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Farm Location Influence on the Optimal Crop Insurance and Pre-harvest Hedging Level

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Market Report	Year Ago	4 Wks Ago	9-21-18
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight.	108.50	*	*
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	175.97	176.47	179.12
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	159.71	163.87	167.53
Choice Boxed Beef, 600-750 lb. Carcass.	191.98	213.86	204.98
Western Corn Belt Base Hog Price Carcass, Negotiated	47.83	36.85	61.58
Pork Carcass Cutout, 185 lb. Carcass 51-52% Lean.	73.96	64.40	77.52
Slaughter Lambs, wooled and shorn, 135-165 lb. National.	158.90	141.26	137.78
National Carcass Lamb Cutout FOB.	406.66	383.67	378.76
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	3.32	4.59	4.61
Corn, No. 2, Yellow **Columbus**, bu.	3.10	3.26	3.22
Soybeans, No. 1, Yellow **Columbus,** bu.	8.85	7.34	7.18
Grain Sorghum, No.2, Yellow Dorchester, cwt.	5.28	5.12	5.10
Oats, No. 2, Heavy Minneapolis, Mn, bu.	2.97	2.82	3.02
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	*	*	*
Alfalfa, Large Rounds, Good Platte Valley, ton.	87.50	102.50	102.50
Grass Hay, Large Rounds, Good Nebraska, ton.	87.50	105.00	102.50
Dried Distillers Grains, 10% Moisture Nebraska Average.	107.50	139.00	135.00
Wet Distillers Grains, 65-70% Moisture Nebraska Average.	40.00	41.49	43.00

*** No Market**

Improving farm financial health can come from improving the understanding of the market forces influencing the optimal crop insurance contract and pre-harvest hedging risk management tools. The biggest challenge for farmers is the difficulty of assessing risk since experiencing risk, is by default, rare. Additionally, farmers receive advice about which crop insurance plan they should purchase or how much pre-harvest hedging they should do from sources, such as farm magazines, that likely do not consider the differences in individual risk exposure. Following the advice of such sources could result in producers being inadvertently exposed to more risk. A producer's location is a primary factor influencing risk exposure. Figure 1 identifies yield risk exposure by county across Nebraska for irrigated corn production. The blue/dark blue counties have a lower yield risk level than the state average yield risk and the red/orange counties have a higher yield risk than the state average. Crop insurance uses the values in Figure 1 to calculate the premium in each county.

The objective of this article is to identify the influence of risk exposure coming from yields and the yield-price relation. This information will then be used to discuss the optimal crop insurance and pre-harvest hedging for irrigated corn for two locations in Nebraska.

Results from this analysis come from the model developed by Walters and Preston (2018) where they develop a framework for risk management decision making that considers factors relevant to the farmer (or county in this case). The model structure allows for an evaluation of how crop insurance contracts affect net income risk and their impact on net income risk when used in conjunction with pre-harvest hedging.

