IMPACT OF CLIMATE VARIATION ON HYDROLOGICAL BEHAVIOR OF SNOW-FED CATCHMENT, A CASE STUDY OF CHITRAL BASIN

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ABSTRACT

The Upper Indus Basin (UIB), situated in the Himalaya Karakoram and Hindu Kush (HKH) mountain ranges, is the major contributor to the supply of water for irrigation in Pakistan. Climate change may have serious implications for the management of water resources as the annual and seasonal variation in the snow cover area (SCA) due to its response to the climatic variables directly influences the water supplies. Improved management of downstream water resources requires studying and comparing spatiotemporal changes in the snow cover and hydrological behavior of the river basins located in the HKH region. Hence, the aim of this study was to examine the Impact of climate variation on hydrological behavior of Chitral basin. The methodology of current study includes (1) Trend analyses to assess the climate variation in snow fed catchment (2) Spatial-temporal analysis of snow covered area (SCA) using MODIS data and GIS (3) Future projection of the climatic data using statistical downscaling modeling to forecast the possible variation in climatic variables (4)-Hydrological modeling using Snowmelt Runoff Model (SRM) to assess snowmelt runoff and to examine the hydrological behavior of snow fed catchment in response to climatic variation.

Trend analysis of the SCA and hydro-climatic variables was carried out using Mann-Kendall's trend test and Sen.'s slope. The results revealed that during historical period (1981-2015) 1). A significant increasing trend in seasonal (winter and summer) precipitation in Chitral basin. The past trend showed that annual precipitation is increasing at 38.1 mm/decade however; winter rainfall is decreasing in a short span and slight increase for a long duration. 2). the highest warming trend was observed at rate of 0.93 °C per decade. On the other hand, the maximum temperatures has

decreased significantly by 0.62°C per decade from (2000-2015) 3). Streamflow of the catchment is increasing 10.93% over a 1991-2015 period possibly due to an increase in temperatures and summer monsoon precipitation and it depends much more on snow and glacier melt than on the rainfall-runoff. Snow accumulation period starts in October and the maximum snow cover reaches in a range of 90–95% in the month of January.

Whereas, during future projected period (2030s, 2050s, and 2099s) 1).Tmax for future periods in the whole basin would be increasing 0.36 °C/decade, decreasing 0.22 °C/decade and increasing 0.34 °C/decade respectively 2). Tmin for future periods in the whole basin would be increasing 0.39 °C/decade, 0.18°C/decade and 0.19°C/decade increasing respectively. The changes in annual stream flows for future periods (2030s, 2050s, and 2099s) in the basin would be increasing 9.94 %, 8.86 % and 17.26 % respectively 3). The mean annual precipitation would be increased by 29.65 mm, 17.26 mm and 26.4 mm per decade respectively.

Furthermore, statistical correlation analysis indicated that the stream flow of Chitral basin is largely dependent on the snowmelt and temperature seasonality. Hence, concluded that the prevailing trends and variability, caused by climate change, have a serious effect on the flows of Chitral basin. These predictive quantified impacts of site-specific climate change on stream flows from the mountainous watershed are quite productive and would be helpful for policy maker's planner and decision makers in the field of water resource management.