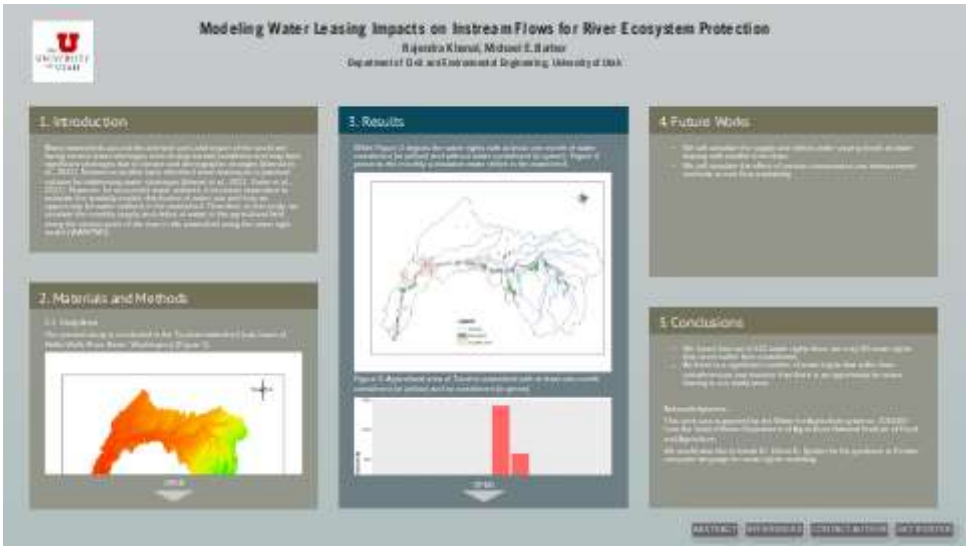
Modeling Water Leasing Impacts on Instream Flows for River Ecosystem Protection



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1. INTRODUCTION

Many watersheds around the arid and semi-arid region of the world are facing severe water shortages even during normal conditions and may face significant shortages due to climate and demographic changes (khanal et al., 2021). Numerous studies have identified water leasing as a practical solution for addressing water shortages (khanal et al., 2021, Yoder et al., 2017). However, for successful water markets, it becomes imperative to estimate the spatially explicit distribution of water use and thus an opportunity for water markets in the watershed. Therefore, in this study, we simulate the monthly supply and deficit of water to the agricultural field along the various point of the river in the watershed using the water right model (WARIPM1).

The objectives of this study are to assess the monthly amount of water available at various points of the rive and subsequently estimate the supply and deficit of water to the agricultural fields with water rights based on priority.

2. MATERIALS AND METHODS

2.1 Study Area

The present study is conducted in the Touchet watershed (sub-basin of Walla Walla River Basin, Washington) (Figure 1).

