9. The Effect of Collective Action Water Policy on Kansas Farmers' Irrigation Decisions

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Krystal Drysdale is a PhD student in the Dept. of Agricultural Economics and is a current CoBank Fellow from the Arthur Capper Cooperative Center. Her research largely centers around issues in food access, water quantity and natural resource management. Her interests expand into topics of water policy, resource scarcity, adaptability, and global food system management using GIS and other spatial analyses within an economic framework.

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Nathan Hendricks is an Assistant Professor in Agricultural Economics at Kansas State University. He holds B.S. and M.S. from KSU and a Ph.D. from University of California, Davis. His research analyzes agricultural supply response and the effect of agricultural and environmental policies. His previous research has investigated agricultural supply dynamics, the cost-effectiveness of alternative water conservation policies, and the production effects of agricultural domestic support programs. He teaches an undergraduate course on international and environmental issues in agriculture, a graduate course on agricultural policy, and a graduate team-taught course in quantitative methods.

Abstract/Summary

We evaluate changes in irrigation decisions in response to two collective action water policies in Kansas: the Rattlesnake Creek Management Plan and the Sheridan 6 LEMA. We estimate the impact of the two policies on total water use, water use intensity (inches per acre irrigated), total irrigated acreage, and cropping patterns. Our results indicate how farmers adjusted to the policies and what proportion of reduced water withdrawals (if any) were achieved through changes in irrigated acres, changes in cropping patterns, or change in the intensity of irrigation.

EFFECTS OF COLLECTIVE ACTION WATER POLICY ON KANSAS FARMERS' IRRIGATION DECISIONS

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OVERVIEW

The focus of this research is to estimate how farmers altered their irrigation strategies in response to two collective action water management plans

1. LEMA in Sheridan County
2. Rattlesnake Creek Management Plan in south central Kansas

HOW DID FARMERS REDUCE WATER USE ?

HOW DID THE OUTCOMES OF TWO POLICIES COMPARE ?

INTRO: THE HIGH PLAINS AQUIFER

Largest groundwater storage reservoir in the US
- covers174,000 square miles (110 million acres) of the Great Plains
- stretches across eight states

Considered a non-renewable resource
- recharge rate of less than an inch per year
- resource changes could affect irrigated crop production and subsequently raise food prices

SOURCE: USGS, ARCGIS MAP SERVICE

BACKGROUND: SHERIDAN 6 LEMA

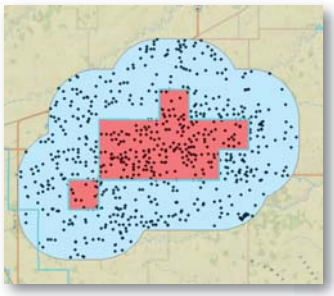
In 2012, new legislation granted localized water conservation management plans which are legally enforced by the state.
- Formed a 5 year Local Enhanced Management Area (LEMA) plan in 2013 in Sheridan County
- Specific goals of the LEMA as described by the order of the Chief Engineer
  - Reduce groundwater pumping by approximately 20%
  - Restricting irrigators to a five-year allocation of 55 inches each

COUNTIES: SHERIDAN, THOMAS
99 SQUARE MILES
185 WELLS FOR IRRIGATION
10 NON-IRRIGATION WELLS

Sheridan 6 LEMA

DATA: KANSAS DEPARTMENT OF AGRICULTURE

Water Rights Information System Database (WRIS)
- reported number of acres irrigated
- reported crop type
- water withdrawal quantities in acre/ft



WHAT CAN WE GET OUT OF THE DATA?

- From these 3 variables we can say something about how irrigators chose to modify their water use
  - reductions/expansions in irrigated acreage
  - changes in cropping patterns
  - changes in water intensity
- We can then answer the questions…

DID FARMERS REDUCE THEIR TOTAL NUMBER OF ACRES IRRIGATED?

DID FARMERS SWITCH TO LESS WATER-INTENSIVE CROPS?

DID FARMERS JUST APPLY LESS WATER ON THE SAME CROP?

WERE FARMERS ABLE TO ACHIEVE THE GOALS OF THE LEMA?

MEASURING THE RESPONSE: 3 SCENARIOS

Case 1: Consider just the difference in behavior of the LEMA irrigators in 2013 compared to a previous "average" response of the same.
- pre-policy vs post-policy

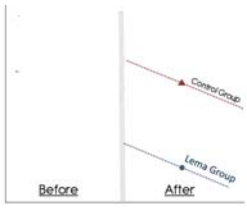
Case 2: Consider just the difference in behavior of the LEMA irrigators in 2013 compared to other nearby irrigators.
- LEMA group vs Non-LEMA group

Case 3: We combine the above 2 scenarios, so that we can effectively model not only how LEMA irrigators changed their behavior pre/post policy but also how that trend is correlated with behavior changes that also occurred in another Non-LEMA group.
- Essentially we can parse out common effects to both groups to isolate the specific effect of the LEMA policy on irrigators.

