

# **The Rural Economic Effects of Ogallala Aquifer Depletion: A Case Study in West-Central Kansas**

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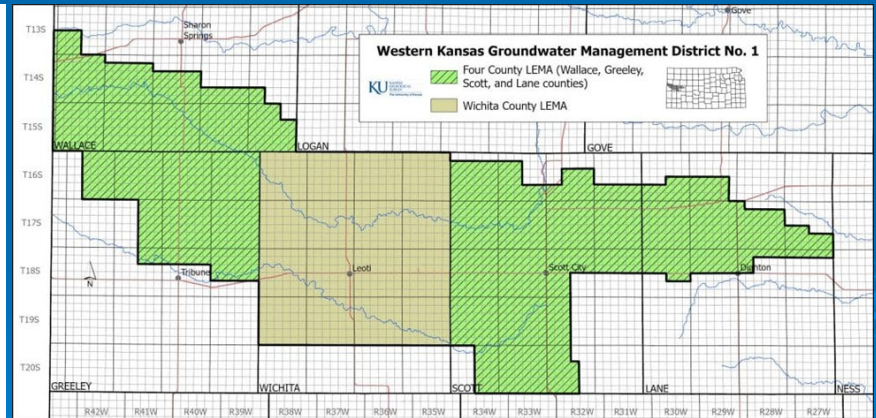
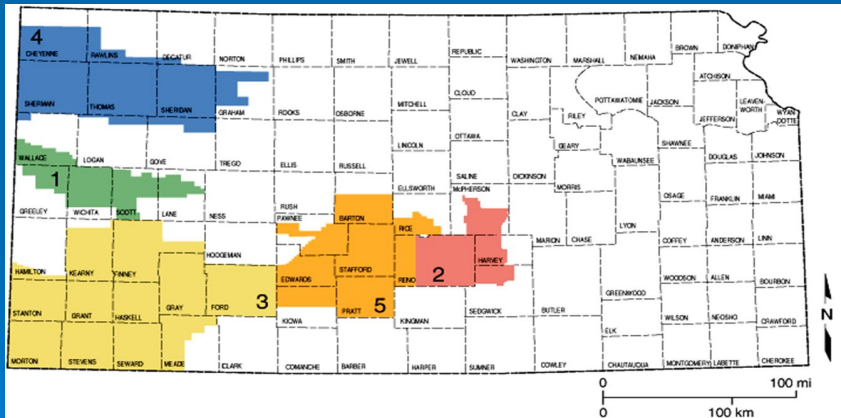
**Ogallala Aquifer Program Annual Meeting  
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# Wichita County Kansas