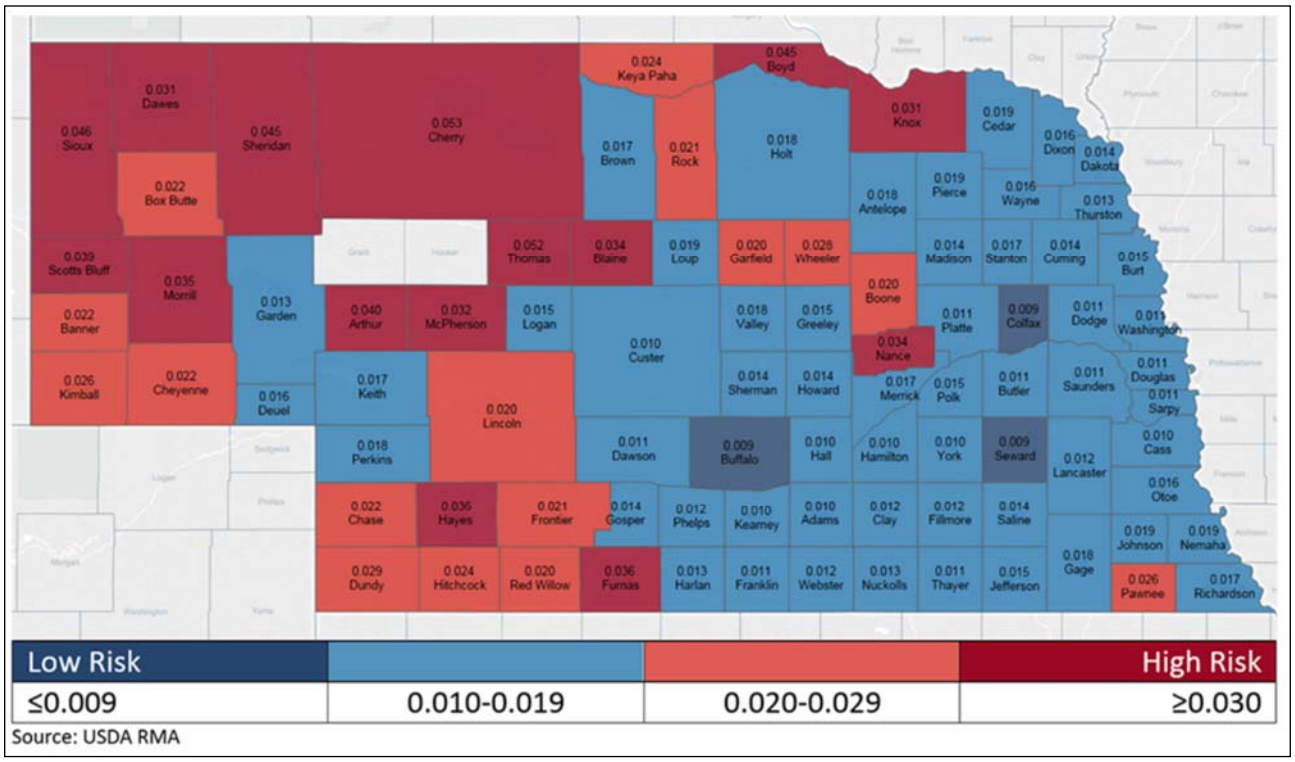

Figure 1. Irrigated Corn Yield Risk

The model provides a tailored risk management response strategy.

Let's consider two irrigated corn counties – Saunders County and Custer County which are separated by about 175 miles from east to west. The analysis is conducted at the county level, implying that farms within the county will likely experience different outcomes; however, farms with acreage spread across a county will be more similar to the county analysis found here. This study evaluates the farm average yield not individual fields and, as a result, experiencing a low yield in one or two fields will move the farm average yield down, but not tremendously, given that there are a sufficient number of fields in the farm. In the crop insurance contract, this would be akin to selecting an enterprise unit structure over basic or optional unit structures.

In order to make a risk management decision, the decision maker must have clear objectives. For this analysis the two main objectives are to maximize net income and minimize the probability of farm failure. Any risk management strategy that increases risk (the probability of farm failure) is deemed irrelevant (and careless) and no longer considered. Risk management strategies that have a lower expected net income than an alternative are less effective and no longer considered.

Three factors contribute to net income risk exposure: yield risk, futures price risk and the relation between yields and prices. These three factors are described in detail below.

Yield Risk - In this analysis, the yearly de-trended county average yield over the previous 34 years is used to describe yield risk. The year 1993 represents the worst yield in the 34 years. In 1993 there was a very wet spring followed by a very cold August.

Futures Price Risk - Futures price risk is defined by the change in December futures price between March 1st and December 1st because these dates correspond to (1) the crop planting decision, (2) Risk Management Agency (RMA) projected price determination and (3) the December futures expiration, which is just after harvest. The futures price volatility factor is used to identify Dec 1st price possibilities on March 1st, which is the same method RMA uses to identify price risk. Futures price risk exposure, which represents the primary source of price risk, does not vary between producers.

Yield Price Correlation - Another source of risk exposure, and one that is often overlooked, is the producer's underlying relation between yields and prices. The negative relation between yields and prices is commonly referred to as the natural hedge. i.e. as yields decrease, the price of that commodity increases. The drought of 2012 was an example of the natural hedge where drought lowered expected yields and prices responded by moving higher.

Crop insurance contract premiums are specific to the location of the farmer. Revenue Protection (RP) and Revenue Protection Harvest Price Exclusion (RP-HPE) across coverage levels ranging from 50% to 85% in 5% increments with enterprise units were tested in this analysis. RP and RP-HPE are considered because they both insure price, but in different ways. Besides RP-HPE having a lower premium than RP, RP will recalcu-

late liability when the harvest price is greater than the projected price. The drought of 2012 is an example when harvest price was greater than the projected price. When the harvest price is greater than the projected price, only yield can trigger an indemnity payment. Limits were set on pre-harvest hedging to Hedge-to-Arrive (HTA) contracts with a 10 cents per bushel initial contract fee, a 10 cent per bushel buyout fee and the dollar amount from being in an oversold position with a lower contract price than the fall price. Pre-harvest hedging quantities range from zero to 110% of expected yield.

It is easy to identify the costs of risk management through crop insurance premiums and pre-harvest hedging costs. The difficulty comes in identifying risk exposure because low yield events do not occur often and the yield price correlation can be difficult to represent. The yield-price correlation in Saunders County is -0.35 and -0.22 in Custer County. This result suggests that moving west away from the Corn Belt results in a weakening relation between yield and price. A lower yield-price correlation implies that the producer in Custer County faces more net income risk than those closer to the Corn Belt (Saunders County) and therefore has more to gain from risk management tools.

To form the net income distribution for each location, yields are drawn out of the county yield distribution and futures price distribution. The first goal of highest expected net income is found by taking the average of all income draws. The second goal of minimizing risk is taken by finding the average of the worst 5% of outcomes. Crop insurance policies and pre-harvest hedging influence the net income distribution and therefore expected net income and the ave-rage of the worst 5% of outcomes. These points are compared for each evaluated crop insurance policy and different levels of hedging to identify the ones that achieve the highest expected net income and lowest risk.

