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Estimation of base flow contribution using hydrograph separation techniques and analysis of temporal variation in Upper Mahanadi basin.

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INTRODUCTION & AIM

In now days, demand of Groundwater is rigorously increasing to be used for drinking water purposes. The Groundwater is fulfilling nearly 50% globally drinking water (Boretti & Rosa, 2019). And also increasing the demand of groundwater for agriculture and industry sector .There are huge economical losses for farmers due to increase in pumping depth and cost of pumping is very high because of reduction in water yield of the wells. Rapid development of land is a big issue regarding the urbanization of watersheds to sustain sufficient base flow during periods of droughts (David Brandes et al, 2007), therefore river base flow is play a vital role for aquatic ecosystem, mainly because its impacts on summer water temperatures (Glenn A. Hodgkins et al, 2011).

Therefore, main objective of the study is investigating current base flow situation in Upper Mahanadi basin and evaluate the contribution of base flow discharge into groundwater system. In this study, identifies important sites throughout the Upper Mahanadi basin in which base flow and base flow index show decreasing trends during 1998 to 2018.

METHOD

(a) Mann Kendall test

The Mann Kendall (MK) is non parametric statistical tests t that does not require samples to follow a certain distribution and is not disturbed by a few outliers (Mann et al, 1945 and Kendall et al, 1948. The statistical variable S is defined as:

$$S = \sum_{k=1}^{n-1} \sum_{j=k+1}^{n} sgn(x_j - x_k)$$

Where;

$$sgn(x_j - x_k) = \begin{cases} +1; x_j - x_k > 0 \\ 0;\ x_j - x_k = 0 \\ -1; x_j - x_k < 0 \end{cases}$$

The standard formula for calculating normal statistical variables is;

$$Z = \begin{cases} \frac{S-1}{\sqrt{Var(S)}}, S > 1 \\ 0, S = 1 \\ \frac{S+1}{\sqrt{Var(S)}}, S < 1 \end{cases}$$

where Var(S) = n (n − 1) (2n + 5)/18, a positive Z indicates an upward trend, and a negative Z indicates a downward trend. The distribution indicates that 90%, 95% and 99% has been passed when absolute value of Z is greater or equal to 1.28, 1.64 and 2.32.

(b) Sen's Slope

With help of this method, slope estimates of N pairs of data are first calculated using the following expressions as;

$$Q_i = (X_j - X_k)/(j-k) \quad \text{for } i = 1,2,3\ldots n$$

Where X_j and X_k are data values at time j and k (j>k) respectively.

RESULTS & DISCUSSION

The local minimum method is used to separate base flow from stream flow. There are six coordinates from Upper Mahanadi basin such as Andhiyare Khore, Ghatora, Jondhara, Kotni, Pathardihi and Simga. The Base flow was ranging from 0 to 189.075 cumecs in all six station and generally Base flow is maximum in monsoon and minimum at Pre-monsoon. The Base flow of all six station for Upper Mahanadi basin is drastically decreasing with respect to time such as base flow was 189.075 cumecs at Jondhra in 2013 which was maximum base flow in all six station and during 2013 to 2015, it was harshly decreasing from 189.075 to 19.494 cumecs and second station was Simga in which base flow decreasing from 62.247 to 6.582 cumecs during 2013 to 2017.