- Wichita County is located in GMD#1 in west-central Kansas

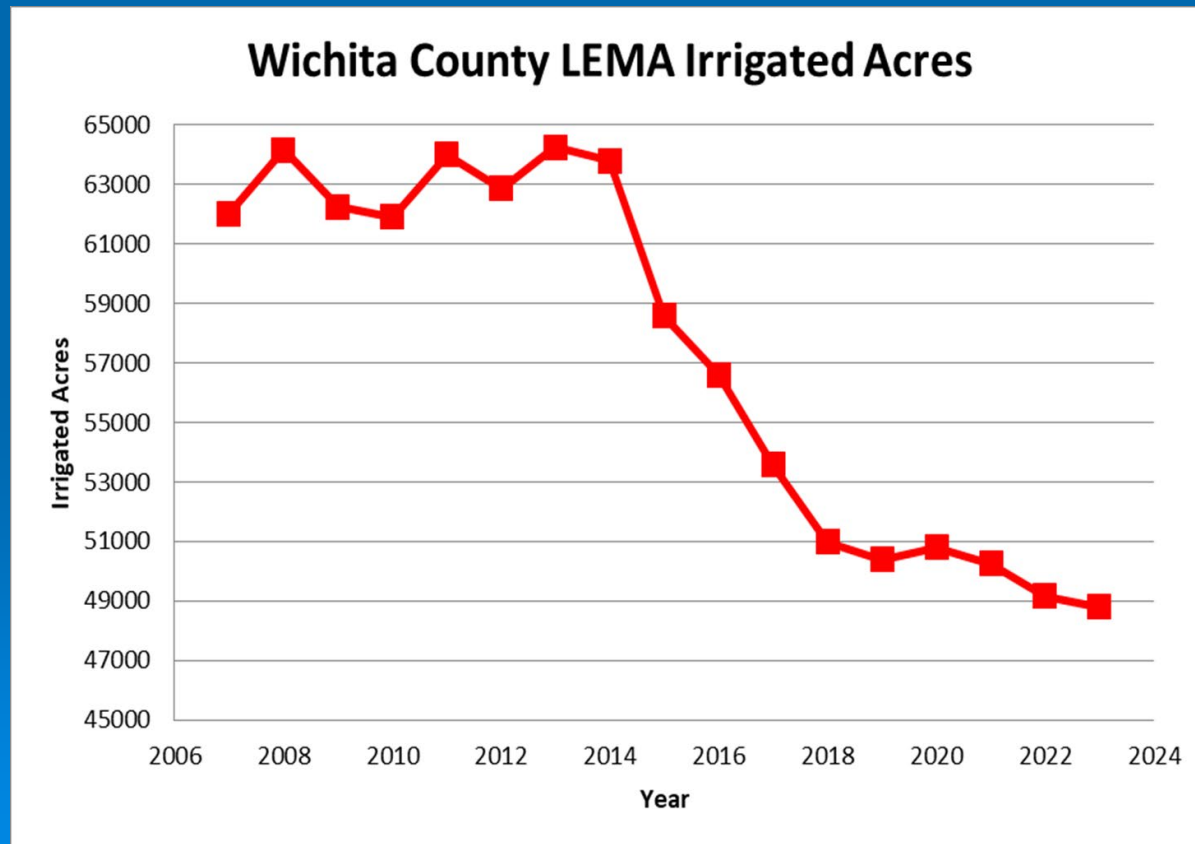


# Water Conservation Areas and Local Enhanced Management Areas

- On March 7, 2017 a county-wide WCA plan was approved by the Chief Engineer for Wichita County. The WCA includes **9,433 irrigated acres** via these voluntary enrollments. Participants committed to a **29% decrease** in groundwater use based on an average of 2009 – 2015 usage during the first of four 7-year periods, and escalating conservation reductions in subsequent periods (up to **50% reductions** in 2038).
- On February 2, 2021, the Chief Engineer of the Division of Water Resources, Kansas Department of Agriculture (DWR) signed an Order of Designation creating the Wichita County Local Enhanced Management Area (LEMA) The plan required most users to reduce **groundwater use by 25%** based on an average of 2009 – 2015 usage. In 2022 approximately **47,000 irrigated acres** were included in the LEMA.

