Effects of Collective Action Water Policy on Kansas Farmers' Irrigation Decisions: The Case of the Sheridan County 6 LEMA

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In 2012, new legislation granted Kansas Groundwater Management Districts (GMDs) the power to originate their own localized water conservation management plans (Kansas Dept. of Agriculture, 2013). Farmers in Sheridan County, located in the northwestern corner of Kansas, were the first to impose restrictions on themselves by forming a Local Enhanced Management Area (LEMA) in 2013 as a collective action effort to regulate their water use. The overarching goal of the LEMA is to reduce irrigated groundwater use in a manner that preserves the economic benefits of irrigation further into the future.

In this ACCC Fact Sheet, we estimate the LEMA's impact on total water use, cropping pattern changes, as well as crop nutrient and seed purchases. Results show that farmers within the LEMA significantly reduce their irrigated water usage and plant fewer total irrigated crop acres. While corn acres declined, sorghum acres increased considerably within the LEMA. With fewer corn acres, farmer cooperatives could be challenged by having fewer bushels coming into the elevator as well as a decline in seed, chemical, and crop nutrient sales in the near future. In the long run, cooperatives could see greater bushels and greater input sales because the reduction in current water use will extend the life of the aquifer.

LEMA's Impact on Farmer Decisions

The focus of this analysis is on the Sheridan County 6 LEMA. The LEMA is a 99 square mile area that contains 185 wells for irrigation and 10 non-irrigation wells (Figure 1). The goal of the LEMA is to reduce groundwater pumping by approximately 20% relative to historical use. This is accomplished by restricting irrigators to a five-year allocation of 55 inches each.

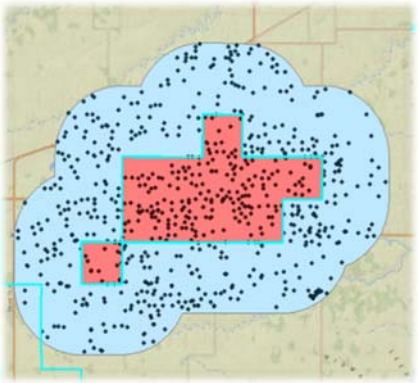


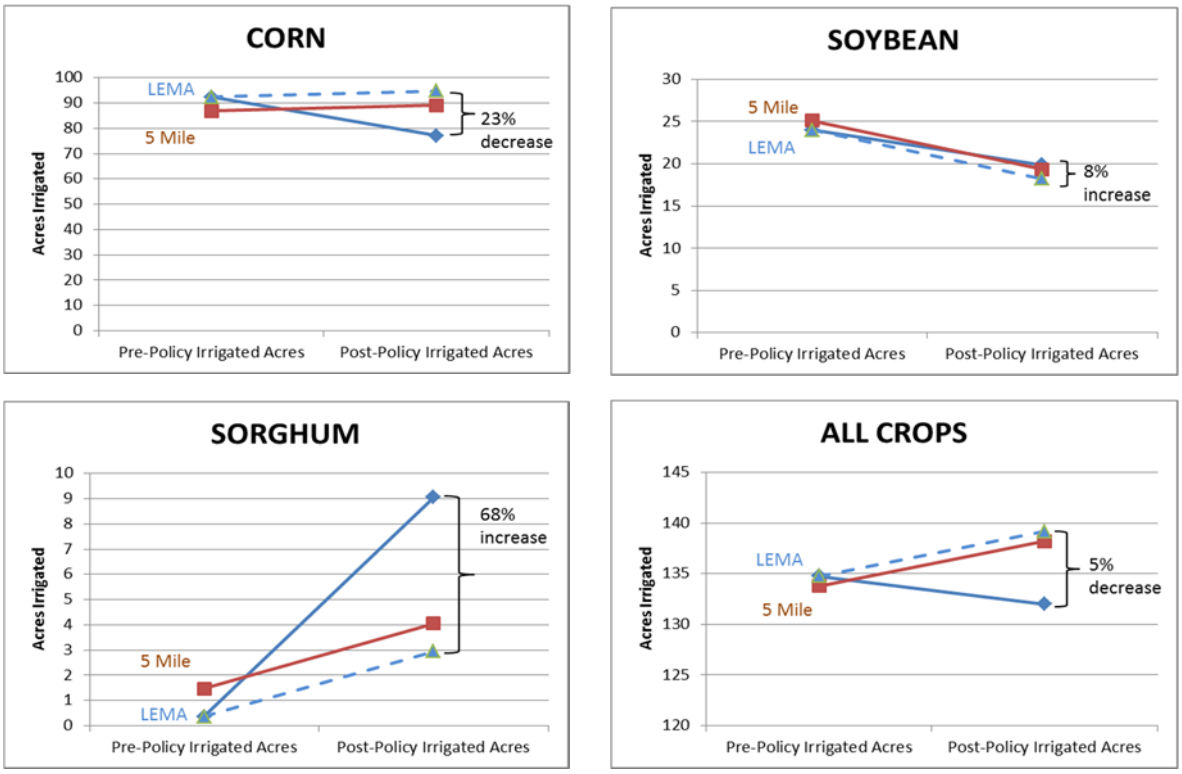
Figure 1: Number of Irrigation Wells in Sheridan County 6 LEMA (red) and Surrounding 5 Mile Boundary (blue)

