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Changing Status of Water Services in Beas Basin of Himachal Pradesh

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Abstract :

The Beas Basin, located in the northern Indian state of Himachal Pradesh, is one of the five major river basins in the state and covers an area of approximately 13,390 sq. km. is a region rich in water resources with several rivers, streams, and natural springs. River Beas along with its tributary streams provides the base upon which whole ecosystem of the region gets flourished with multifacetd ecological services. The objective of this paper is to do quantitative and qualitative assesment of provisioning services of Beas River. The results indicate that water availability in Beas River has decreased as river discharge of Beas River at Pong Dam has declined during period 1980 to 2020. For instance,

the highest discharge recorded was 695.13 cubic meters per second (m^3/s) in 1992, while the lowest was 469.53 m^3/s in 2008. Seasonal analysis of river discharge at Pong Dam also shows decline in river discharge in all seasons except slight increase in post monsoon period. Further assessment of water quality of river Beas on parameters such as pH, BOD and Nitrate concentration between 2008 to 2020 reflects deteriorating trend however still range lies within acceptable limit prescribed by Bureau of Indian Standards (BIS) for drinking water in India.

Introduction :

In high-mountain areas such as the Himalaya Karakoram-Hindukush region, the livelihoods of local communities heavily rely on the sustained availability of water resources (Kreutzmann 2000; Parveen et al. 2015). Over the past few decades, significant glacier retreat and mass loss have been observed in nearly all mountain regions worldwide (Braun et al. 2019; Bolch et al. 2012; Paul 2011; Sorg et al. 2012; Meier et al. 2018; Yao et al. 2012). These changes in glaciers can be attributed directly or indirectly to shifts in temperature, precipitation, and moisture patterns. Particularly in the broader Himalaya region, there has been a notable acceleration in ice loss in recent decades, leading to significant alterations in the availability of meltwater for river catchments in South Asia (Maurer et al. 2019; Immerzeel et al. 2010).

River discharge is an important parameter that reflects the water availability, sediment transport and erosion rate of a river basin. Zakwan and Ahmad (2021) conducted a study on the Ganga river, analyzing discharge and sediment load data from 1980 to 2010 at multiple gauging sites. They employed statistical methods like the Mann-Kendall test, Sen's slope method, and innovative trend analysis to identify hydrological trends. Results indicated a decreasing trend in both water and sediment discharge, particularly in the western Ganga plain. Sreekanth et al. (2009) collected water samples from 18 locations along the Bharatpuzza river from 2004 to 2006, examining various physico-chemical parameters and using statistical techniques to assess spatio-temporal variations in water quality. Physico-chemical and biological assessment of river Beas (Sharma and Walia 2016; Awasthi and Tamot 2010) has been conducted using water samples collected from sampling stations along the river and analyzed and were found that turbidity, iron and lead were higher than the acceptable limit prescribed by Bureau of Indian Standards (BIS) for drinking water in India.

Study Area :

The Beas Basin is a major river basin located in the northern Indian state of Himachal Pradesh. Beas Basin's latitudinal and longitudinal extent is between 31°25'N to 32°45'N latitude and 75°35'E to 77° 50'E longitude, covering 24.50 per cent of Himachal Pradesh catchment area. The catchment area of River Beas is around 13390 sq. km and the River travels around 245 Km in the given stretch from Kullu to Dehragopipur (Figure 1). This stretch of river passes through four districts of Himachal Pradesh i.e. Kullu, Mandi (from Bajaura to Sachuhi i.e. 103 Km), Hamirpur (from Sachuhi to Kaloor i.e. 54 Km) and Kangra (From Kaloor to Dehragopipur i.e. 35 Km).

