Potential for Mobile Drip Irrigation Technology to Reduce Water Use on Low Capacity Wells

A Conservation Innovation Grant-Funded Research Activity

Technology Used

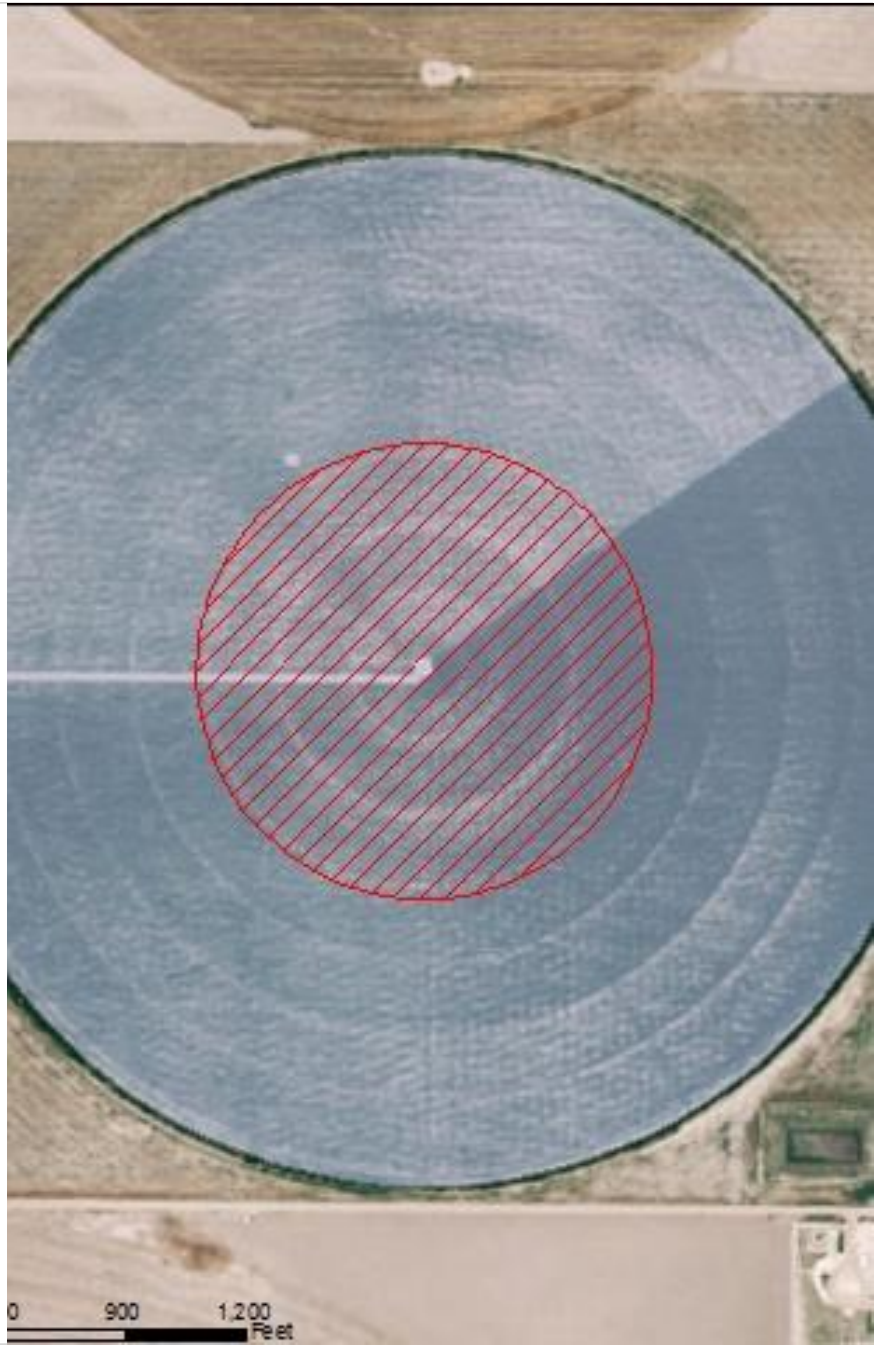
- Mobile drip on inner 3 spans
- Bubblers on all other spans
- Soil moisture probes used to schedule irrigation

Why upgrade the inner spans?

- This research was conducted on low-yielding wells.
  - Traditional nozzle packages are not sized small enough to provide efficient irrigation at lower flow rates.
  - Mobile Drip tape emits water at a much lower rate than traditional nozzles, so it can accommodate the lower flow rate.

Improved Efficiency

- Efficiency improved by 38% over the acres under MDI.
- Efficiency on the whole system improved by 6.8%.