Results

Crop Insurance contract type. The optimal insurance contract for both counties was RP-HPE. This is because RP-HPE had a lower premium than RP but provided similar reductions in risk exposure. RP-HPE is often overlooked as an inferior contract when compared to RP since RP-HPE does not protect against higher fall prices. Recall that in an event with higher prices, like the 2012 drought, only yield losses trigger crop insurance indemnity payments. The question then becomes, will an irrigator face the possibility of indemnity payments when higher prices occur? A primary role of irrigation is to protect yields against drought. The combination of experiencing higher prices with a loss in an irrigated production practice in the same year is a very rare combination of events.

However, before adopting RP-HPE, let's walk through a few reasons why a farmer may want to stick with RP. First, crop insurance does not allow for separate insurance types (RP or RP-HPE) between practices (irrigated vs. non-irrigated). Having RP-HPE when non-irrigated corn is in the production mix can be problematic, especially as the percent of non-irrigated corn to irrigated corn grows. Facing the threat of losing irrigation water during a drought, say your pumping out of a river, improves the chances of an irrigated loss during a drought and places more value on having RP over RP-HPE. The county level model used here implies a producer has acreage spread over a large part of the county, which is unlikely. If the producers' acreage is within a smaller area then the threat of a lower farm yield through hail or wind increases, again implying a higher value for having RP. Of course the producer can add hail/wind insurance on top of the crop insurance policy. There is little RP-HPE purchased in Nebraska with just under 69,000 corn acres insured using RP-HPE in 2017.

Crop insurance coverage level. Results indicate 85% coverage level as optimal with 80% just behind. Identifying the highest coverage levels as being optimal is a function of our objectives, to minimize a rare event that could result in farm failure. No one knows when a rare event will happen, just that they will. If you are planning on farming for the next 20 or so years then lean toward the higher coverage level because it is likely you will experience one of these rare events. If you are not convinced that one of these catastrophic events will occur this upcoming year, then select a lower coverage level. If you are short on capital, select the higher coverage level knowing that your expected income goes down (due to a higher premium) but the probability of survival goes up because of the protection provided by an RP or RE-HPE policy.

Pre-harvest hedging. In both locations hedging without insurance reduced risk and net income. Recall that hedging is costly (HTA costs money to implement) so on average across time it will reduce expected net income with the benefit being reduced risk. With no insurance, hedging past 70% of expected yield begins to increase risk in Custer County while hedging past 60% of expected yield in Saunders County begins to increase risk. The opportunity to hedge in irrigated production without insurance is a result driven by the low yield risk (as viewed through the county). Any amount of hedging up to the point of increasing risk is optimal. This is because for each level of hedging the decision maker is trading a lower expected income for less risk. A producer who places a low chance on a low price to occur in the fall will hedge less, maybe zero, while a producer placing a high chance on the low price to occur in the fall will do more hedging.

Any amount of hedging from zero to 70% in Custer County and zero to 60% in Saunders County is optimal. A smaller maximum on the level of hedging in Saunders County is a result of the stronger yield price correlation. Recall that a stronger yield price correlation means less net income risk and therefore less need to protect against bad events.

Insurance and pre-harvest hedging. What does buying an optimal crop insurance policy do to the optimal amount of hedging? For irrigated corn, buying an optimal crop insurance policy (RP-HPE at 85% coverage level) reduces the maximum amount of pre-harvest hedging in Custer County from 70% to 40% and in Saunders County from 60% to 25%. This result indicates substitutability between crop insurance and hedging.

Conclusions

Devising a risk management plan requires not only an understanding of how the risk management policies work but more importantly, having a set of objectives and knowledge of the risk exposure. The county analysis presented here suggests that the optimal risk management plan can vary due to risk exposure. Focusing on irrigated corn production results finds that the RP-HPE insurance policy with high coverage levels (we only considered enterprise units) to be optimal. However, farm characteristics that increase .the chance of yield losses in years with higher fall prices can change the optimal policy back to RP. A declining yield price correlation, which implies more net income risk, suggests a higher maximum amount of pre-harvest hedging before hedging starts to increase risk. Going from Saunders County to Custer County increased the maximum hedging amount by 10 percentage points. Any level of hedging from zero to the point at which hedging increases risk is optimal The results of this analysis are intended to provide guidance on the role of risk exposure the optimal crop insurance contract and pre-harvest hedging, not what crop insurance contract to purchase or how much pre harvest hedging should be done. This analysis provides a glimpse of the influence risk exposure has on the optimal crop insurance policy and range of pre-harvest hedging. Future articles will focus on different risk exposures from different locations and crops across Nebraska.

Walters C.G., and R. Preston. 2018. "Net Income Risk, Crop Insurance and Hedging: A Producer's Level Framework" *Agricultural Finance Review*, Vol 78 Issue: 1, pp. 135-151. https://doi.org/10.1108/AFR-05-2017-0036

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