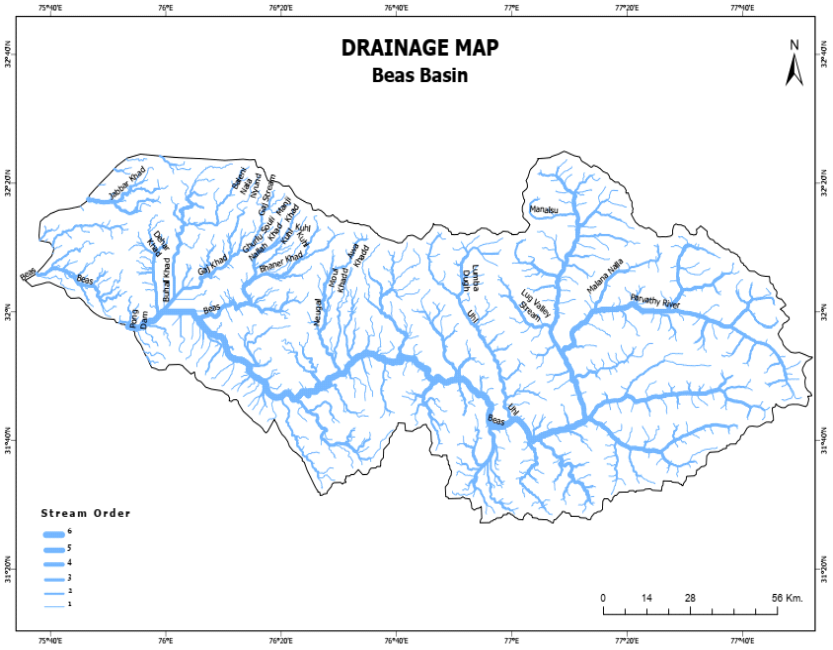


Figure 1 : Drainage Map of Beas Basin

Data Base and Methodology :

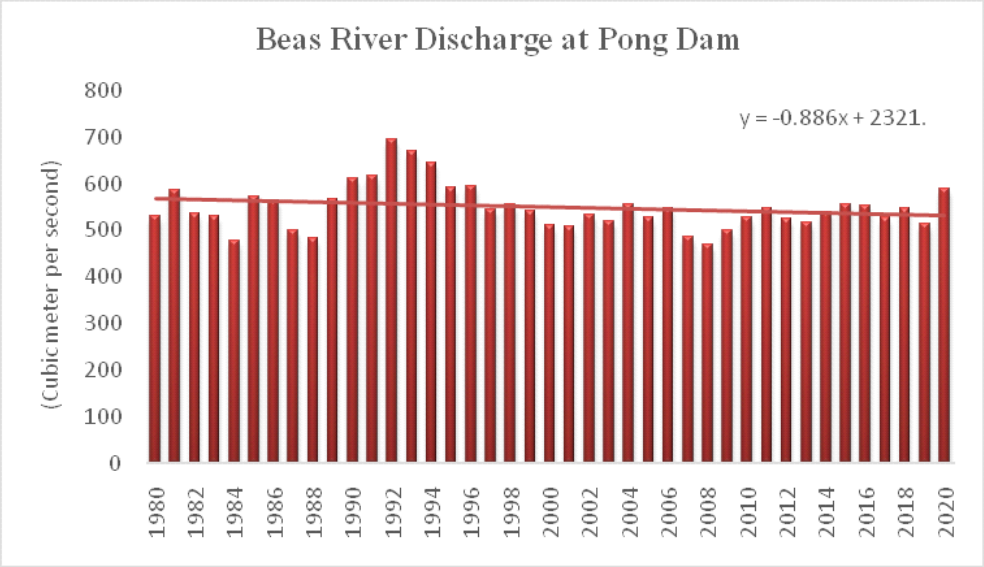
The data set required for water availability assessment is river discharge data of Beas River at Pong Dam. The monthly data for the period 1980-2020 has been collected from Bhakra Beas Management Board (BBMB) and for water quality assessment data of different physical, biological and chemical parameters i.e. pH value, B.O.D and Nitrate concentration in river water at Manali Upstream (U/S) and

Pong down stream (D/S) for the period 2008-2020 has taken from central pollution control board (CPCB). Yearly and seasonal trend analysis has been done of river discharge data has been and regression cofficient value is taken out for rate of change of value. Similarly trend analysis of pH, B.O.D and Nitrate concentration is done to find out direction and rate of change.

Results and Discussions :