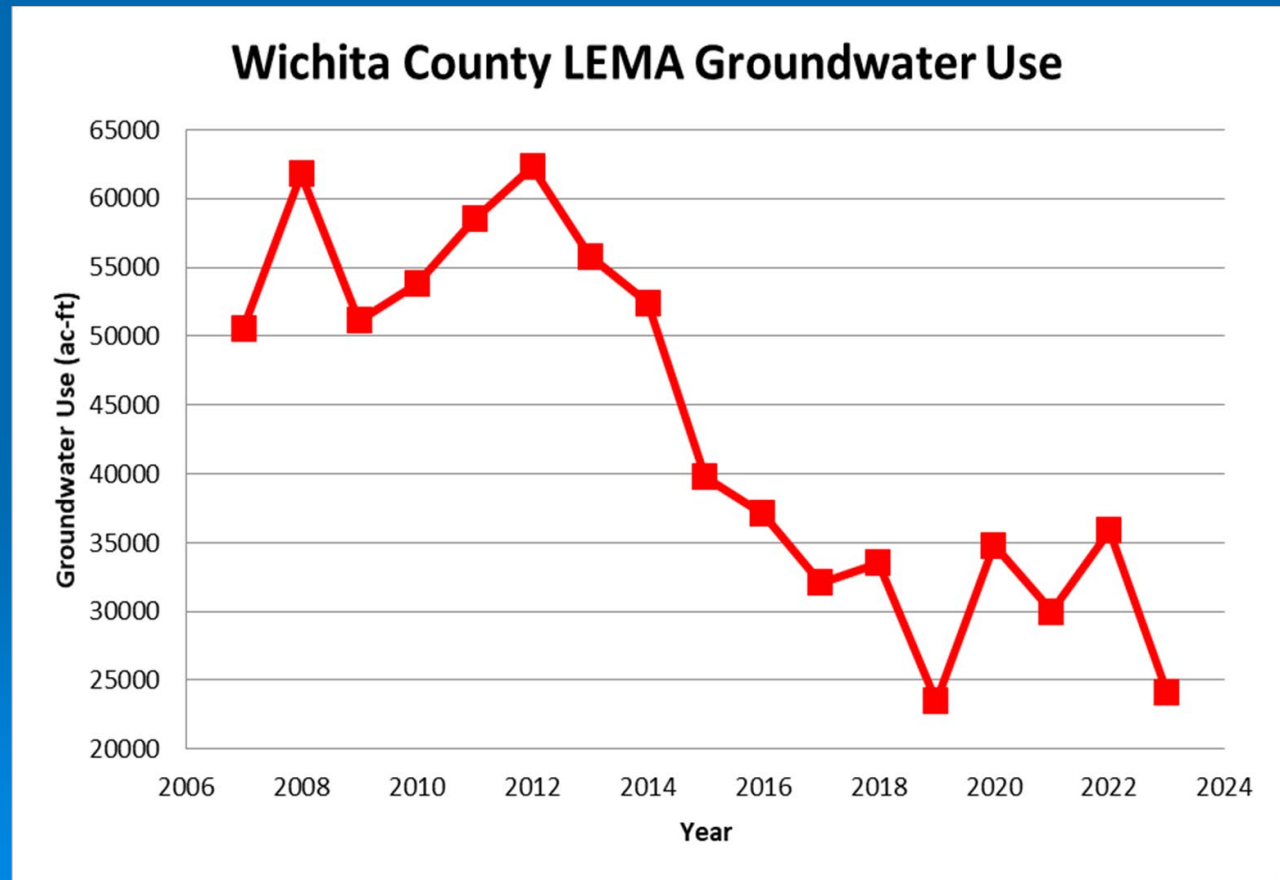
# Background

- From 2007 to 2023 irrigated acres declined by 21.3%



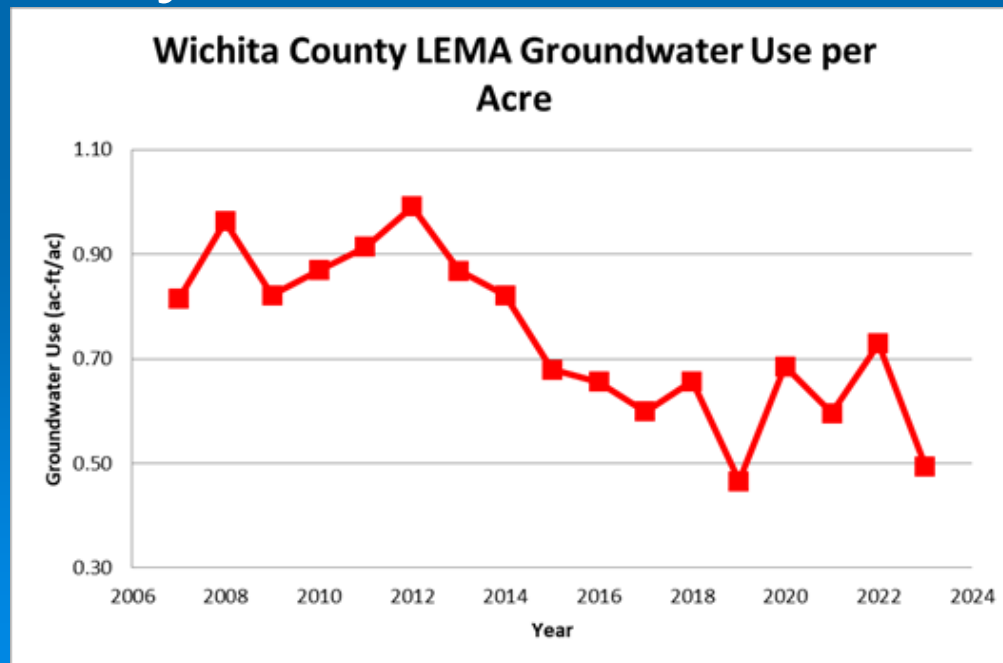
# Background

- From 2007 to 2023 groundwater use declined by 52.3%.

