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Predicting Groundwater Trading in the Upper Republican Natural Resource District

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Market Report	Yr Ago	4 Wks Ago	4/19/13
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight	$123.46	$124.93	$126.11
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	180.44	165.52	162.72
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	*	131.54	136.66
Choice Boxed Beef, 600-750 lb. Carcass	185.12	193.57	190.51
Western Corn Belt Base Hog Price Carcass, Negotiated	80.63	72.30	78.11
Pork Carcass Cutout, 185 lb. Carcass, 51-52% Lean	77.34	77.98	83.26
Slaughter Lambs, Ch. & Pr., Heavy, Wooled, South Dakota, Direct	*	90.00	115.00
National Carcass Lamb Cutout, FOB	366.57	293.42	288.29
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	5.46	7.11	6.99
Corn, No. 2, Yellow Nebraska City, bu.	6.10	7.46	6.66
Soybeans, No. 1, Yellow Nebraska City, bu.	14.13	14.56	14.33
Grain Sorghum, No. 2, Yellow Dorchester, cwt.	10.23	12.52	11.21
Oats, No. 2, Heavy Minneapolis, MN , bu.	3.51	4.26	4.25
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton	225.00	*	245.00
Alfalfa, Large Rounds, Good Platte Valley, ton	145.00	227.50	227.50
Grass Hay, Large Rounds, Good Nebraska, ton	97.50	217.50	222.50
Dried Distillers Grains, 10% Moisture, Nebraska Average	236.50	265.00	239.50
Wet Distillers Grains, 65-70% Moisture, Nebraska Average	78.00	100.50	91.50

***No Market**

While surface water trading has occurred regularly throughout the Western United States and the rest of the world for decades, the use of any type of groundwater trading has been very limited. However, groundwater is increasingly under stress from overuse and many areas are starting to regulate groundwater use. While the public benefits from efficient use of groundwater include adequate stream flow in hydrologically connected areas and future availability of groundwater supplies, there are significant private benefits to landowners, especially in water short areas. Groundwater trading can help move water from low-value to high-value areas of use. Previous work on water trading has focused on surface water trading and theoretical approaches to analyzing groundwater trading. Empirical analysis of groundwater trading is a new area of research, due in part to the lack of recorded usage, trade data and binding constraints on groundwater use by landowners.

Unlike many other groundwater-dependent areas across the nation, the Upper Republican Natural Resource District (URNRD) has had metering and use restrictions in place for over 30 years. The URNRD has also developed some mechanisms to help producers use water most efficiently under allocation restrictions. Two of the tools available include creating pools and formally trading water. Formal water trading occurs when the irrigation rights are permanently transferred from one field to another field. When multiple fields are combined to create a pool, a producer can temporarily move a water allocation from one field to another field in the same pool. Within-pool transfers are conducted when fields under the same owner aggregate their total allocations into a pool, as approved by the URNRD board, and then redistribute the water to each field at the owner's discretion. These within-pool transfers have much lower transaction costs than the formal trades, due to less time and money spent

finding a trading partner and gaining board approval. Therefore, the URNRD provides a great opportunity to better understand the impacts of allowing some restricted trading. Results are useful both for the potential expansion of groundwater trading in the URNRD and the rest of Nebraska, as well as in other areas.

Our study examines formal trading and within pool transfers using thirty years of water use and field level characteristics provided by the URNRD. The district has historically allocated water over three to five year periods, which allows the landowners more flexibility in planning their irrigation schedules. Allocations began at 22 inches per certified acre in 1980 and have since been reduced to 13 inches per certified acre for the 2008-2012 allocation period. Specifically, we want to determine if standard economic criteria based on the cost of pumping groundwater and the expected yield are useful indicators in determining trading behavior.

To measure some of the relevant economic criteria we use a marginal abatement cost (MAC) curve that is calculated based on well-level characteristics and average market prices.[1] The MAC curve measures the lost profit of reducing water use for a particular well. Figure 1 provides an example of two different MAC curves for representative wells. In Figure 1, annual profits on Field A are reduced by approximately $23 per acre if water applications are reduced by two inches per acre, while annual profits on Field B are reduced by approximately $3 per acre for the same reduction in water use. In this example, if we observe Field A and Field B trading water, we would expect Field A to be the buyer while Field B is the seller. This is because the lost profit from reducing water use is higher for Field A, and so the owner would be willing to pay for extra water to offset the lost profits.

