Understanding the impact of anthropogenic activities on river ecosystem services in India : A hydro-economic approach

Anjana Ekka[1], Saket Pande[1], Yong Jiang[2], Pieter van der Zaag[1, 2]

[1]Delft University of Technology, The Netherlands

[2]IHE-Delft Institute for Water Education, The Netherlands

1.Highlights

- In recent decades, the demand for water has increased due to increase in human population, economic growth and industrialization.
- The diversion of water by dam construction, groundwater abstraction, stream channelization and inter-catchment transfer are some of the example of anthropogenic modifications of river landscape. In addition, land-use pattern can contribute significantly to modify natural flow regime in catchments.
- The present study highlights the use of Landscape based hydrological modelling (Flex-topo hydrological model) to study the changes caused by anthropogenic modification in the form of irrigation on river flow regime and its impact on production of ecosystem services in India.

2. Introduction

River ecosystem services are governed by river flow regime and it is influenced by many biotic and abiotic factors which includes topography, land cover, climatic condition and anthropogenic modifications [1]

Hydrological alterations of rivers flow regime while benefitting human development in many ways have damaged the delivery of ecosystem services [2]

The Cauvery basin in India is becoming increasingly water scare due to rapidly growing water demands for irrigation, household consumption and generation of electricity. The situation is further complicated by multitude of water uses and stakeholders with conflicting interest.

The present study aims to answer the following research questions :

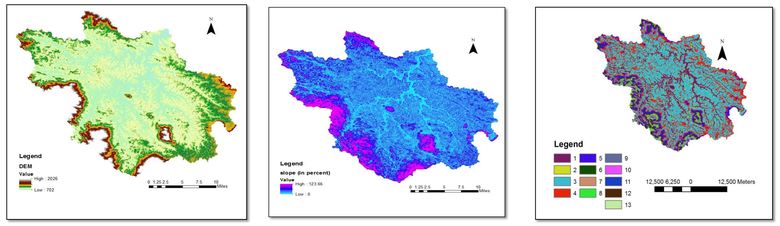
- **How a change in the flow regime can impact the services provided by the river?**
- **How to maximize economic and social welfare while maintaining the ecological health of rivers?**

3.Study area

4. Methods

4.1 The Landscape Classification (Input data)

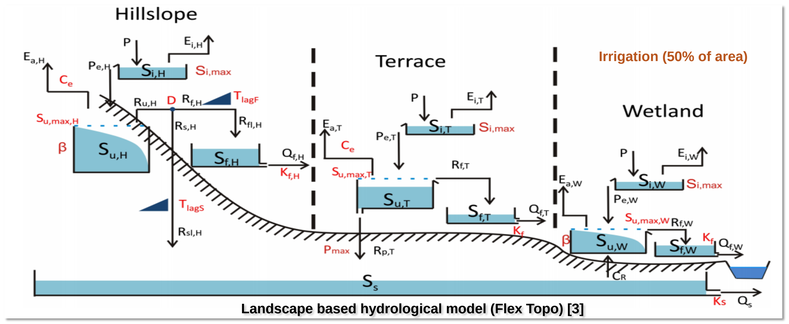
The Sub-basin is divided into landscape class based on topographic Information



DEM | Slope | HAND (Height above nearest Drainage)

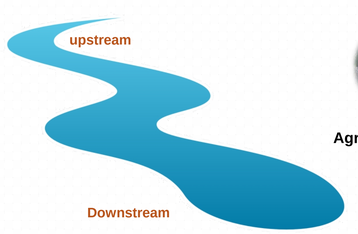
4.2 Incorporate anthropogenic modification in model structure

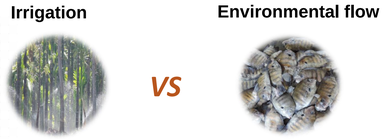
Based on coverage of area under irrigation in study area, irrigation component is added in model structure



4.3 The tradeoff analysis & maximizing welfare

Both agricultural production and species richness are considered as function of the flow regime



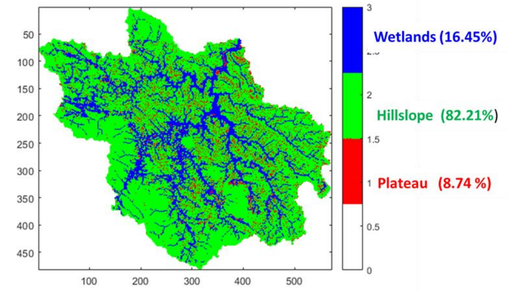


Steps

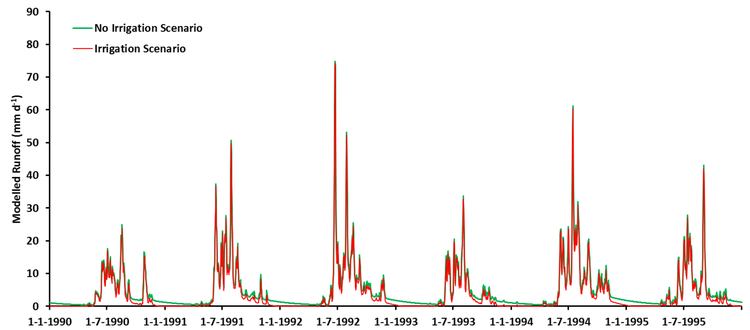
- **Identification of ecosystem services that have tradeoff's**
- **Identifying utility of different stakeholder's group**
- **Construction of production possibility frontier (PPF)**
- **Construction of utility curve (UC)**

5. Results

5.1 The landscape classes

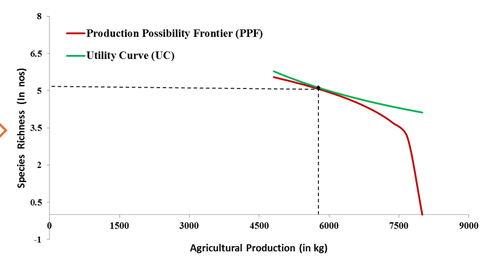


5.2 Estimation of change in flow regime



5.3 The optimum condition for production of ecosystem services

The boundary of PPF plots irrigation and environmental flows in 2 dimensions for all possible flow regimes as simulated by the hydrological model for production of ecosystem services and UC curve represents preference of stakeholders



6. Conclusion

The results shows how a landscape based hydrological modelling approach along with knowledge of economics can be used to predict the changes in flow regime and socially justify allocation of water between humans and the environment.

References

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Contact: Anjana Ekka
A.Ekka@tudelft.nl