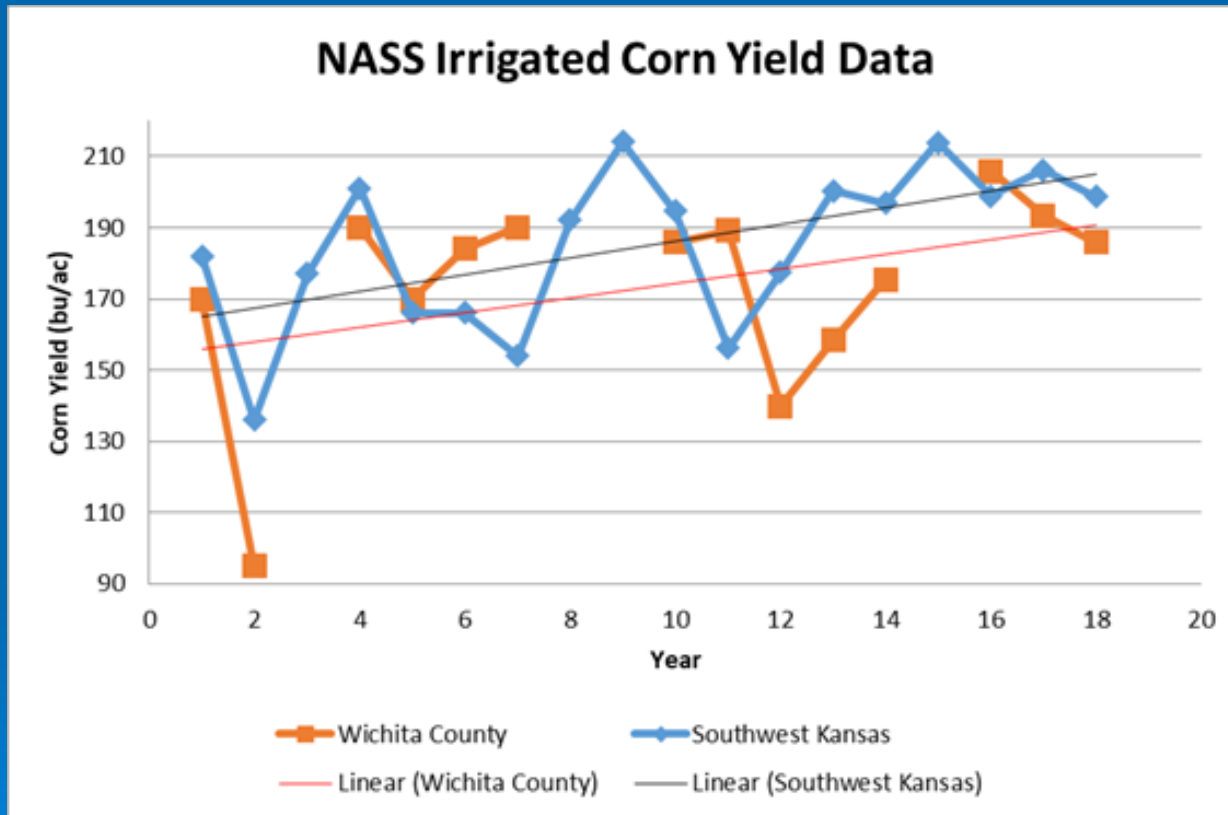


# Background

- From 2007 to 2023 groundwater use per acre declined by 39.4%.
- Groundwater use per acre for corn has declined by 40.3%



# Yield Trends



- RMA data will provide insight into irrigated yield trends

# Research Question

- To provide the methods, assumptions, and estimates of the likely economic impacts associated with a groundwater use reduction in the Wichita County Local Enhanced Management Area (LEMA).
- The Wichita County LEMA Order of Designation requires annual reviews of the LEMA. It indicates that the Review Board shall conduct a more comprehensive review in the fourth year of the LEMA Period. The review will focus on the economic impacts. This analysis will assist in determining the economic impacts.