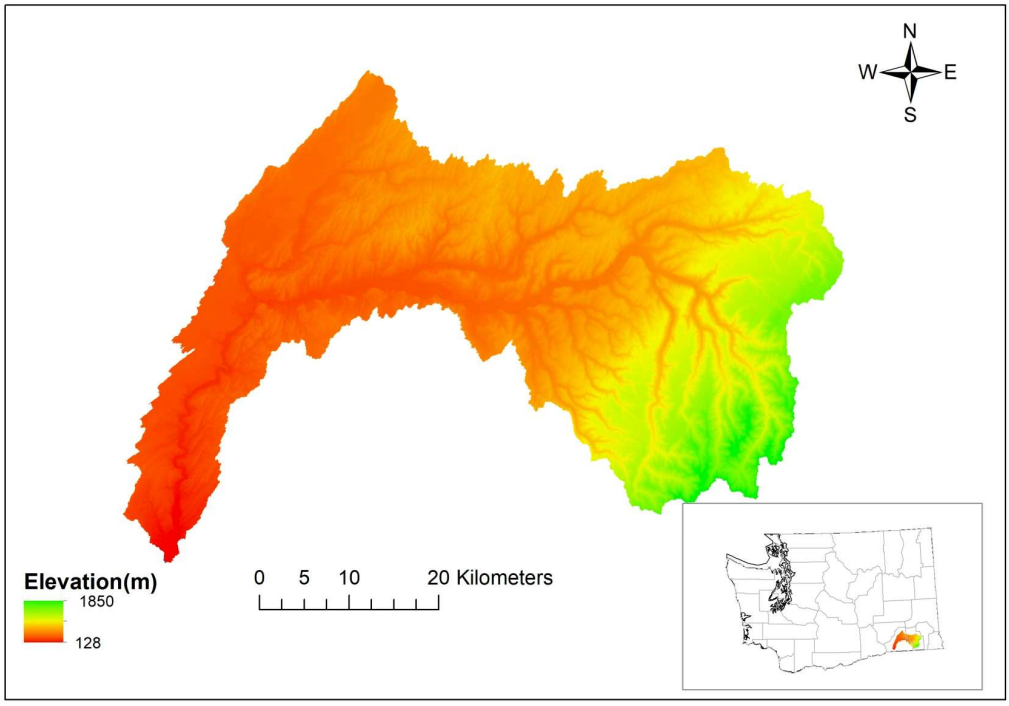

Figure 1: Location of the study area (Touchet watershed)

2.2 Methods

The current study was conducted using the methodology presented in the flow chart (Figure 2).