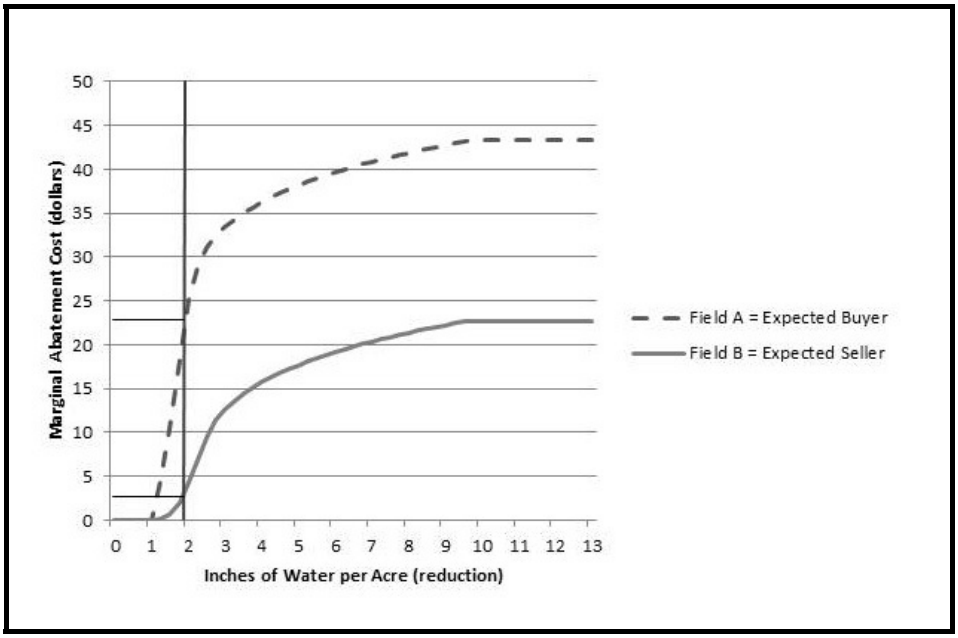

Figure 1. Marginal Costs of Reducing Irrigation Application

The analysis uses information on over 3,000 fields in the URNRD. Results show that larger fields and larger operation sizes were more likely to participate in a formal trade. Fields with a higher pumping rate and depth to groundwater are less likely to participate in formal trades. Presumably, a well with a higher pumping rate has greater capacity to meet its own water needs without trading for additional water. Also, an individual who has invested in a high pump capacity well may be less likely to want to sell some of his water after making the capital investment. Similar results were found with the analysis of within-pool transfers. Specifically, larger fields and larger operations are more likely to participate in within-pool transfers, while fields with a higher pumping capacity or depth to groundwater are less likely to participate.

In addition to examining participation in trades and transfers, we also considered the direction of those trades/transfers. The MAC curves are used to predict whether a field was a net buyer or seller of water during trades/transfers. With formal trading, fields that are predicted to be sellers are 30 percent more likely to actually be sellers. This result shows that the variables that measure the expected profit loss from reduced water use are significant in determining behavior. This result is useful in predicting the potential effects of developing new groundwater markets in other areas. It shows that we can have some confidence that predictions of trading behavior in a newly developed market will be accurate. We also find no evidence of any additional stream depletion due to trades; in fact, the overall effect of the water trades that have occurred is a reduction in streamflow depletion. While this result is not something that can be applied to other basins, it does reduce some of the concerns with allowing trading/transfers in the URNRD.

The results of this analysis show that in both types of decisions (formal trades and within-pool transfers), producers behave rationally and generally as expected. If designed appropriately for the different regions, the curves and MAC indicators can be used to predict direction and ultimately the impacts of groundwater trading in an area.

[1] Specific details on the development of the MAC curves are in Palazzo and Brovovic, 2012. The underlying costs are generated by Water Optimizer (Martin et. al., 2007).

These results will allow us to better predict the effects of expanding groundwater markets in Nebraska and other regions. However, the results depend on having field-level information that is often not available. Thus, expanding the collection of data on groundwater use will allow policymakers to be better informed when creating new groundwater markets.

For additional information on the study and results, refer to Juchems (2013) at:
http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1012&context=agecondiss

References:

Juchems, E. M. (2013). *Predicting Groundwater Trading Participation in the Upper Republican River Natural Resource District*. (Master's Thesis), Department of Agricultural Economics, University of Nebraska-Lincoln.

Martin, D., R. Supalla, B. McMullen and S. Nedved, (2007, December). "Water Optimizer: a Decision Support Tool for Producers with Limited Water." University of Nebraska-Lincoln Departments of Biological Systems Engineering and Agricultural Economics.

Palazzo, A. M. and N. Brozovic, (2012). "Spatial Water Management Policies for the Protection of Instream Flows." *Working Paper*, 1-41.

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