Hydro-Meteorological Study for the Mountainous Region of Kali Gandaki Basin in Nepal

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ABSTRACT:

Kali Gandaki basin, a typical sub-catchment of Narayani catchment in west Nepal, has a very unique topographical pattern. Annapurna Himalaya, with the altitude of 8,091 meters, has nearly divided the basin into two distinct parts. The Annapurna Himalayan belt is solely responsible for the diverse rainfall distribution in the basin due to the windward and leeward effects of this Himalayan belt. Thus, the orientation of the Annupurna at the center of the basin acts as barrier for the orographic rainfall both for summer monsoon and winter rainfall. Consequently, the basin has a very contrasting rainfall distribution with annual rainfall more than 5000 mm in Lumle and less than 300 mm in Jomsom, which are the highest and lowest observed rainfall of Nepal respectively. These regions comprise a typical example of rainfall distribution in mountain regions. Thus, the authors have attempted to study various aspects of the hydro-meteorology in the basin.

Mean annual and seasonal rainfall (pre-monsoon, monsoon, post-monsoon and winter) have been calculated for the basin with different methods like the arithmetic, Thiessen polygon and isohytel methods. The results thus obtained are compared with each other. The southeastern region of the basin receives the highest rainfall with the northern region being very arid. Similar rainfall distribution has been noticed in all the seasons.

Regression analysis of the rainfall and runoff has been conducted for monthly, seasonal and annual basis. The complex topography pattern on rainfall with limited station has given poor relationship of rainfall-runoff on the monthly and seasonal basis. However, the relations are comparatively satisfactory in the monsoon period, indicating the influence of the monsoon throughout the basin except for northern part. A comparison has also been made between observed runoff and estimated runoff obtained from the regression. Frequency analysis has been also carried out incorporating the instantaneous floods. Gumbel distribution has been used to estimate the flood with the corresponding return period.

Kali Gandaki basin is highly potential for water resources. Thus results obtained for different time scales from the study is quite useful for the water resources planning, projects and managements for various purposes. Despite the limited data, the results of rainfall and runoff analysis are indeed encouraging. As the distribution of hydro-meteorological stations is very poor in the upper part of the basin as compared to the lower part, sufficient station network density in accordance with the WMO criteria is recommended. The study of snowmelt runoff and sediment yield is also essential for the water balance of this important region.

Key word: Annapurna Himalaya, Orographic effect, Rainfall depth, Gumbel distribution, Lumle