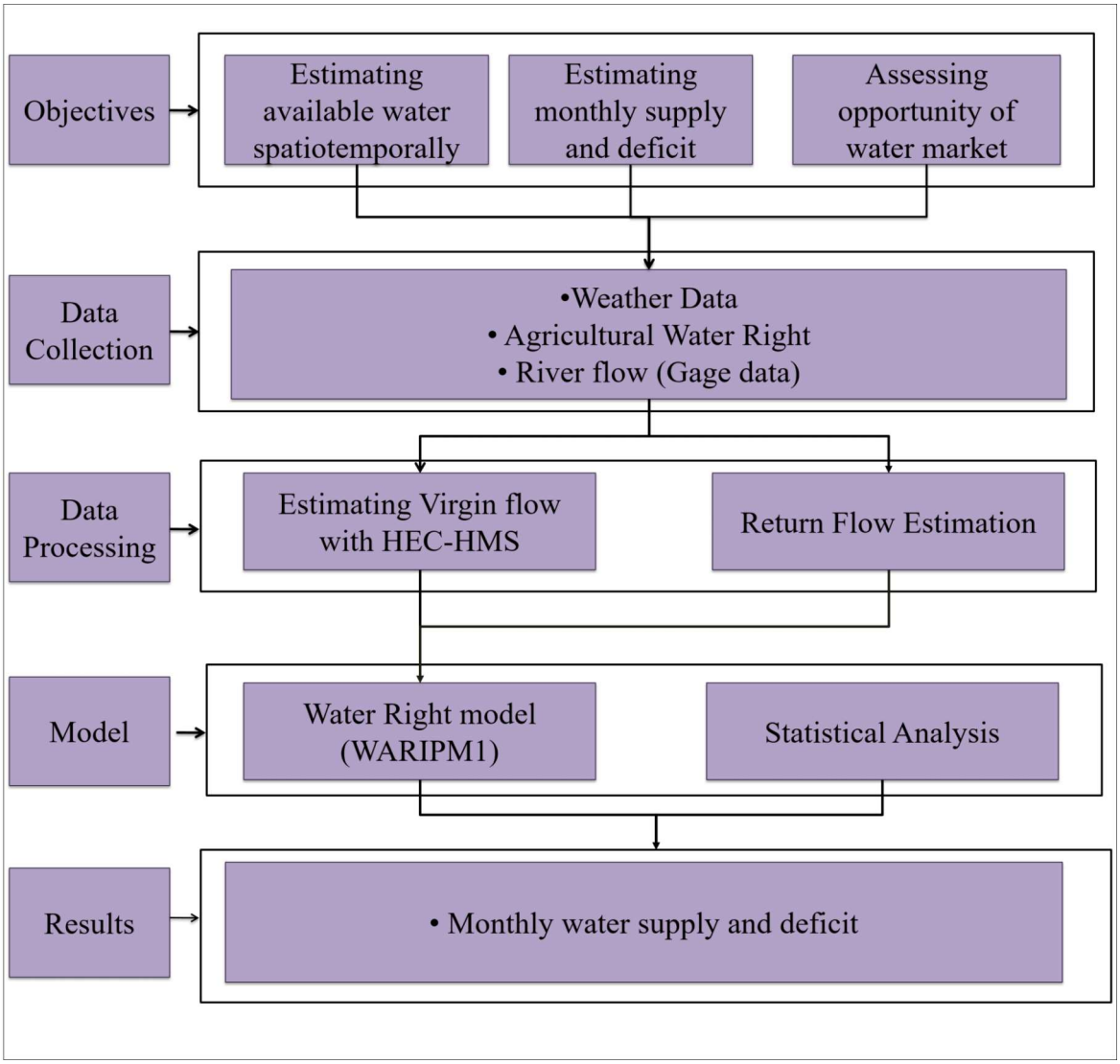

Figure 2: Flow chart representing the detailed methodology

3. RESULTS

While Figure 3 depicts the water rights with at least one month of water curtailment (in yellow) and without water curtailment (in green), Figure 4 presents the monthly cumulative water deficit in the watershed. We found that in the month of July there is the highest water deficit of approximately 1200 acre-ft of water.

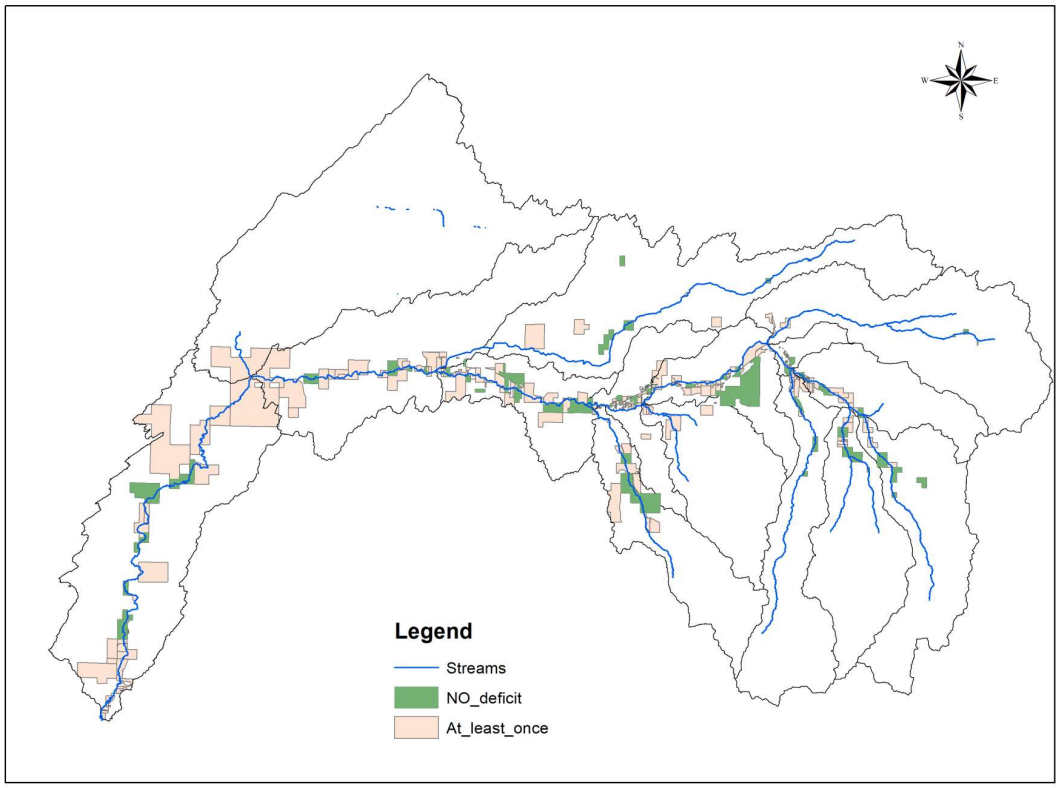

Figure 3: Agricultural area of Touchet watershed with at least one-month curtailment (in yellow) and no curtailment (in green).