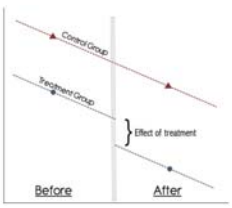
MEASURING THE RESPONSE: 3 SCENARIOS

Case 1:
Pre-policy vs Post-Policy

Case 2:
LEMA vs Non-LEMA

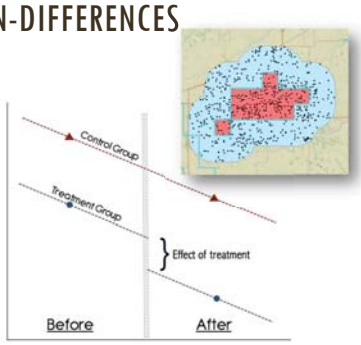


Case 3:
Difference-In-Differences

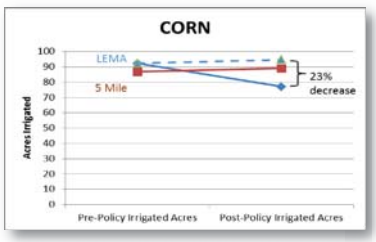


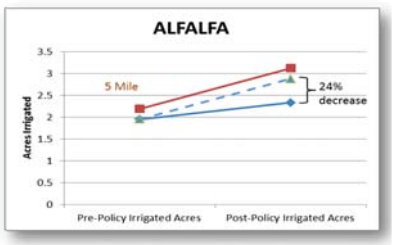
METHODS: DIFFERENCES-IN-DIFFERENCES

Evaluate the change of the LEMA irrigators water use behavior compared to the change of the Control Group
- Allows for differences between irrigators in LEMA and Control that stay constant over time
- Assumes same change in behavior would have occurred in LEMA and Control in absence of policy
  - Uses 4 Data pts at the mean to deduce the impact of a policy change



RESULTS: D-I-D CHANGES IN AVERAGE IRRIGATED ACREAGE





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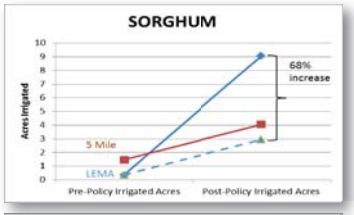

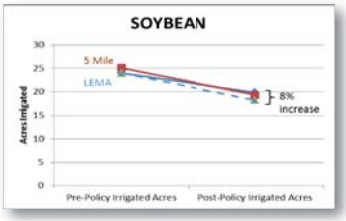

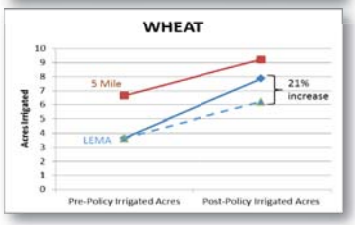

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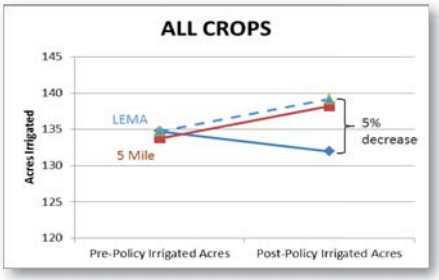
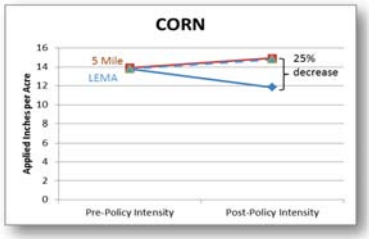


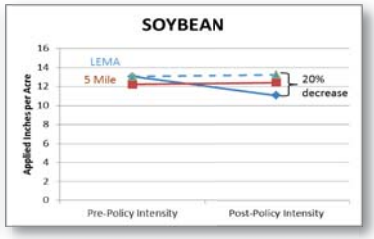
DID FARMERS REDUCE THEIR TOTAL NUMBER OF ACRES IRRIGATED?

