Hydro-climatic Trends in Karnali River Basin of Nepal Himalaya

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Introduction

Global climate change has local implications. Available observations suggest that Himalayan region is experiencing warming with higher rates than the global average and is more sensitive than other land surfaces at the same latitude (Beniston et al., 1997). The trend of above average warming and more erratic rainfall as seen in 20th century are likely to continue (IPCC, 2007). Rise in temperatures in combination with change in precipitation pattern and hydrologic regime are affecting biodiversity and livelihood of the people in the Himalayan region with far-reaching implications. Due to topographic and inaccessibility nature of the region, the mountain regions of Nepal do not have adequate data.

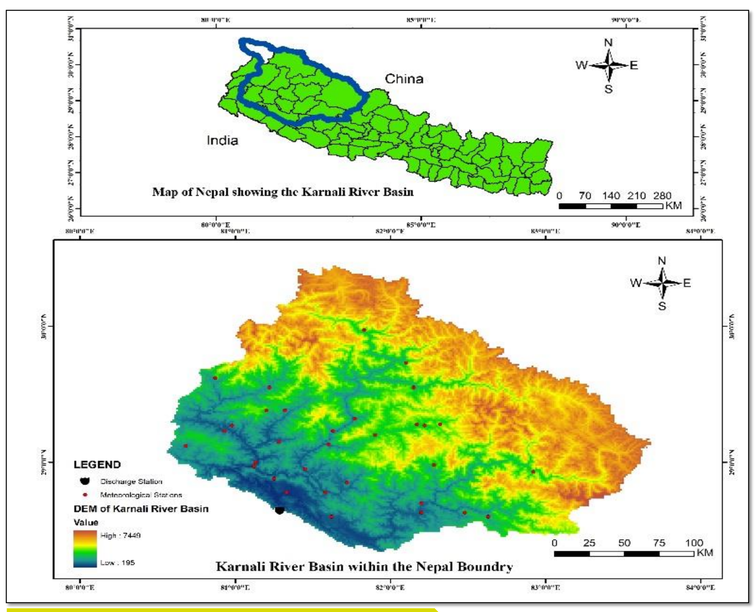


Fig1: Study Area Karnali River Basin

Why ???

This research project has been carried out in the Karnali river basin (fig 1) of Nepal as this is the most vulnerable basin (IWMI, 2012). This research will focus to contribute to a better interpretation of the hydro-climatic (temperature, precipitation, discharge) status of the Karnali river basin which ultimately contributes to fill data gap in the Himalayan region.

How ???

►Precipitation observations from 32 stations and temperature observation from 7 stations for the period of 32 years (1981-2012) of the Karnali river basin were obtained from the Department of Hydrology and Metrology (DHM).

►Terai (< 500m), Hills (500-2500m), Mountain (>2500m) and Trans-Himalaya (Dolpa & some parts of Mugu districts).

►The non-parametric approach Mann-Kendall test was used for indication of trend; identifying whether the trend is positive or negative and Sen's Nonparametric Estimator of Slope was used to detect and determine magnitude of trends.



Results

The research had the following results .

About precipitation

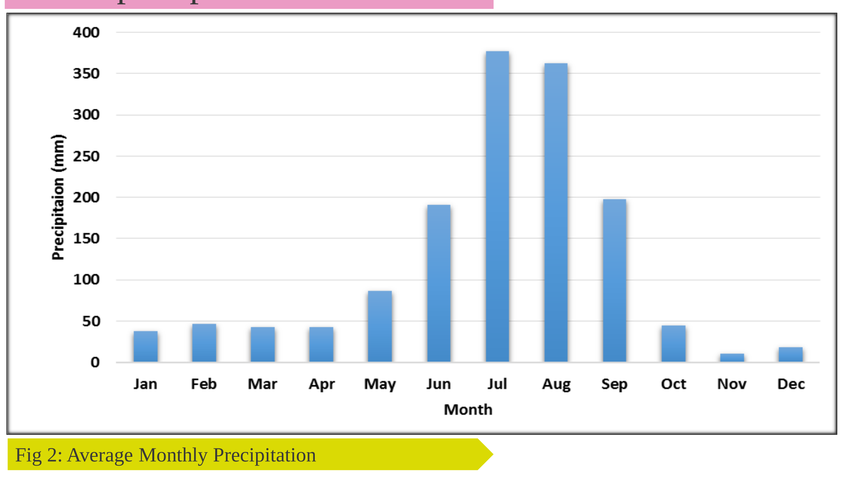


Fig 2: Average Monthly Precipitation

July is the highest rainfall month (376.94 mm) and November (10.49 mm) is the lowest rainfall month (fig 2). The Spatial precipitation distribution is shown in figure 3.

