A multi-regional input-output linear programming model of water allocation in the Southeastern US

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Introduction

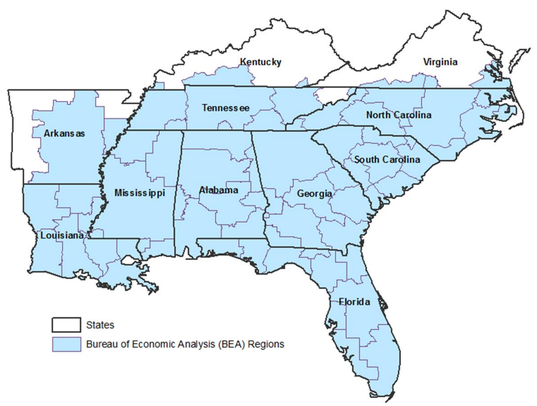
Population expansion, increased biofuel production and climate change increase concern about water stress in the southeastern United States

- Tri-state water wars among Georgia, Alabama and Florida
- 2007 and 2012 drought revealed the vulnerability in water resource for agriculture and power generation in Tennessee and North Carolina
- Droughts expected to be more frequent

Objectives

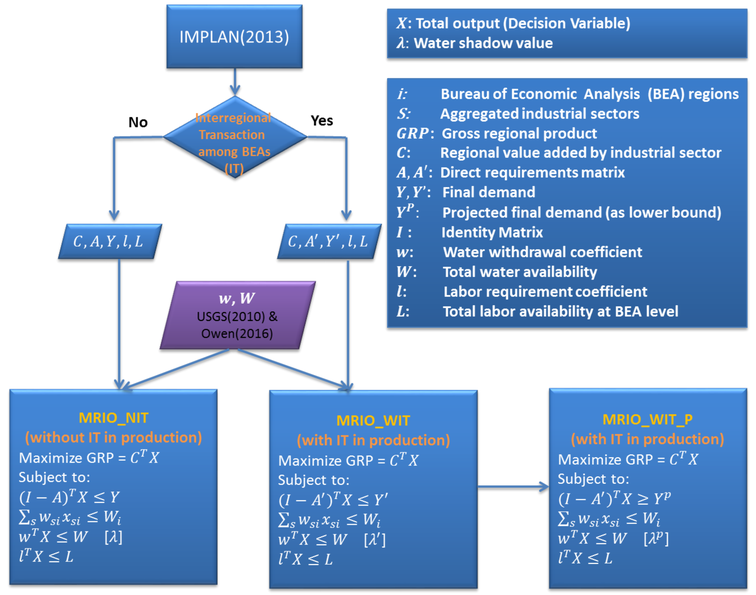
- Use an Input-Output Linear Programming approach to derive and compare water demand curves for Bureau of Economic Analysis (BEA) regions in the southeastern U.S. at alternative supply levels both with and without interregional industry transactions
- Estimate gross regional product for the southeastern BEA regions and the marginal value of water of the economy

Research Region, Economic Unit of Analysis, and Aggregated Industrial Sectors



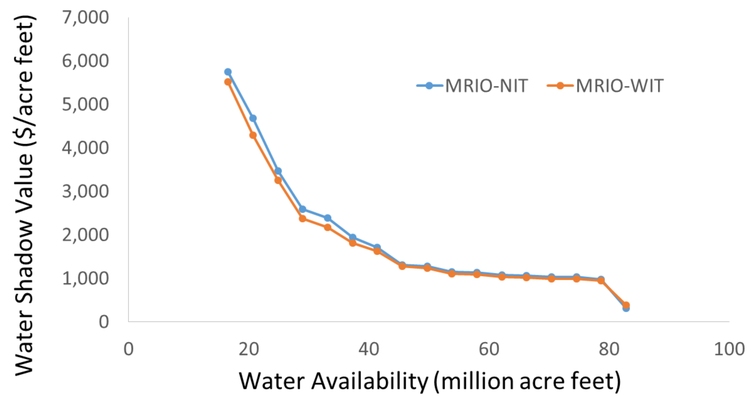
Aggregated Industrial Sectors
Primary agricultural crops
Primary agriculture livestock
Forest inputs
Mining
Services
Utilities
Water, sewage and other systems
Construction
Secondary agriculture
Manufacturing
Primary forestry
Secondary forestry
Agriculture inputs
Wholesale trade
Retail trade
Transportation
Finance
Insurance
Real Estate
Government
Miscellaneous

Multi-regional Input-Output Linear Programming (MRIO-LP)



Derived Water Demand Curve for the Southeastern U.S.

(MRIO_NIT and MRIO_WIT)



Gross Regional Product and Water Marginal Value at Different Water Supply Levels (*MRIO_WIT_P*)

SE Water Availability (acre-feet)	SE Gross Regional Product (million $)	Marginal Value of Water ($/acre-feet)
82,825,409	2,940,626	367
78,684,139	2,937,180	836
74,542,868	2,933,629	877
70,401,598	2,929,996	879
66,260,327	2,926,315	906
62,119,057	2,922,515	1,031
57,977,786	2,910,783	4,837
53,836,516	2,858,003	27,256
49,695,245	infeasible	/

Conclusion

- The southeastern U.S. is able to meet its final demand without inputs from outside of the southeastern U.S. until water availability decreases to 60% of its current withdrawal level, which is around 50 million acre-feet in total
- Transactions among regions can help to reduce water stress
- The marginal value of water increases dramatically when restricted regional final demand is posed.

References

IMPLAN Group, LLC, IMPLAN System (2013 data and software),16740 Birkdale Commons Parkway, Suite 206, Huntersville, NC 28078

U.S. Department of the Interior – U.S. Geological Survey (USGS) National Water Information System – 2010 Water Use Data for Tennessee

Owen, S. (2016). Estimating the Economic Value of Water for Agriculture and Other Industries in Tennessee. University of Tennessee. (MS thesis).

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