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Weather Derivatives as a Potential Risk Management Tool for Irrigators

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Market Report	Yr Ago	4 Wks Ago	5/29/09
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight	$94.46	$86.29	$84.45
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	117.50	119.89	117.45
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	*	102.66	102.86
Choice Boxed Beef, 600-750 lb. Carcass	155.98	151.00	145.60
Western Corn Belt Base Hog Price Carcass, Negotiated	72.49	53.90	59.22
Feeder Pigs, National Direct 50 lbs, FOB	37.00	65.00	*
Pork Carcass Cutout, 185 lb. Carcass, 51-52% Lean	80.25	57.43	59.18
Slaughter Lambs, Ch. & Pr., Heavy, Wooled, South Dakota, Direct	110.50	112.25	*
National Carcass Lamb Cutout, FOB	255.98	244.55	253.15
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	7.45	5.35	6.46
Corn, No. 2, Yellow Omaha, bu.	5.64	4.02	4.26
Soybeans, No. 1, Yellow Omaha, bu.	12.77	10.78	12.25
Grain Sorghum, No. 2, Yellow Dorchester, cwt.	9.54	6.02	6.86
Oats, No. 2, Heavy Minneapolis, MN , bu.	3.84	2.12	2.59
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	*	190.00	*
Alfalfa, Large Rounds, Good Platte Valley, ton.	77.50	77.50	*
Grass Hay, Large Rounds, Premium Nebraska, ton.	*	85.00	*
Dried Distillers Grains, 10% Moisture, Nebraska Average.	172.50	143.00	152.50
Wet Distillers Grains, 65-70% Moisture, Nebraska Average.	62.25	51.75	49.50

***No Market**

Irrigators in the Republican Basin and in parts of the North Platte Basin must learn to incorporate multiple year drought risk into their management plans, as they adapt to the limitations imposed by five-year pumping allocations. A major concern involves the implications of being water-short during the later years of the allocation period, because of an accumulative rainfall shortage or drought. Currently, producers can either ignore the risk of substantially lower incomes if their allocation is exhausted too soon, or reduce the risk by using less water early in the allocation period. The latter approach, however, may substantially reduce the present value of total net income over the five-year period. Alternatively, in the future it may be possible to use weather derivatives to manage income risk.

Currently in agriculture, weather derivatives are used mainly to hedge the risks of input cost variability that can be linked to weather, such as energy costs for irrigation pumping. However, in a recent study we found that derivatives may also have potential as a management tool for addressing the risks associated with being short of irrigation water. A weather derivative is a financial instrument that operates similar to an insurance product that uses a traditional premium to pay-out structure. They are most useful in cases where variations in rainfall or temperature can be closely linked to variations in profits or sales. In irrigated agriculture, rainfall variability can be directly related to farm profits using estimated relationships between total available water (irrigation plus rainfall) and grain yields. Weather derivatives differ from conventional crop yield insurance, in that pay-outs and premiums are based on rainfall rather than the actual experience of producers. This means that an important advantage of weather derivatives is that there is no need to track a yield history, verify production activities or protect against ethical misconduct.

In a recent paper we analyzed the potential for using a weather derivative to manage the annual risk associated with entering the crop year with less than a normal irrigation supply. This situation may occur either because the irrigator chose to use a disproportionate amount of a multi-year allocation of water during the early years of the period, or because exogenous factors

have reduced the irrigation supply below normal levels for the forthcoming cropping season.

The estimated empirical relationships between economic net returns, effective rainfall probabilities and selected irrigation water supply levels are depicted in Table 1. This table can be used to find the probability that a given net return can be achieved, given a specified seasonal irrigation water supply. To illustrate, assume a producer has only six inches of water to use during the cropping season. In a normal year, with average rainfall and 12 inches of irrigation water, a typical irrigator in the Republican Basin would be able to produce a normal net return of $352 per acre. If this irrigator had a minimum net return target equal to 60 percent of normal, or $210 per acre, and had only 6 inches of irrigation water available, his target net return would be achievable with 9.1 or more inches of rain, which would occur 72 percent of the time.