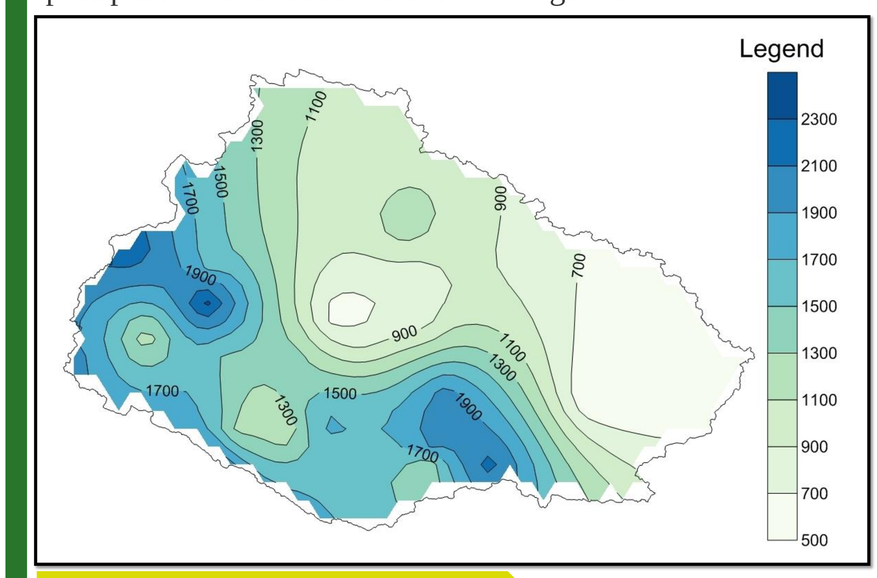


Fig 3: Spatial distribution of precipitation

Precipitation in the mountains is significantly increasing while in other regions it is decreasing (fig 4). During monsoon season, the precipitation found to be significantly increasing over the Mountain region with negative trend over Terai and Hills. Such characteristics in precipitation will result more flood in the rainy season and drought situation in the dry season.

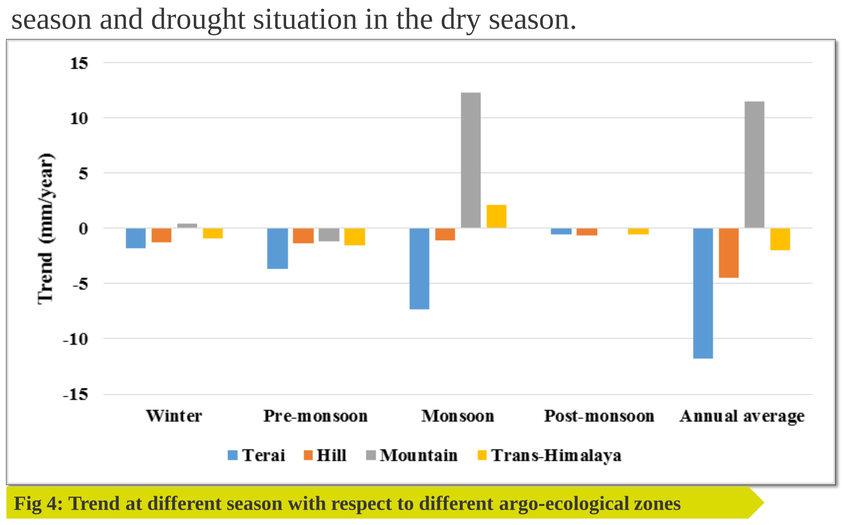


Fig 4: Trend at different season with respect to different argo-ecological zones

Station wise increasing or decreasing trend (fig 5) of precipitation do not follow any fixed spatial pattern but it is randomly distributed and few of them are statistically significant at 5%.