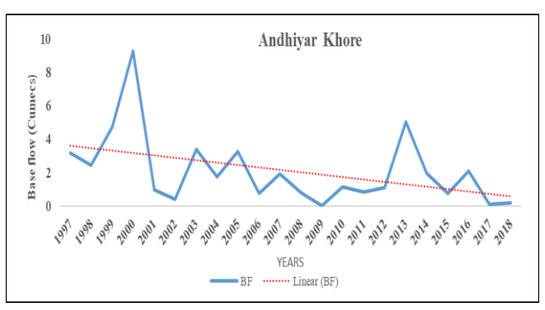

Fig. 1 Base flow

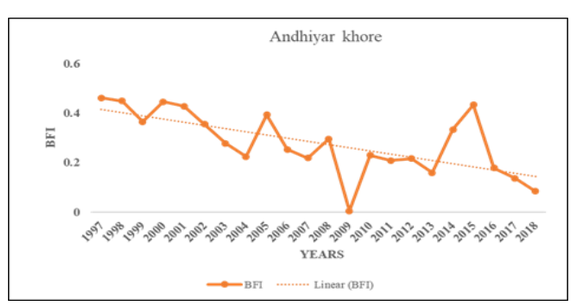

Fig. 2 Base flow Index

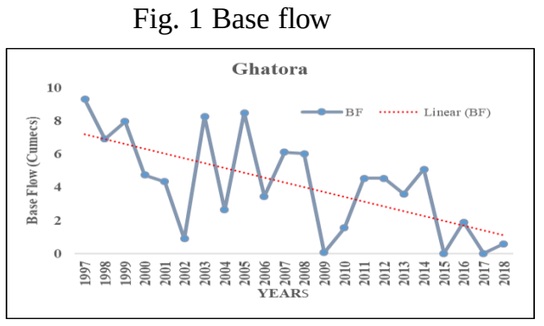

Fig. 3 Base flow

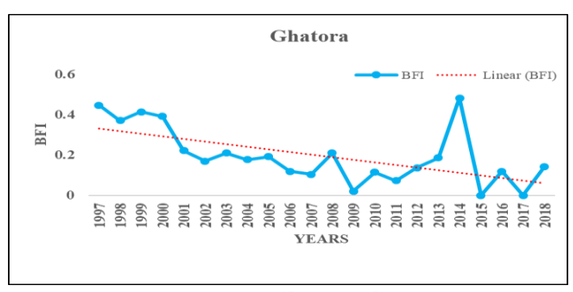

Fig. 4 Base flow Index

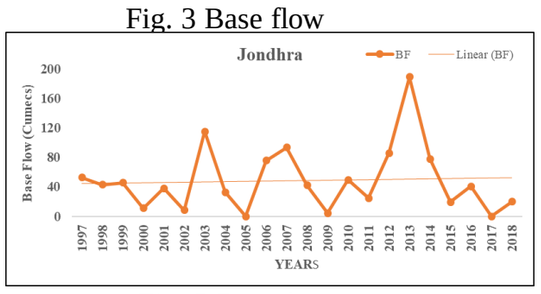

Fig. 5 Base flow

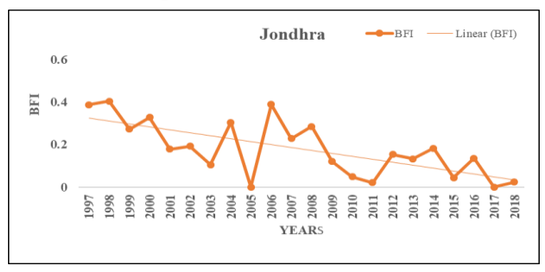

Fig. 6 Base flow Index

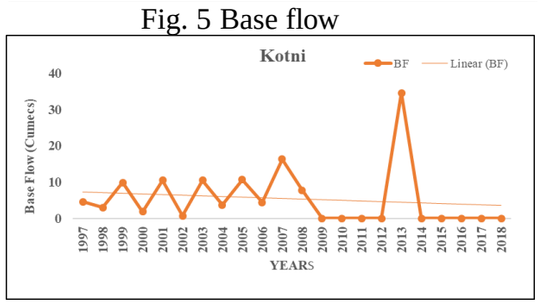

Fig. 8 Base flow

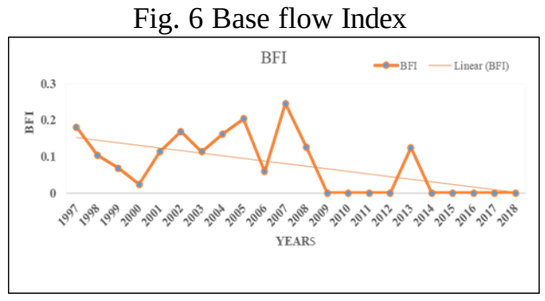

Fig. 9 Base flow Index

CONCLUSION

The Base flow in rivers has an important indication for the river's ecosystem and water quality. In present study was based on observed data sets to investigate the spatiotemporal property of base flow behaviors and its impact on natural factors and human activities on the base flow in the Upper Mahanadi basin .

FUTURE WORK / REFERENCES

Mann, H. B. (1945). Nonparametric tests against trend. Econometrica: Journal of the econometric society, 245-259.

Kendall, M. G. (1948). Rank correlation methods.

Boretti, A., & Rosa, L. (2019). Reassessing the projections of the world water development report. NPJ Clean Water, 2(1), 15