Quantifying the Economic Benefit of More Water for Agriculture: Drought Mitigation

INTRODUCTION

Much of the concern over climate change for agriculture in Washington comes not from changes in average year conditions, but from an increase in the frequency and magnitude of drought. In order to make decisions in regards to trying to mitigate drought it is valuable to have a tool ready in advance that reports the value of making additional water available to reduce curtailments to agriculture during a drought. The objective of this poster is to demonstrate how to arrive at these values and how they are sensitive to varying assumptions about which crops are affected by drought.

There are two important components to estimating economic impacts of drought on agriculture for a given region. The first is knowing the following relationship:

Drought severity → in-stream flows → curtailment or prorationing of agriculture

In some parts of Eastern Washington there is very accurate information on how much water agriculture loses during a drought. This requires knowing a lot about water rights and how calls are made on diversions. Issues like unadjudicated water rights can muddy the understanding of this. An example where it is very well understood is in the Yakima Basin where a basin-wide adjudication is nearly finished.

WHICH CROPS ARE AFFECTED?

It turns out that the critical assumption that affects drought impact estimates is which crops are affected and how.

Lower-Bound Estimate

A lower-bound estimate of drought impacts is arrived at when it is assumed that lowest value crops are curtailed first. If the option is available it makes sense that water would go to apples rather than wheat. However, this assumes either that (1) there is adequate farm level crop-diversity, or (2) there is trading of water between farms.

Upper-Bound Estimate

The upper bound estimate on the costs of drought are arrived at by assuming that all crops lose water in proportion to their use of water.

ESTIMATING WATER VALUES

With either approach it is necessary to arrive at a water value associated with each crop. It is convenient to think in terms of $/acre-foot. From an economic perspective, the value of water is the additional revenue net of production costs that accrue to the farmer from being able to use another acre-foot of water. The two numbers needed for this calculation are estimates of the profit per acre, which is often taken from enterprise budgets, and water use per acre. Of course, both of these numbers are crop and location specific. Dividing the prior by the latter gives an estimate of water value.

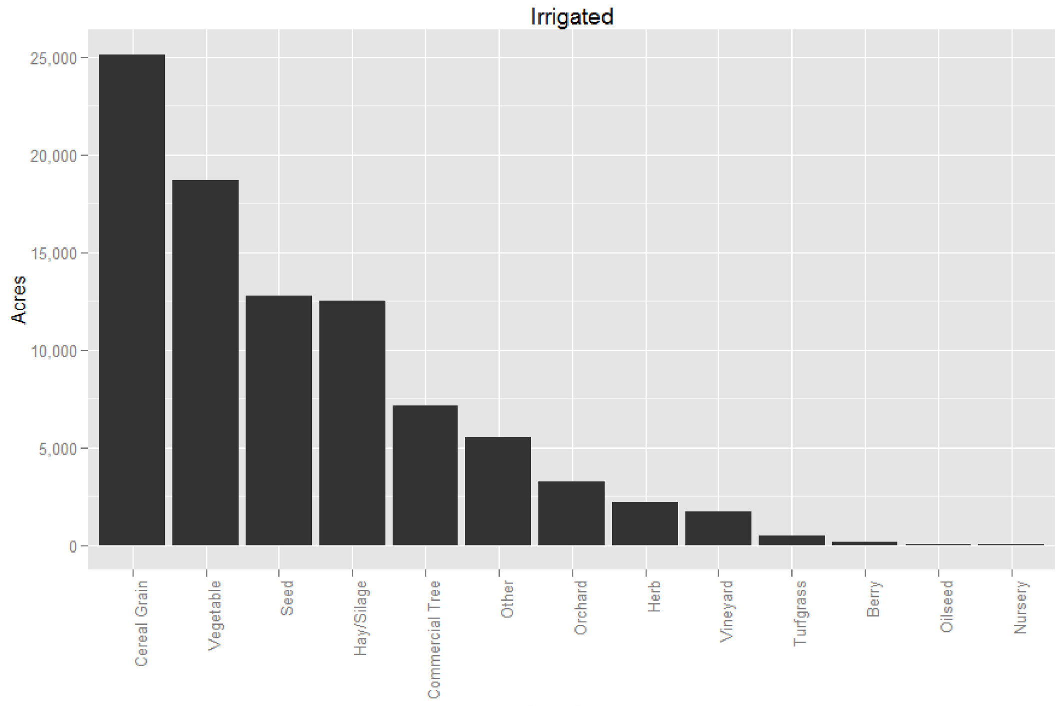
$/acre-foot = (profit/acre)/(acre-feet/acre)

