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Estimation of discharge from glacierized basins of Nepal and possible impact of climate change on discharge

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Prediction of melting of snow and ice in a glacierized basin is very important to estimate basin discharge. It is more important in the Himalayas where direct field observations are very difficult to carry out due to rugged and remote mountain terrain. Study of basin discharge is important to know the long-term availability of water resource and to assess impact of climate change. The studied river basins were Langtang Khola Basin (area: 333.0 km2) and Lirung Khola Basin (area: 13.8 km2) in Langtang Valley, central Nepal. Since glaciological and hydro-meteorological data are very scarce in high mountains areas, the degree-day method was used to calculate snow/ice melting using monthly mean air temperature and monthly total precipitation. The lower parts of glaciers in both basins are covered with debris and hence a relation between degree-day factor and debris properties was used to estimate ice melting under debris layers. Then the basin discharge was calculated as a sum of snowmelt above debris and rock, melting from snow and ice, melting under debris layer and rainfall.

Compared to the simplicity of the method, results were very encouraging. The calculated discharges from Langtang and Lirung Khola Basins were compared with the observed ones from July 1985 to June 1986 and from May to September in 1996, respectively. The calculated discharge was very close to the observed discharge in both basins. The annual total calculated discharges from Langtang Khola Basin was 1475 mm which was little overestimated compared to the observed discharge 1357 mm. The trend of calculated discharge from 1985 to 2007 showed that discharge increased considerably from 1995 corresponding to increase in air temperature, but there was no significant change in precipitation amount except in 2001. This implies that the mass of snow and ice in the studied basins was depleting. The discharge may increase now for some years but would start to decrease due to less amount of snow and ice reserve in the basin in the near future. Such variations of discharge should be taken into account while formulating any water projects for hydropower, irrigation and drinking water in such basins.

Test of the sensitivity of discharge to change in air temperature was also done. It was done by increasing 1 oC air temperature as observed in 1997 keeping other parameters unchanged. The discharge was found to be increased by 25 % compared to when the air temperature did not increase; showing strong sensitivity of discharge to air temperature. Therefore, glacio-hydrological studies are very important in glacierized basins for proper estimation of discharge from such basins. It is highly recommended such studies on more and more glacierized basins to assess possible impacts of climate change on water resources in the Himalayas.