

Welfare Gains from Water Trading under Population Growth and Climate Change Scenarios in the Yakima Basin, WA

Qingqing Yang¹, Michael Brady¹, Jonathan Yoder^{1,2}

¹Washington State University School of Economic Sciences ²State of Washington Water Research Center

Abstract

Municipalities face concerns over water security due to potential curtailment of groundwater rights, which can be driven by population growth (increasing demand) and climate change (reduced supply). It is widely recognized that water markets can mitigate this risk at lower cost than alternatives like new storage. This research estimates the social welfare gains of Agriculture-to municipal water transfers under a range scenarios for the Yakima Basin in Washington State.

Background/Introduction

- A basin-wide adjudication in the Yakima only includes surface water rights.
- The source of most municipal water rights in the Yakima basin is groundwater.
- There is potential for legal action by junior surface water rights holders to curtail municipal groundwater pumping.
- Motivation for legal action arises from hydraulic continuity between surface and groundwater in the basin.

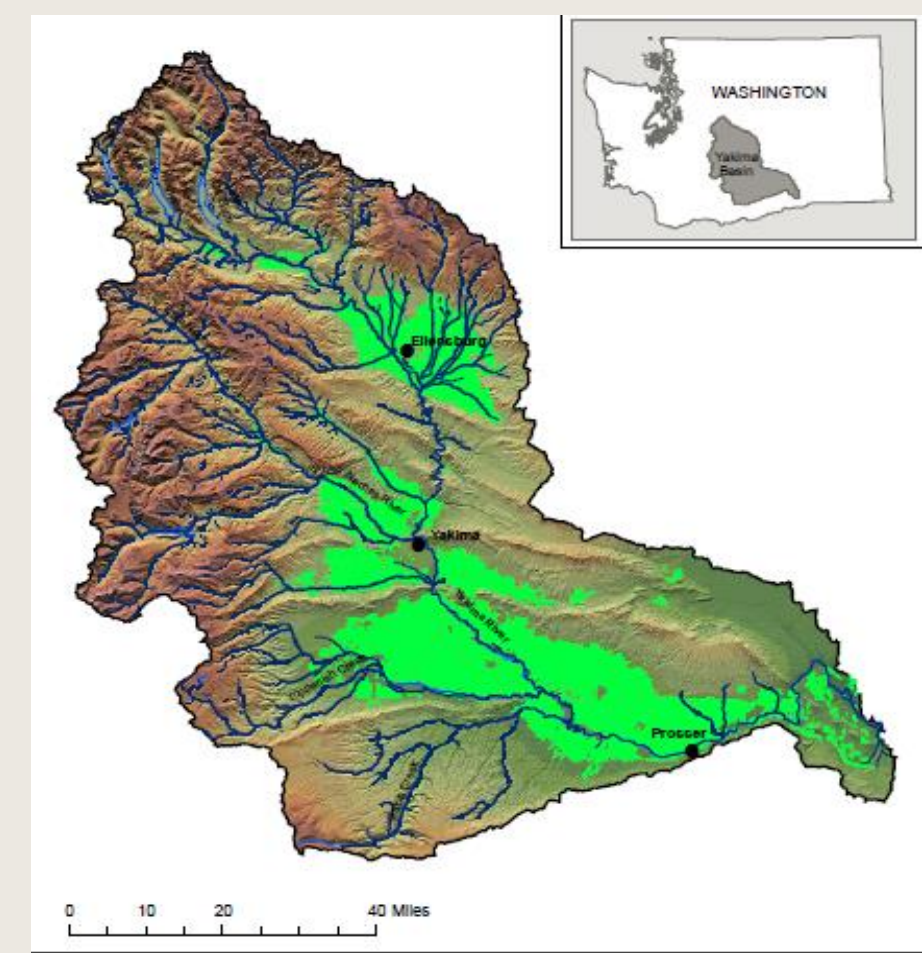


Figure 1. The map and the position of the Yakima basin

Methods

1. The agricultural water demand function can be converted from a step-function (Burt, 1964), which shows the relationship between the marginal value product of water and water quantity.
2. We use a benefit-transfer methods based on a meta-regression to derive the municipal water demand curve.
3. The welfare gains with trading are estimated with the demand curves (solid line: municipal water rights; dash line: municipal water demands).