# Economic Models



$$\text{➤ } TIO_{County} = \beta_0 + \beta_1 * TREND + \beta_2 * CommodityPrices + \beta_3 * Precipitation + \beta_4 * LEMAImpact + u_{TIO}$$



$$\text{➤ } VA_{County} = \beta_0 + \beta_1 * TREND + \beta_2 * CommodityPrices + \beta_3 * Precipitation + \beta_4 * LEMAImpact + u_{VA}$$



$$\text{➤ } TIO_{CropSector} = \beta_0 + \beta_1 * TREND + \beta_2 * CommodityPrices + \beta_3 * Precipitation + \beta_4 * LEMAImpact + u_{TIOC}$$



$$\text{➤ } VA_{CropSector} = \beta_0 + \beta_1 * TREND + \beta_2 * CommodityPrices + \beta_3 * Precipitation + \beta_4 * LEMAImpact + u_{VAC}$$

➤ Total Industry Output (TIO) data obtained from IMPLAN

➤ Value Added (VA) data obtained from IMPLAN

➤ Commodity Price based on corn data obtained from KSU extension budgets

➤ Precipitation data obtained from NOAA



# Results

| Variable         | Description          | TIOcounty<br>Parameter<br>Estimate | VAcounty<br>Parameter<br>Estimate | TIOcrop prod<br>Parameter<br>Estimate | VAcrop prod<br>Parameter<br>Estimate |
|------------------|----------------------|------------------------------------|-----------------------------------|---------------------------------------|--------------------------------------|
| Intercept        | Intercept            | 306564016.5*                       | 33607988.6                        | 156120072.8*                          | -14739994.4*                         |
| Trend            | Time Trend           | 11455341.1*                        | 2675973.5*                        | 529047.7                              | -483741.2                            |
| Commodity Prices | Corn Price           | 27553548.3                         | 19107068.1*                       | -7722884.0*                           | 6125009.7*                           |
| Precipitation    | Annual Precipitation | 58198.8                            | 655264.6                          | -2669781.3*                           | 568761.9                             |
| LEMA Impact      | Impact of LEMA       | -86302116.1                        | -25882075.3                       | 28113040.1                            | 3233865.6                            |
| R2               | Degree of Fit        | 46.2%                              | 54.9%                             | 69.8%                                 | 68.2%                                |