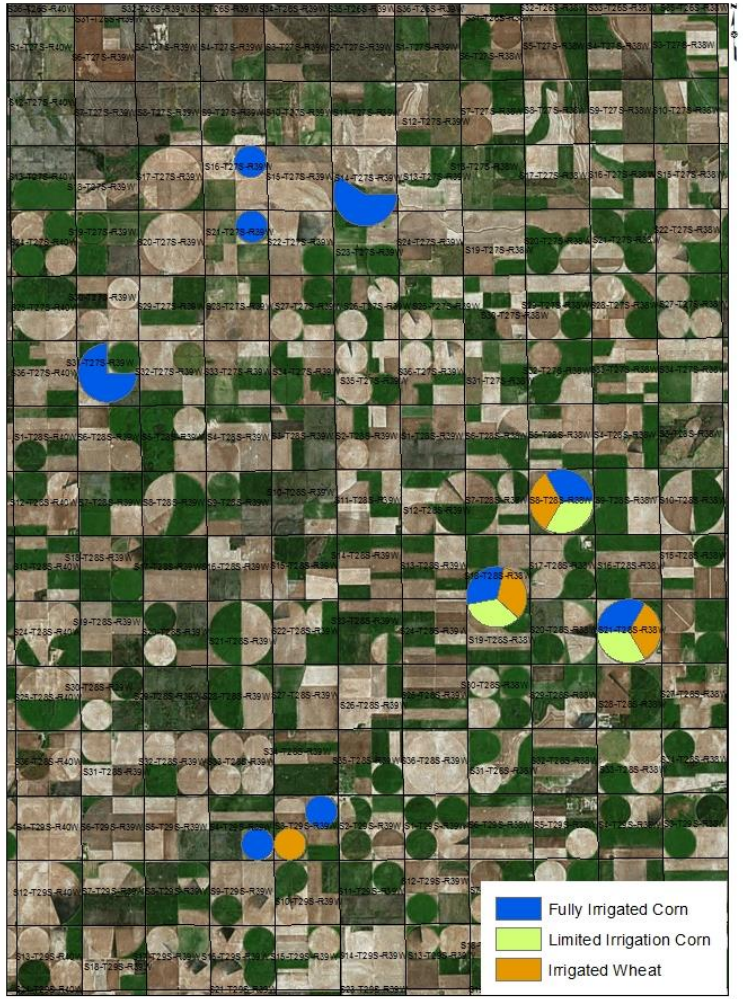
Quantified Water Savings

- MDI replaces water application at a rate of 0.204 in./hr with an application at a rate of 0.126 in./hr

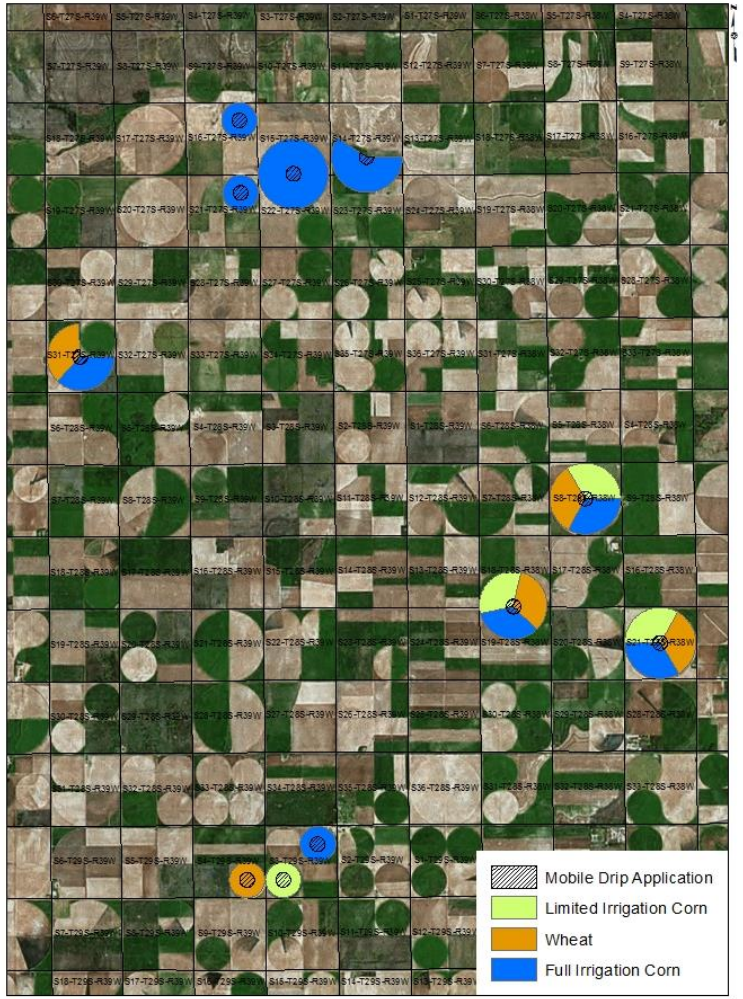
$$water\ savings = water\ use * (1 - \frac{0.126}{0.204})$$

- 2016 water savings = 128.9 AF
- 2017 water savings = 83.8 AF
- 2018 water savings = 194.1 AF