We find the irrigators in the LEMA chose:

- Overall, a 5% reduction in total irrigated acreage
- reductions in irrigated acreage planted to corn and alfalfa
- expansions in irrigated acreage planted to soybeans, sorghum, and wheat

RESULTS: D-I-D CHANGES IN AVERAGE WATER INTENSITY (APPLIED INCHES/ACRE)





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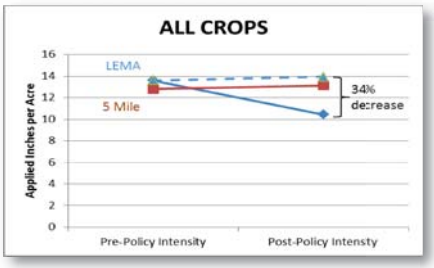


DID FARMERS APPLY LESS WATER ON THE SAME CROP?

We find the irrigators in the LEMA chose:

- Overall, a 34% reduction in total applied inches per acre
  - reductions on same crop
  - crop switching
- to reduce water intensity on corn & soybeans
  - this can only be observed for points of diversion that irrigated a single crop

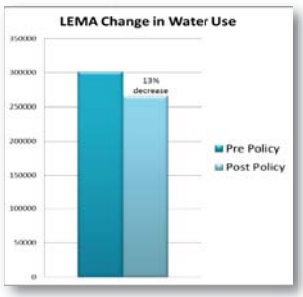
HOW DID THESE CHANGES IMPACT TOTAL WATER USE IN THE LEMA?

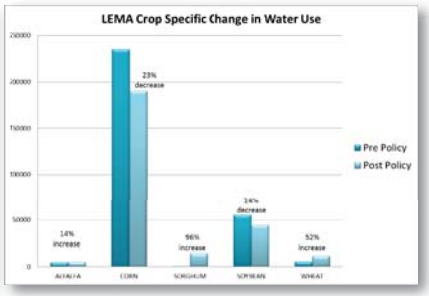
Alternatively, we estimate a D-I-D regression model that allows use to decompose the source of total water savings by different margins of adjustment

- so that we can determine where the largest behavior changes are attributed

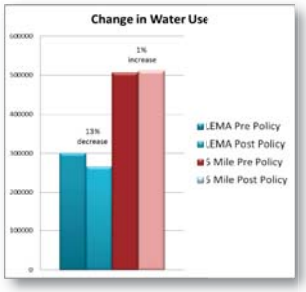
Margin of Adjustment	Estimates
changes in irrigated acres	-5%
changes in applied inches/acre	-30%
applied intensity	-28%
crop switching	-2%
Total Effect on Water Use	-35%

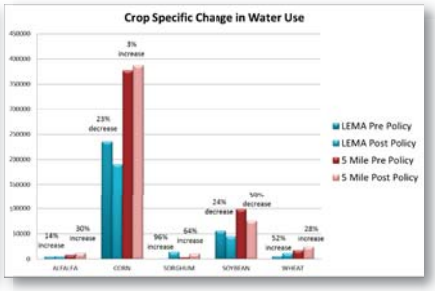
IMPACTS TO TOTAL WATER USE: DUE TO CHANGES IN IRRIGATED ACRES & CROP SWITCHING



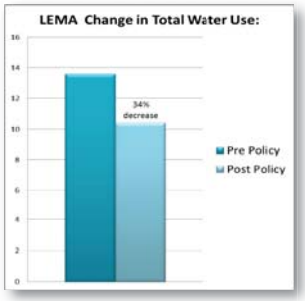


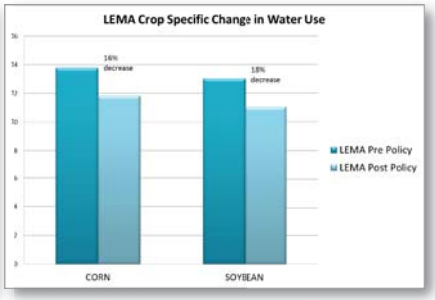
HOW DOES THIS COMPARE TO THE IRRIGATORS IN THE 5 MILE CONTROL GROUP?





IMPACTS TO TOTAL WATER USE: DUE TO CHANGES IN WATER INTENSITY (APPLIED INCHES/ACRE)





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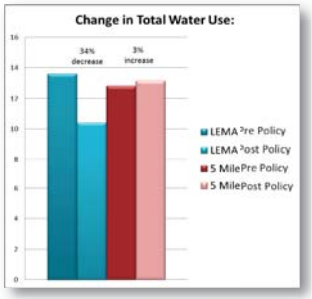
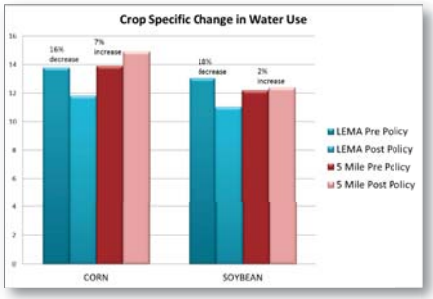




RESULTS: HOW DID IRRIGATORS IN THE LEMA BEHAVE DIFFERENTLY?