To model farmers' response to the LEMA, we compare farmers' decisions within the LEMA to those outside of the LEMA. So, reported farmers' water use from the Kansas Department of Agriculture within the LEMA are compared to farmers' water use within a 5 mile boundary outside of the LEMA (as shown Figure 1). The key assumption is that irrigation decisions inside the LEMA boundary would have followed the same trend as those in the 5 mile boundary if the LEMA water use restriction had not been in place. Therefore, the model calculates the difference between pre- and post-LEMA irrigation water usage and planted crop acres are calculated for farmers within and outside of the LEMA.

The change in total water use due to the LEMA policy is decomposed into three adjustments. First is the changes in irrigated acreage. Second is the changes in applied water intensity on the same crop. Finally, changes in crop allocation are calculated. These adjustments assume that the irrigator's total water use is a coupled decision between the total number of irrigated acres and total inches of applied water per acre.

Overall, the LEMA results in a decrease in total irrigated crop acreage, led by a steep decline in irrigated corn acres. Farmers within the LEMA reduced their "All Crops" irrigated acreage by 5 percent (Figure 2). The largest reductions were in irrigated acreage of corn (-23%) with smaller relative expansions in soybean (8%).

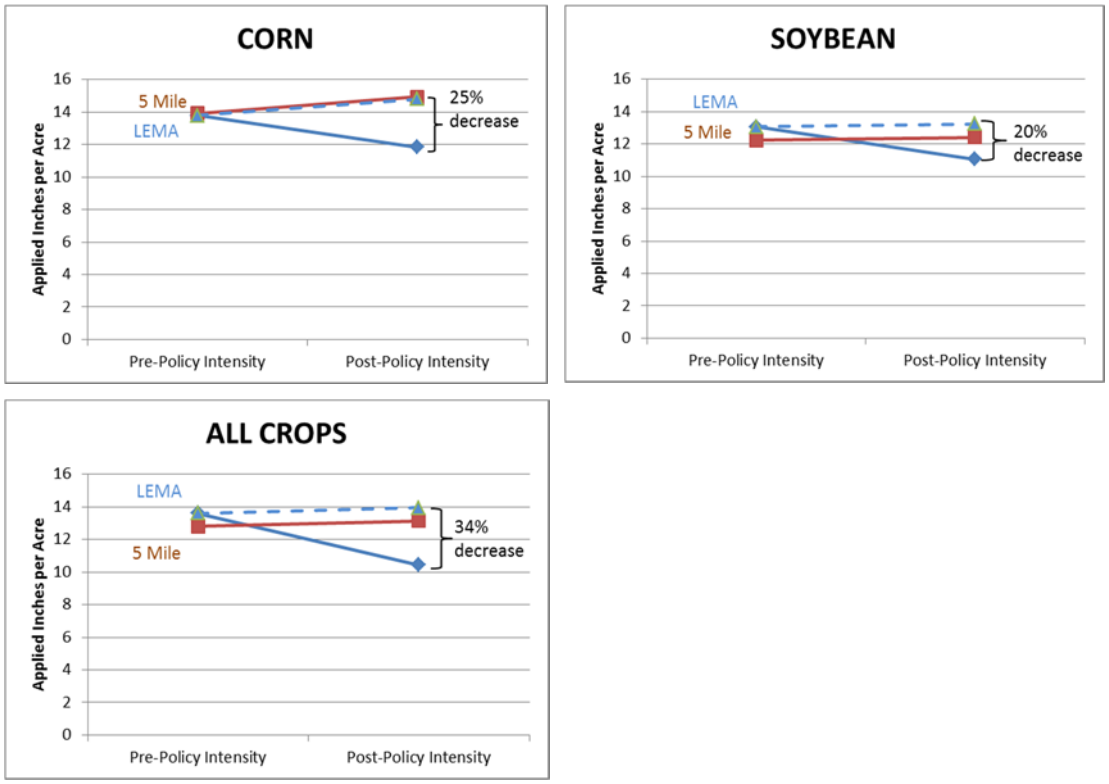
Interestingly, sorghum irrigated acres rose sharply within the LEMA. While all farmers in the area increased their planted irrigated sorghum acres, those farmers within the LEMA planted 68 percent more acres. It should be noted that there were very small quantities in acreage dedicated to sorghum. As a result, all crop acres fell within the LEMA because the increased sorghum acres were not enough to offset the decline in corn and soybean acres.



