K., Joshi, Y., Upadhyay, S. and Mehta, P. (2018a) Recession of Milam Glacier, Kumaun Himalaya, observed via lichenometric dating of moraines. Jour. Geol. Soc. India, v.92, pp.173-176.

Bisht, K., Joshi, Y., Upadhyay, S. and Chandra, K. (2018b) Assessment of climate change impact on recession of Adi Kailash Glacier Kumaun Himalaya: a lichenometric observation. ENVIS Bull. Him. Ecol., v.25, pp.24-27.

Chaujar, R.K. (2009) Climate change and its impact on Himalayan glaciers–a case study on the Chorabari glacier, Garhwal Himalaya. Curr. Sci., v.96, pp.703-708.

Haeberli, W., Hoelzle, M. and Suter, S. (1996) Glacier Mass Balance Bulletin 1994-1995. Bulletin No. 4. Zurich: World Glacier Monitoring Service, pp.89.

Immerzeel, W.W., van Beek, L.P.H. and Bierkens, M.F.P. (2010) Climate Change Will Affect the Asian Water Towers. Science, v.328**,** pp.1382-1385.

Kulkarni, A.V. and Karyakarte, Y. (2014) Observed changes in Himalayan glaciers. Curr. Sci., v.106(2), pp.237-244.

Viviroli, D., Durr, H. H., Messerli, B., Meybeck, M. and Weingartner, R. (2007) Mountains of the world, water towers for humanity: Typology, mapping, and global significance. Water Resour. Res., v.43(7), pp.W07447.

Wiltshire, A.J. (2014) Climate change implications for the glaciers of the Hindu Kush, Karakoram and Himalayan region. Cryosphere, v.8, pp.941-958.

DOI: 10.1007/s12594-019-1353-z