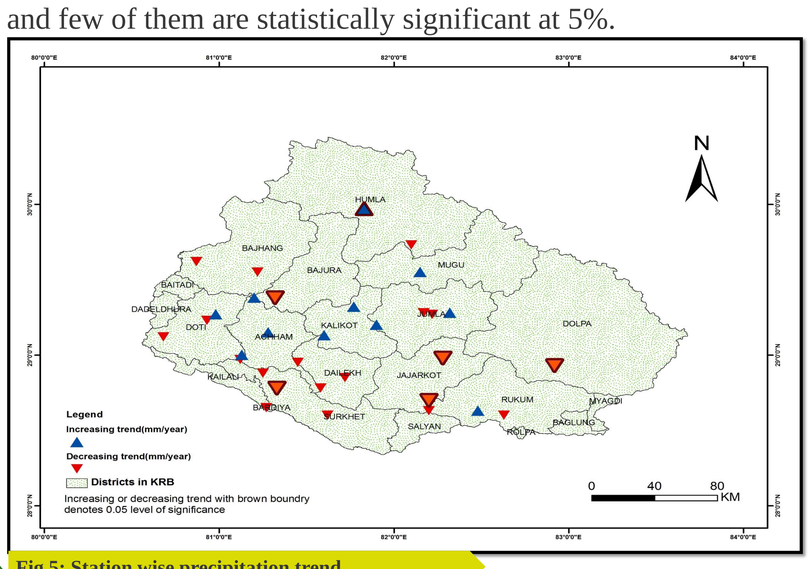


Fig 5: Station wise precipitation trend

About temperature

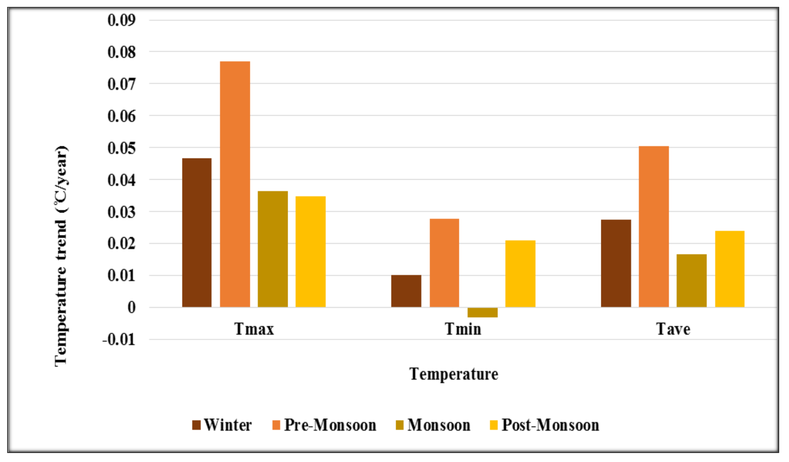


Fig 6: Temperature trend in four different seasons

Maximum temperature is increasing at faster (0.046°C/year) rate than minimum temperature (0.011 °C/year). The temperature trend indicates that the basin is getting warmer and the rate is higher in high elevation mainly in the winter and pre monsoon seasons (fig 6).

About precipitation-discharge

The river discharge is correlated with the precipitation and the peak discharge in August is found to be a month later than the peak precipitation in July over the KRB(fig 7). If we look at the yearly precipitation and discharge trend

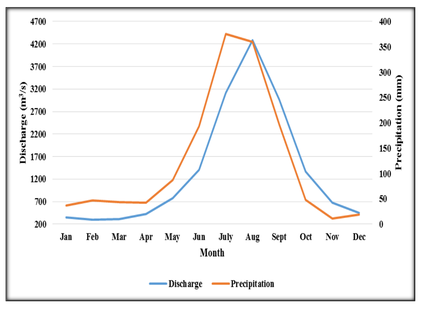


Fig 7: **Monthly average precipitation Vs discharge**

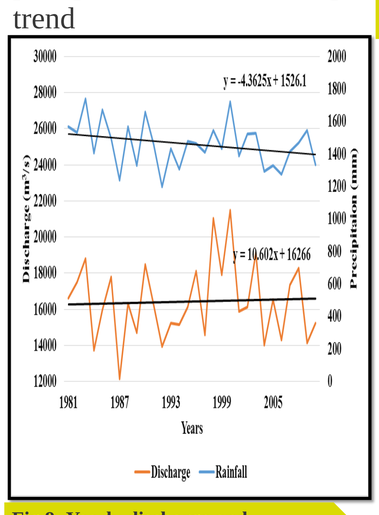


Fig 8: Yearly discharge and precipitation

result shows even though the precipitation is decreasing, the discharge is increasing significantly in annual basis (fig 8).

This could be due to increased snowmelt in high altitude region which is getting warmer than other regions and other physical, chemical activities in the basin which needs further exploration.

Conclusion

This research shows that the average precipitation in the basin is decreasing by 4.36 mm/year. However, the precipitation trend in monsoon season over mountain region is increasing significantly. Also, increasing trends were observed for both minimum and maximum temperature. At the same time, the peak discharge (August) is found to be a month later than the peak precipitation (July) over the basin. While trying to understand the rainfall-runoff relationship it shows that the annual precipitation amount is decreasing but the river discharge is found to be significantly increasing. So, needs further exploration of the basin.

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