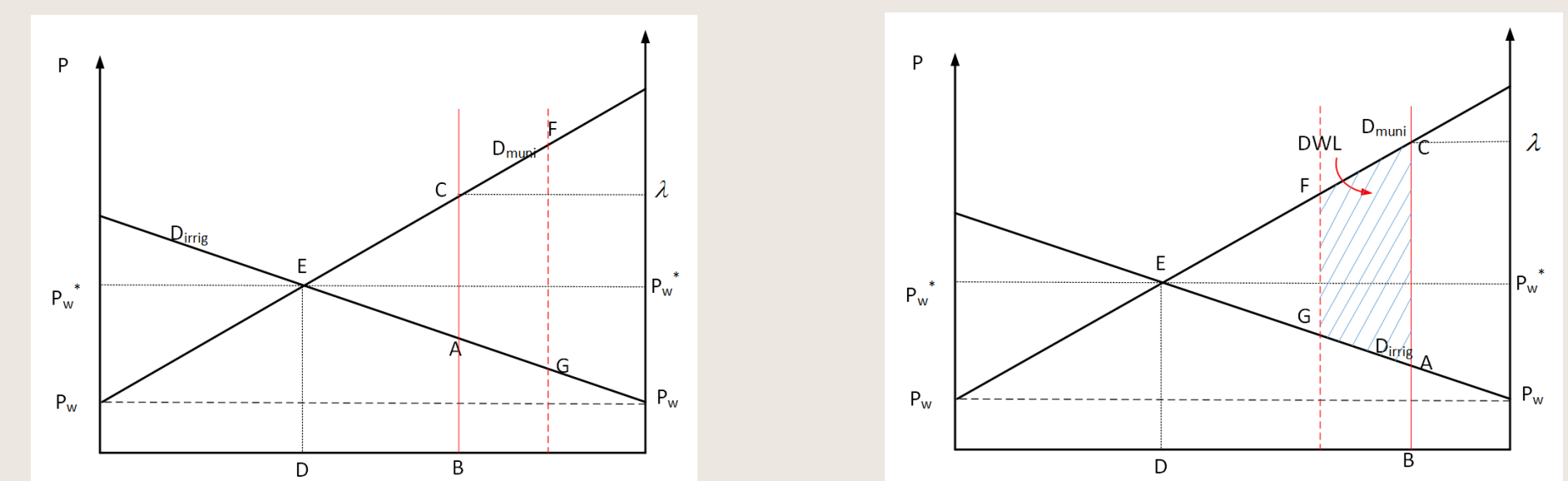


Figure 2. Dead weight loss of trade restriction

Results

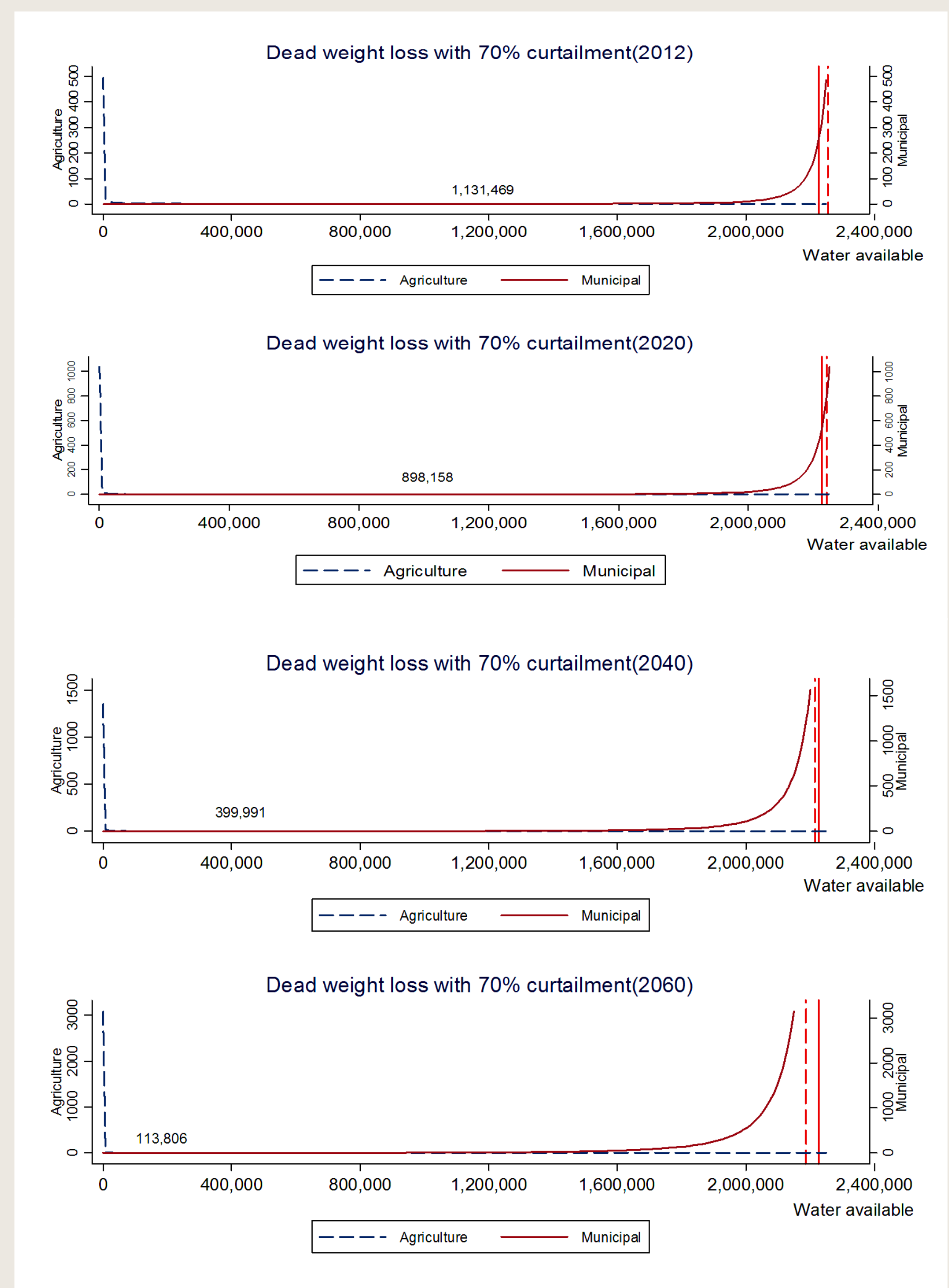


Figure 3. Water market change with population growth under 70% curtailment

Table. Estimated dead weight loss under different scenarios.

Scenarios	2012	2020	2040	2060	
No curtailment	0	0	0	0	
Convert the curtailed municipal water rights to the agricultural sector	40% curtailment	0	0	0	
	70% curtailment	0	27,963,022	375,633,311	
	90% curtailment	125,716,932	281,598,942	1,588,015,226	8,084,892,004

Interpretation

1. Even under legal threat, existing municipal water rights can satisfy full-water-year water demands even under projected future population growth. The dead-weight loss is not applied in those scenarios.
2. Curtailments may occur in drought years. Deadweight losses assuming no trade (purchases from agriculture to municipal) increases with the population growth.
3. With 90% curtailments, the dead weight loss without trade will be \$1.6 billion in 2040 and 8.1 billion in 2060 .

Conclusions

- With population growth and potential municipal water rights curtailment, the municipal water demands in the Yakima basin will exceed the water rights during drought years, and junior municipal water rights are at risk.
- Social welfare increases if the water transactions between sectors are allowed because the marginal value in the municipal sector is higher

Acknowledgements

This research is funded by the Project: Benefit-Cost Analyses of the Yakima River Basin Integrated Plan Projects 2013-2014.

Selected References

Burt, Oscar R. 1964. "Curve Fitting to Step Functions." *Journal of Farm Economics* 46 (3): 662-72.

Dalhuisen, J. M., et al. (2003). "Price and Income Elasticities of Residential Water Demand: A Meta-Analysis." *Land Economics* 79(2): 292-308.

Mansur, E. T. and S. M. Olmstead (2012). "The value of scarce water: Measuring the inefficiency of municipal regulations." *Journal of Urban Economics* 71(3): 332-346.

Yoder et al. 2014. *Benefit-Cost Analysis of the Yakima Basin Integrated Plan Projects*. State of Washington Water ResearcCenter. December. Available at <https://swwrc.wsu.edu/2014ybip>. 196.pp.

Contact information:
qingqing.yang@wsu.edu, bradym@wsu.edu, yoder@wsu.edu