Example: ($300/acre)/(4 aft/acre) = $75/acre-foot

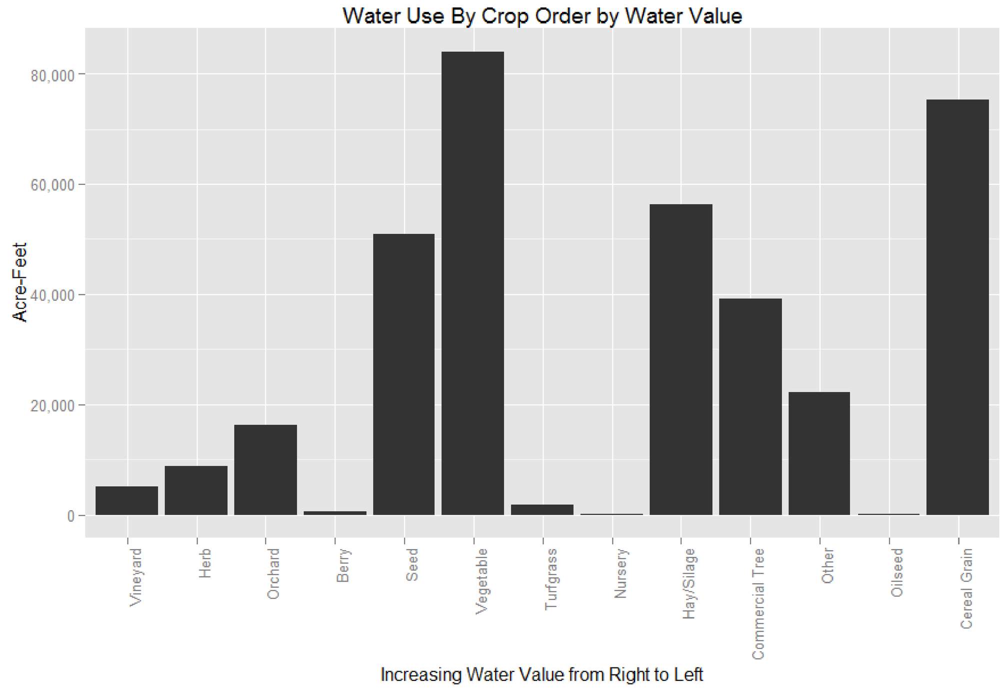
EXAMPLE: WRIA 32

An example using WRIA 32 demonstrates how to model a drought with some concrete numbers.

Step 1: Acres by crop



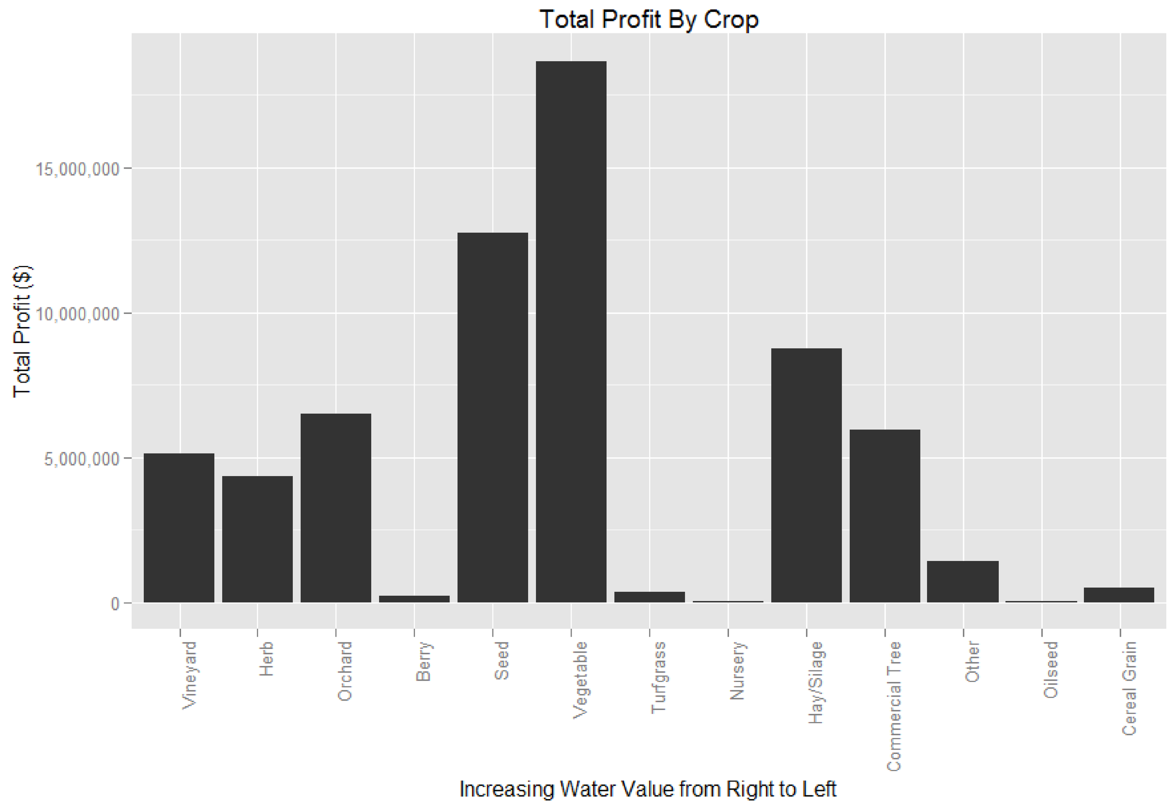
Step 2: Quantify water use for each crop and order by water value



Step 3: Simulate drought by removing water from right to left

In order to calculate drought impacts to generate a lower-bound estimate use the figure below. The crops increase in their assigned water value going from left to right. So, assuming lower value crops are affected first, add up the height of the bars from right to left under the reduced water budget is met. The height of the "removed" bars represents the economic costs of the drought. A more severe drought involves adding up more crops.

The upper-bound estimate requires less work. It is based on the average water value for a WRIA, which is weighted by the water use share by crop.



CONCLUSIONS

It is critical to be aware of how varying assumptions on which crops are affected during a drought alters economic cost estimates. The approach described here is useful in that it shows how to generate an upper and lower-bound estimate. The reality is likely somewhere in the middle.

DEPARTMENT OF ECOLOGY State of Washington
WASHINGTON STATE UNIVERSITY
THE UNIVERSITY OF UTAH
Aspect
WRC STATE OF WASHINGTON WATER RESEARCH CENTER