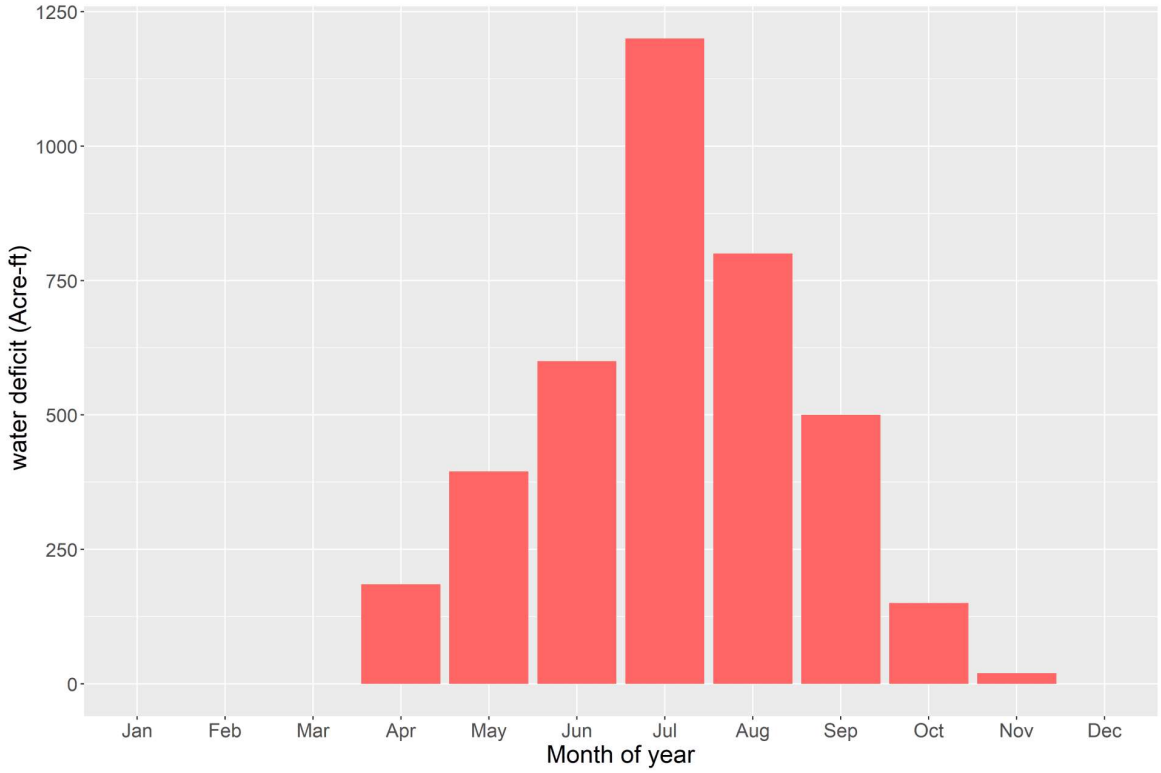

Figure 4: Monthly cumulative water deficit

4. FUTURE WORKS

- We will simulate the supply and deficit under varying levels of water leasing with smaller time steps.
- We will simulate the effect of various consumptive use measurement methods in river flow availability

5. CONCLUSIONS

- Our results suggest that there is significant water deficit in summer months in our study area.
- We found that out of 422 water rights there are only 83 water rights that never suffer from curtailment.
- As there is a significant number of water rights that suffer from curtailment we can assume that there is an opportunity for water leasing in our study area.

Acknowledgments:

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ABSTRACT

Overallocation, increased demands, recognition and quantification of environmental flows, and climate change have combined to make water leasing a practical solution for addressing water shortages in many watersheds. Leasing involves the temporary transfer of the consumptive use portion of a water right to another user presumably for a higher value purpose. Therefore, understanding the effect of water leasing on river flow availability and river ecosystem protection is critical for the watershed-scale water management. Numerical and computational watershed simulation techniques coupled with water right models can allow water managers to allocate water based on the legal framework within the watershed, which in the western United States is typically based on the prior appropriation doctrine. In this study, we simulate the water trades on instream flow using an ASCE Penman-Monteith method of evapotranspiration estimation on water right model. Using the Touchet River basin in Washington State as a study location, we successfully demonstrated simulation of water leases on instream flow. We choose the Touchet River basin as a study location as this basin suffers frequent water curtailment and has existing partnerships across diverse sectors including water leasing markets to address this water resources concern. This information will be extremely valuable for river ecosystem protection and to watershed managers trying to plan future water managements, water storage, and water trading projects.

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