\* Statistically significant at the 10% level

No statistically significant economic impact of the LEMA

Results have been shared with the State and at the UCOWR conference

# Conclusions

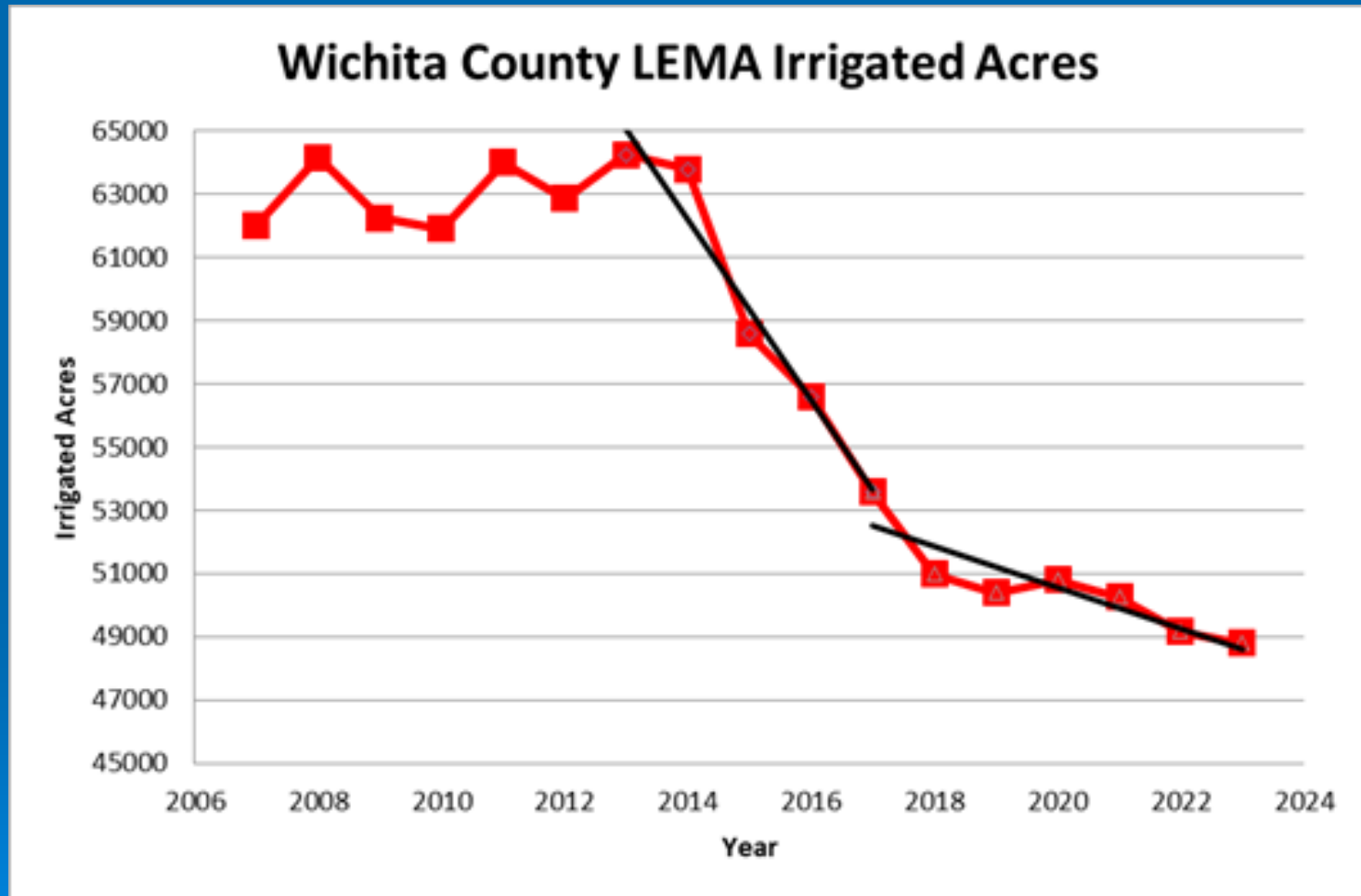
- Very little economic data
- Relationship of crop yield to applied irrigation needed
- Only three years of post LEMA data to analyze
- Can conclude that, given current data, the LEMA has not had a negative economic impact on the county or crop sector economies
- Some individual irrigated producers may have experienced economic losses.