*Note: Each figure represents the following three comparable scenarios:
1. The solid red line connects points between the 2009-2012 avg. and 2013 of actual reported data from irrigators in a 5 mile boundary surrounding the LEMA
2. The solid blue line connects points between the 2009-2012 avg. and 2013 of actual reported data from irrigators in the LEMA
3. The dashed blue line connects points between the 2009-2012 average of actual reported data from irrigators in the LEMA and a counterfactual value for 2013 that represents what the irrigators would have done had they not been subject to the water policy and followed a similar trend to the irrigators in a 5 mile boundary surrounding the LEMA

Figure 2: LEMA Policy Impact on Planted Irrigated Acreage

Additionally, farmers in the LEMA applied less water, while farmers outside of the LEMA increased their water usage. Within the LEMA, farmers decided to reduce total applied inches per acre by 34 percent (Figure 3). , Irrigators in the LEMA chose to reduce applied water intensities from 13.8 inches/acre to 11.9 on corn acreage and 13.1 to 11.0 on soybean acreage. Comparatively the irrigators in the neighboring 5 mile boundary increased applied intensities moving from applying 14.0 inches/acre to 14.9 inches/acre on corn and slightly increasing from 12.2 inches/acre to 12.4 on soybean acreage. Due to limited irrigated acres before the policy on sorghum, we cannot determine changes in applied inches before and after the water policy.



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1. The solid red line connects points between the 2009-2012 avg. and 2013 of actual reported data from irrigators in a 5 mile boundary surrounding the LEMA
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Figure 3: Changes in Applied Inches per Acre

Effects on Crop Input Expenditures

Given the LEMA Policy significantly impacted planted acres, there could be a potential impact on seed and chemical expenditures. Using Kansas State University's recommended crop budgets for Northwestern Kansas, the affect the LEMA could have on expenditures for corn, soybean, sorghum, and wheat is estimated. Our estimates assume that farmers had the same expenditures for corn before and after the LEMA was implemented so the only change in input expenditures is due to changes in cropping patterns.

For farmers within the LEMA, seed and chemical expenditures dropped significantly, especially for corn. The overall reduction was nearly 20 percent. Herbicide and insecticide expenditures each fell by 16 and 23 percent, respectively. Additionally, the largest estimated drop was fungicide applications plummeting more than 30 percent. Changes in corn acreage led to seed and fertilizer expenditures falling roughly 20 percent.

Conclusion

The impact of the LEMA significantly impacted producers' choices on how much water to use and the crops raised. By in large, producers chose to just reduce their applied inches of water per acre on the same crop rather than making changes to cropping patterns. Reductions of applied intensity occurred primarily on corn and soybean accounting for the largest proportion of overall reduced water use. In addition, few irrigated acres were planted to corn with the primary switch being to sorghum and soybeans. These changes have an impact on the crop input markets such as herbicides, pesticides, fertilizer and seed.

Although reductions in water use will slow the depletion of the aquifer, many agricultural businesses could be directly impacted by changes in water use decisions including changes to seed and chemical purchases and grain flows. The changes in cropping patterns in the Sheridan County LEMA were estimated to reduce crop input expenditures of herbicides, pesticides, fertilizer and seed by nearly 20%. On the other hand, reduced groundwater depletion means that there will likely be more seed and chemical purchases in the future by extending the life of the aquifer. Producers have also made changes to irrigated acreage and have opted to switch crops for less water intensive varieties although these changes were not the predominant factor.

In summary, the collective action management plan was able to reduce water use overall, which caused a positive impact on the aquifer. However, the current data were not able to identify if the reduction in water intensity resulted in reduced crop yields. Future research will add to the data to quantify these impacts and continue to monitor the progress of the LEMA to uncover any potential adaptations that irrigators exhibit when subject to a water quantity restriction.

Crop budgets for Western Kansas used in estimating the effects on crop input expenditures are available for download at www.agmanager.info.