Table 1. Net Return Distribution at Three Irrigation Levels

		Irrigation Amounts		
Growing Season Rainfall	Probability of Non-Excedence	*0 acre inches*	*6 acre inches*	*12 acre inches*
0.0	*0%*	*-$101.03*	*$68.89*	*$209.86*
1.5	*1%*	*-$72.71*	*$97.21*	*$229.88*
3.0	*2%*	*-$44.39*	*$125.51*	*$249.90*
4.5	*4%*	*-$16.07*	*$149.73*	*$269.91*
6.1	*9%*	*$12.25*	*$169.83*	*$289.17*
7.6	*17%*	*$40.57*	*$189.85*	*$307.18*
9.1	*28%*	*$68.89*	*$209.86*	*$324.99*
10.6	*42%*	*$97.21*	*$229.88*	*$342.81*
11.4	*50%*	*$112.50*	*$240.29*	*$352.08*
12.1	*57%*	*$122.79*	*$247.17*	*$357.80*
13.6	*71%*	*$141.09*	*$261.27*	*$367.40*
15.2	*83%*	*$155.27*	*$274.61*	*$373.13*
16.7	*91%*	*$169.36*	*$286.69*	*$391.77*
18.2	*96%*	*$183.46*	*$298.59*	*$391.77*
19.7	*98%*	*$197.56*	*$310.49*	*$391.77*
21.2	*99%*	*$211.65*	*$322.28*	*$391.77*
22.7	*100%*	*$225.75*	*$331.88*	*$391.77*
24.2	*100%*	*$239.09*	*$337.61*	*$391.77*

A derivative to cover the times when rainfall was less than 9.1 inches, which occurs 28 percent of the time, was found to have an expected value of $9.60 per acre per year for this level of protection. The total price of a weather derivative would be the expected value of the protection, plus any additional administrative costs and profits accruing to the company selling the protection.

This example illustrates that weather derivatives may be attractive to some producers who find themselves facing a very limited irrigation supply. The premium cost of $9.60 per acre amounts to $1.07 per acre-inch of protection, plus a profit margin for the derivative seller for each inch of rainfall below nine, whereas the value of an acre-inch of rainfall is $15.67. Irrigators that are more or less concerned about meeting net return goals may choose to pay different premiums in order to secure a different level of risk protection. Hypothetically, an irrigator could purchase a weather derivative to protect a wide variety of rainfall shortages and net return goals, assuming that there is a weather derivative company willing to offer the coverage. However, the cost of risk mitigation increases exponentially as the level of protection is increased.

Potential areas of application for weather derivatives in irrigated agriculture include any crop production situation where there are no traditional forms of cost, yield or revenue insurance available at a competitive price. Weather derivatives are most likely to be attractive, however, in those situations where there is a predetermined water shortage and a preferred irrigation practice that is not insurable from other sources. For example, irrigators who know at the beginning of the season that they will not receive as much water as they have historically, and who do not want to change crops or reduce irrigated area, cannot get conventional crop insurance for this practice. Irrigators in this predicament can only insure their crop as dryland or not at all.

The appropriate weather derivative insurance products for these potential customers are not available at the present time, but there is industry interest in making them available. Such products could help many producers optimally manage water supply uncertainty, and may make it easier for the State of Nebraska and Natural Resources Districts to implement the control policies that will be necessary to meet long-term water policy objectives.

REFERENCES:

Thompson, Christopher L., Raymond J. Supalla, Derrel L. Martin, Brooks J. Neely and Brian P. McMullen. "Weather Derivatives as a Potential Risk Management Tool for Irrigators," 2009 AWRA Summer Specialty Conference, June 29 – July 1, Snowbird, Utah.

Neely, Brooks J. "Potential Use of Weather Derivatives as a Risk Management Tool in Irrigation," Unpublished M.S. Thesis, Department of Agricultural Economics, UNL (forthcoming).

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