HOW DID FARMERS REDUCE WATER USE ?

Reduced groundwater use by roughly 35% in 2013 compared to the counterfactual scenario of having not implemented the restriction

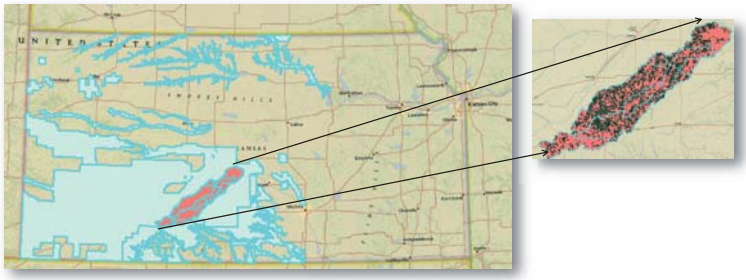
- Irrigators primarily responded by reducing the number of applied inches of water per acre and reducing irrigation intensity on corn or soybean
- Smaller water savings to reductions to irrigated acreage or switching to different crops

HOW DID FARMERS RESPOND DIFFERENTLY TO THIS POLICY COMPARED TO PREVIOUS POLICIES ?

BACKGROUND: RATTLESNAKE CREEK MANAGEMENT PLAN

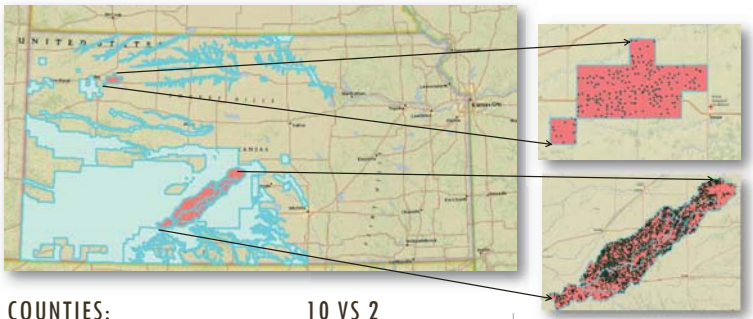
In 1993, residents and government agencies formed a collective partnership to address long-term water resource problems.

- The partners agreed to use a voluntary community involvement approach and signed a Cooperative Agreement in 1994 and developed the 12 year plan (RCMP) in 2000.
  - Big Bend Groundwater Management District No. 5
  - Water Protection Association of Central Kansas
  - Kansas Department of Agriculture-Division of Water Resources
  - U.S. Fish and Wildlife Service
- Specific goals of the RCMP
  - Stream Corridor: Reduce irrigators annual groundwater pumping 12% to 29,284 acre ft.
  - GMD Area: Reduce irrigators annual groundwater pumping 16% to 84,996 acre ft.
  - new management Programs (Water Rights Purchase, Water Banking, Flex Allocation, & conservation incentives)
  - implement an information/education program & enhance the compliance and enforcement effort



COUNTIES: STAFFORD, EDWARDS, KIOWA, RICE, RENO, BARTON, PAWNEE, PRATT, FORD, AND CLARK
1303 SQUARE MILES
3668 WELLS FOR IRRIGATION
INCLUDES MANAGED WILDLIFE AREAS

Rattlesnake Creek Management Plan



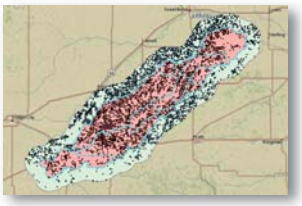
COUNTIES:	10 VS 2
SQUARE MILES:	1303 VS 99
WELLS:	3668 VS 185

Comparison

HOW DID BEHAVIOR CHANGES IMPACT TOTAL WATER USE IN THE RCMP?

LEMA

RCMP



HOW DID BEHAVIOR CHANGES IMPACT TOTAL WATER USE IN THE RCMP?

LEMA

Marginal Effects	Estimates
changes in irrigated acres	-5%
changes in applied inches/acre	-30%
applied intensity	-28%
crop switching	-2%
Total Effect on Water Use	-35%

RCMP

Margin of Adjustment	Estimates
changes in irrigated acres	0.89%
changes in applied inches/acre	0.40%
applied intensity	-0.44%
crop switching	0.84%
Total Effect on Water Use	1.29%

THANK YOU FOR YOUR TIME

Questions ?

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