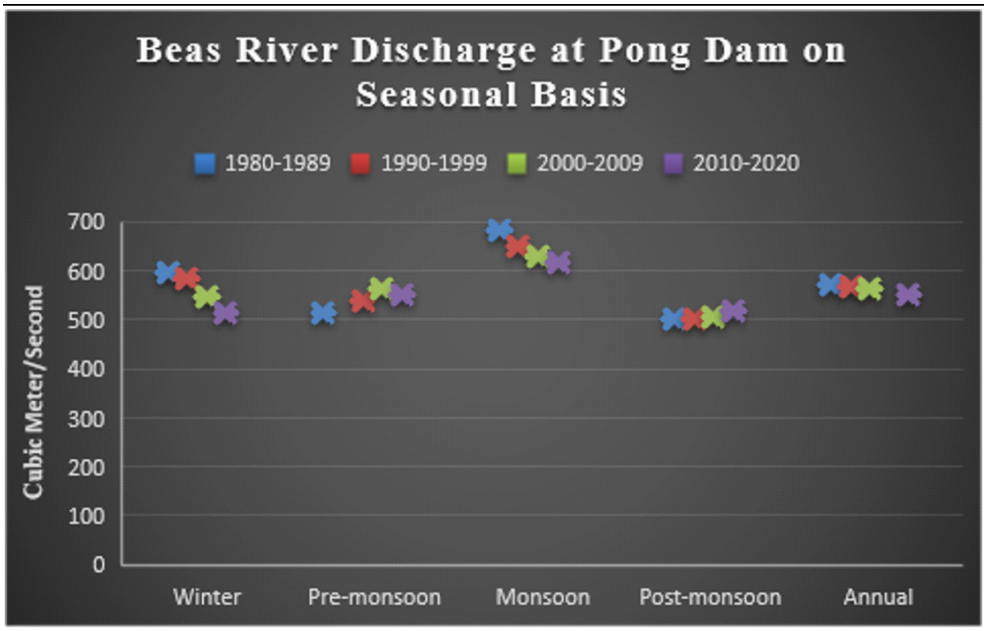
Water availability assessment in this paper has been done on the basis of trend of discharge rate of river Beas at Pong dam. River discharge rate shows decreasing trend with certain fluctuations over period between 1980-2020. For instance, the highest discharge recorded was 695.13 cubic meters per second (m^3/s) in 1992, while the lowest was 469.53 m^3/s in 2008 (Figure 2).

Seasonal analysis of river discharge at Pong Dam also shows decline in river discharge in all seasons except slight increase in post monsoon period during 1980-2020. Between 1980 to 1989 the average discharge rate during post monsson was 501.63 m^3/s, however it increased to 517.97 m^3/s (Figure 3).