# Other Interested Findings

Table 5. IMPLAN Value Added Data for Designated Categories

| Year                   | Crop<br>Production | Livestock<br>Production | Total All<br>Sectors |
|------------------------|--------------------|-------------------------|----------------------|
| 2007                   | \$15,155,555       | \$49,636,754            | \$112,830,402        |
| 2008                   | \$20,067,004       | \$53,646,420            | \$127,842,639        |
| 2009                   | \$19,853,798       | \$49,474,429            | \$126,579,597        |
| 2010                   | \$20,635,245       | \$58,984,493            | \$142,619,518        |
| 2011                   | \$28,246,843       | \$82,835,966            | \$174,498,228        |
| 2012                   | \$32,759,740       | \$64,851,378            | \$165,617,664        |
| 2013                   | \$26,134,430       | \$114,490,089           | \$216,687,841        |
| 2014                   | \$19,260,212       | \$69,596,158            | \$162,324,908        |
| 2015                   | \$21,284,031       | \$53,602,956            | \$146,086,549        |
| 2016                   | \$19,771,243       | \$63,032,712            | \$154,381,773        |
| 2017                   | \$16,765,778       | \$51,568,150            | \$140,441,712        |
| 2018                   | \$18,690,514       | \$30,246,967            | \$159,587,924        |
| 2019                   | \$14,362,709       | \$44,837,159            | \$167,319,872        |
| 2020                   | \$2,578,558        | \$43,147,271            | \$134,942,569        |
| 2021                   | \$18,802,724       | \$48,443,382            | \$150,318,601        |
| 2022                   | \$21,204,106       | \$57,129,317            | \$164,292,888        |
| 2023                   | \$25,840,693       | \$52,064,828            | \$166,779,928        |
| Average                | \$20,083,128       | \$58,093,437            | \$153,714,860        |
| Percentage of Economy  | 13.07%             | 37.79%                  | 100%                 |
| Correlation to Economy | 51.43%             | 70.29%                  | 100%                 |

