THESIS

INVESTIGATION OF RUNOFF REGIMES AND THE LINKAGE BETWEEN CLIMATIC VARIABLES AND RIVER FLOW IN SWAT RIVER

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ABSTRACT

As much of the flow abstracted from the River Indus for irrigation originates in the Himalaya, Karakuram and Hindukush mountains, an understanding of hydrological regimes of mountain rivers is essential for water resources management in Pakistan.

It is said that Indus is the lifeline of Pakistan. In the same way River Swat can be called as the lifeline of North Western Frontier Province. River Swat supplies water to main valley of Swat and Peshawar plains, comprising District Swat, Malakand Agency, Charsadda, Mardan and Swabi districts. Water has been diverted into traditional channels of the mountainous areas in Swat, which is famous for producing rice, maize, wheat, orchards and vegetables. Near Batkhela, the Upper Swat Canal has been diverted under the hilly tunnel to produce electricity at Durgai and irrigate fields. Lower Swat Canal is providing water to the deep fertile soils of Charsadda District. These areas are famous for cash crops cultivation i.e. sugarcane and tobacco.

As there are no proper estimates and relationships of river flow and climatic variables and especially snow-melt stream flow relationships there is always a chance of floods which causes serious damages to crops, human beings and other infrastructures. A proper study therefore is required to understand and analyze the runoff regimes and its relation to the climatic variables to forecast the river flow.

In this study different hydrological regimes of River Swat Basin at Kalam are investigated by using different approaches i.e Graphical approach, Regression analysis, Annual and Seasonal Correlations, Monthly Correlations of Runoff with rainfall and temperature and Serial Correlation Analysis. In graphical analysis, it is found out that the river flows are maximum in the months of June and July based on temperature and minimum in the months of December to March. Similarly, precipitation starts increasing in the month of December and goes up to maximum in March and then starts decreasing from March and goes to minimum in June. Temperature is also maximum in June and July and mininmum in January and

February. Snowmelt causes to increase the river flows in the months of April, May, June and July. The dominant weather in this region is due to western disturbances and the monsoon effect is very low. In regression analysis, two techniques are used in this study, first is Individual Monthwise Regression in which 30 years monthly values of each parameter are regressed for each month individually. The second is Collective Monthwise Regression in which normal value of each month is tabulated against each parameter and then collectively flow values are regressed on precipitation, temperature and relative humidity. In this collective monthwise technique encouraging results were obtained, which can be used for future prediction of flow if other climatic data is known. In annual and seasonal correlations and monthly correlation technique, results are not good; however, serial correlations give better results.

Thirty years data was used for the analysis of runoff regimes and the linkages between river flows and climatic variables (temperature, precipitation and relative humidity) in this study. Linkages in collective monthwise approach of regression analysis came out quite better, especially of flow and temperature, while in other approaches; results are very weak or non-existing except serial correlations. This is due to not having gauging stations at upper elevations, or it may be due to the reason that the station is not representative of the whole catchment. In this study it is found that the Collective Month-wise Technique is a useful tool for Swat River Basin at Kalam for predicting flow in River Swat if other climatic data is known. It is also found that the only Kalam gauging station and Kalam Weather observatory is not sufficient for the analysis and prediction point of view. Observatories and gauging stations are also recommended in upper elevations.