Source: BBMB

Figure 2 : Trend of River Discharge at Pong Dam



Source: BBMB

Figure 3 : River Discharge on Seasonal Basis

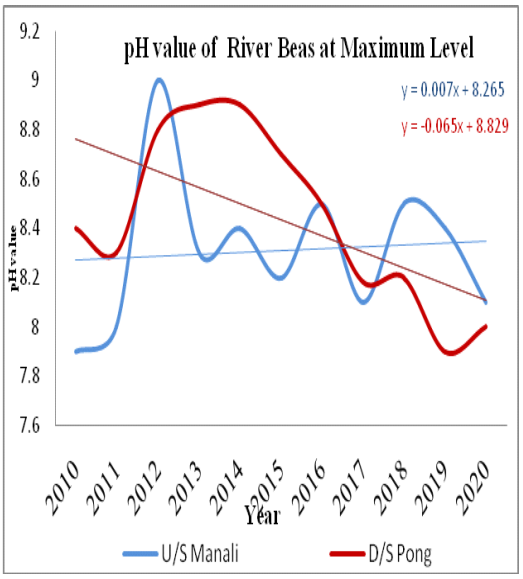


Figure 4 : Trends of Maximum pH value

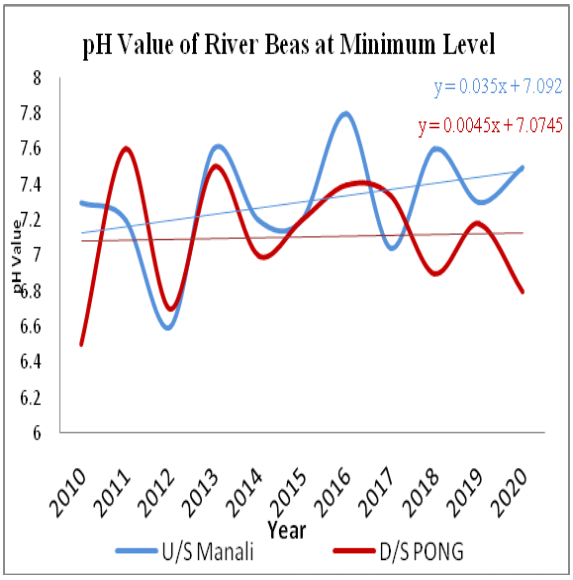


Figure 5 :Trends of Minimum pH value

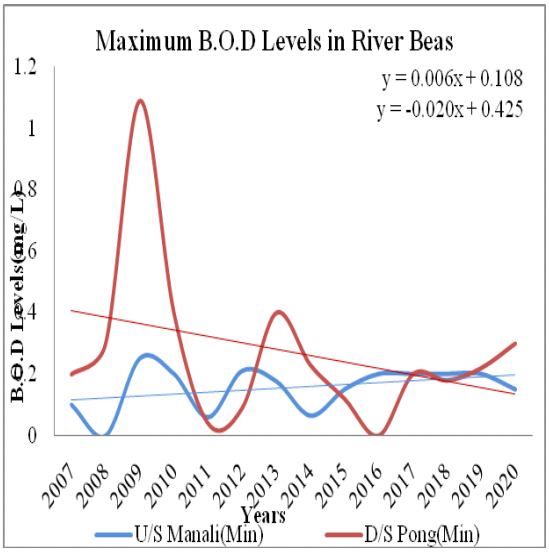


Figure 6 : Trends of Maximum BOD Levels

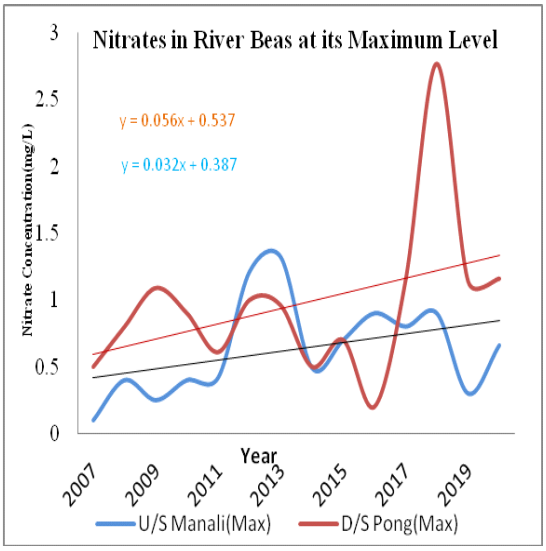


Figure 7 : Trends of Maximum Nitrate concentration

Similarly qualitative assessment of river water is done with the use of physical, biological and chemical parametrs namely pH vlue, BOD levels and Nitrates concentration in the river at upper stream in Manali and in lower streams at Pong. Comparative assessment reveals on above parametrs at these two locations reveals that in upper stream the water quality is much better than that of at Pong site located in lower stream of the region. Though the pH value at minimum level in both site remained almost constant over time, the pH value at maximum level shows declining trend at both site (Figure 4 and Figure 5). However the rate of decline of pH value is much steeper at Pong dam.

BOD stands for biological oxygen demand. A high BOD value indicates a high level of organic pollution in water, which can affect the aquatic life and human health. The above data is of maximum BOD value in Beas river at upper stream Manali and down stream Pong. The data shows that the BOD value of Beas River varies from year to year and from location to location. The highest BOD value recorded at upper stream Manali was 0.3 mg/L in 2016, while the lowest was 0.1 mg/L in 2017. The highest BOD value recorded at down stream Pong was 1.8 mg/L in 2010, while the lowest was 0.3 mg/L in 2008. The average BOD value at upper stream Manali was 0.72 mg/L, while the average BOD value at down stream Pong was 0.81 mg/L (Figure 5).

The sources of nitrate in river water include agricultural runoff, sewage discharge, industrial effluents, and atmospheric deposition. The nitrate concentration in both U/S Manali and D/S Pong varies significantly from year to year. The nitrate concentration in both U/S Manali and D/S Pong shows a rising trend from 2007 to 2013, reaching the peak values of 1.32 mg/L and 2.77 mg/L respectively in 2018 (Figure 6). This could be attributed to the intensification of human activities such as fertilizer application, wastewater discharge, and fossil fuel combustion in the watershed during this period. The nitrate concentration in both U/S Manali and D/S Pong shows a declining trend from 2014 to 2020, reaching the lowest values of 0.3 mg/L and 1.14 mg/L respectively in 2019. This could be due to the implementation of some mitigation measures such as improved wastewater treatment, reduced fertilizer use, and increased afforestation in the watershed during this period.

Conclusion :

Yearly and seasonal trend analysis of river discharge of beas and water quality assessment of same river on spatio-temporal basis reveals interesting findings. Declining river discharge reflects water availability in the region is decreasing in the region and under the cloud increasing intensity of climate change it will further aggravate in the region causing negative consequence to ecosystems and related ecological services.

Further water quality of river Beas on different parameters is deteorating however the water quality of Beas on different parameters were within the limit prescribed by World Health Organization (WHO) and BIS for drinking water in India.

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