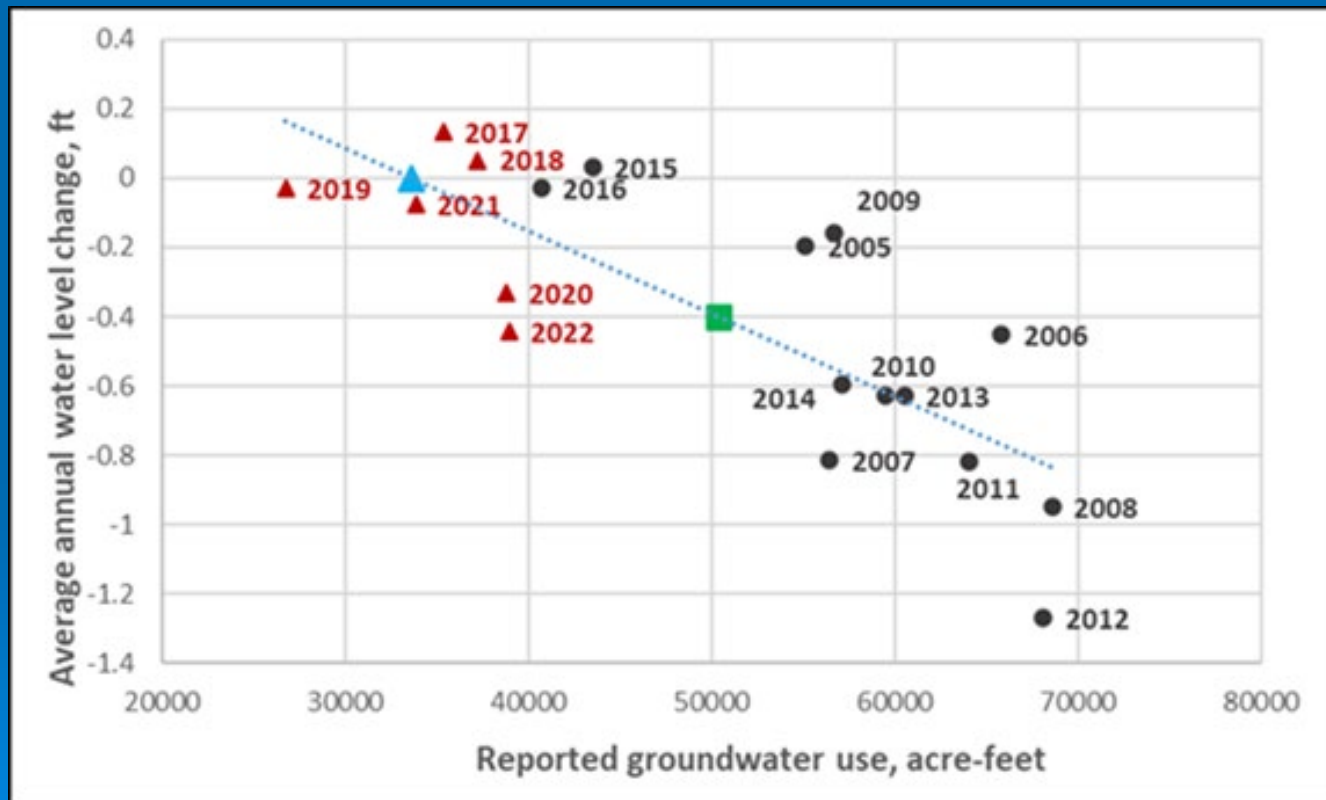
# Other Interested Findings



These trend lines indicate that during the years preceding the LEMA & WAC irrigated acres were declining at a rate of 2,853 acres per year. During the years after the LEMA & WAC irrigated acres were only declining at a rate of 648 acres per year. This might imply that the LEMA & WAC might have had the positive impact of stabilizing the decline in irrigated acreage. Additional research is needed to confirm this hypothesis.

# What About the Aquifer ?

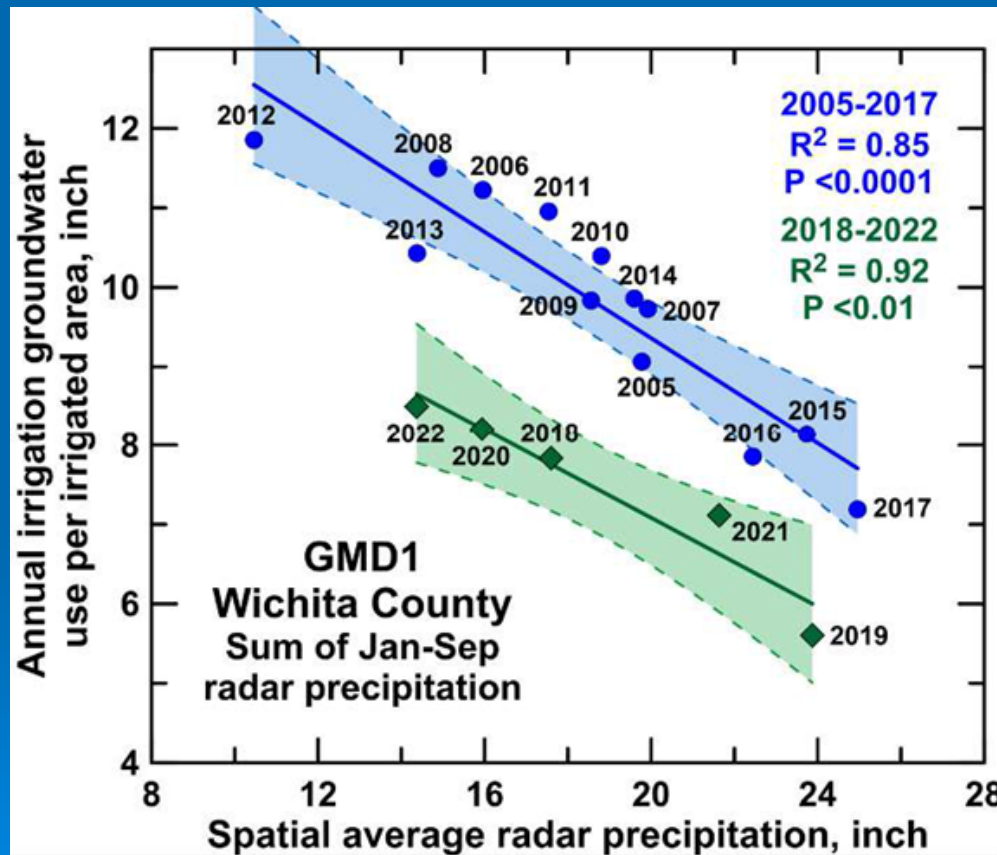
Figure 11. The Relationship Between Groundwater Use and Water Level Change



Source: Brownie Wilson of the Kansas Geological Survey shared this graph.

# What About the Aquifer ?

Figure 12. The Relationship Between Groundwater Use and Rainfall



Source: Brownie Wilson of the Kansas Geological Survey shared this graph.

# Where Do We Go From Here

- Continue this study for 2 more years
- Add RMA analysis to this study
- Expand the study to multiple counties in Texas and Kansas

# Questions