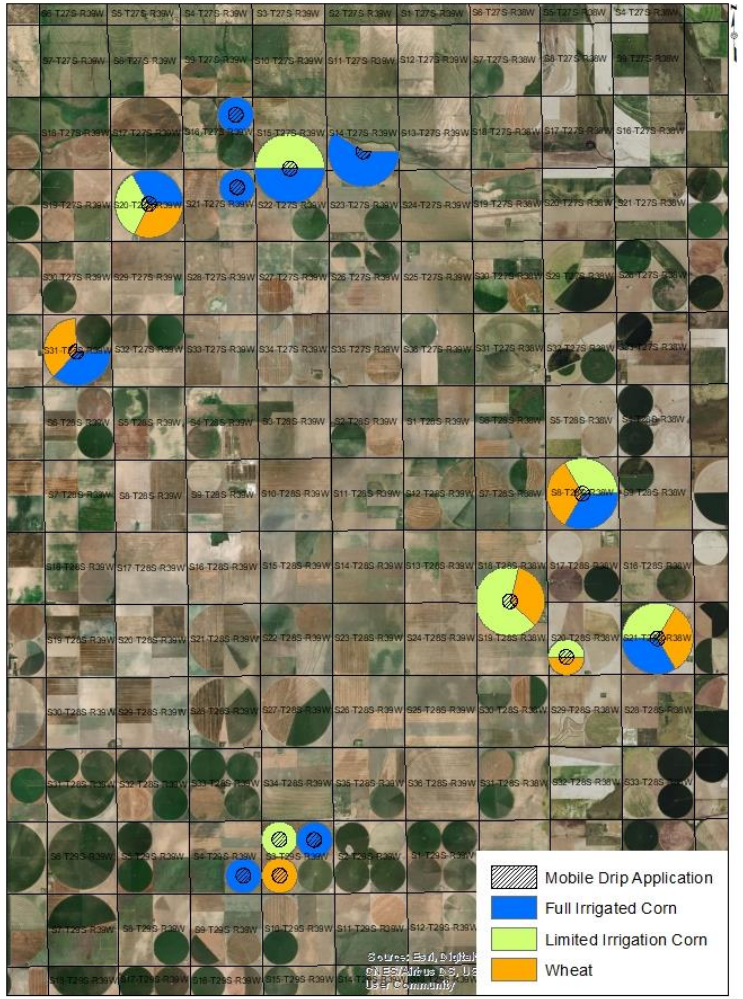
- Under this formula, more use equates to more savings.



2016 PROJECT AREA



2017 PROJECT AREA



2018 PROJECT AREA

What Was Analyzed?

- Water Use
  - Water use was tracked on each crop type to quantify water savings. Application rates were known so savings due to improved water use efficiency were easy to calculate.
  - Growing season rainfall was tracked to verify that improved efficiency was reducing overall water use.
    - Well pumping rate was unchanged by this project. Nozzle sizes on the outer spans were increased as inner spans were converted to MDI to accommodate the resulting increase in pressure.
      - Overall water savings only occur if the increased moisture can be accounted for by the producer. Soil moisture probes were utilized in this project to schedule irrigation.
- Yield
  - Yields were tracked for use in cost-benefit analysis.
    - Yields in this project were not different under MDI than CP so they were irrelevant in the cost-benefit analysis.
      - It is likely that in a drier year, the increased water availability would have increased yield.

What was analyzed? (cont.)

- Cost
  - Cost of installing MDI was compared to the cost of pumping an acre-ft of water to determine the time period necessary to recoup cost for fully irrigated corn, limited irrigation corn, and irrigated wheat.
    - Average cost of MDI installation was $3,960.24.
    - Average energy cost per acre inch of water pumped was $7.50.
- Cost-Benefit Analysis
  - Average water use plus rainfall for fully irrigated corn was 32.8 in.
  - Average water use plus rainfall for limited irrigation corn was 27.7 in.
  - Average water use plus rainfall for irrigated wheat was 19.0 in.

Water Use

2016

- Full Irrigation Corn
  - 14.7" irrigation avg
  - 19.0" rainfall
  - 33.7" total moisture
  - 227 bsh/acre avg yield
- Limited Irrigation Corn
  - 9.8" irrigation avg
  - 19.0" rainfall
  - 28.8" total moisture
  - 220 bsh/acre avg yield
- Irrigated Wheat
  - 8.0" irrigation avg
  - 8.8" rainfall
  - 16.8" total moisture
  - 80 bsh/acre avg yield

2017

- Full Irrigation Corn
  - 7.0" irrigation avg
  - 25.3" rainfall
  - 32.3" total moisture
  - 238 bsh/acre avg yield
- Limited Irrigation Corn
  - 2.9" irrigation avg
  - 25.3" rainfall
  - 28.2" total moisture
  - 202 bsh/acre avg yield
- Irrigated Wheat
  - 6.8" irrigation avg
  - 14.1" rainfall
  - 20.9" total moisture
  - 74 bsh/acre avg yield

2018

- Full Irrigation Corn
  - 17.6" irrigation avg
  - 14.9" rainfall
  - 32.5" total moisture
  - 256 bsh/acre avg yield
- Limited Irrigation Corn
  - 11.2" irrigation avg
  - 14.9" rainfall
  - 26.1" total moisture
  - 221 bsh/acre avg yield
- Irrigated Wheat
  - 7.1" irrigation avg
  - 12.4" rainfall
  - 19.4" total moisture
  - 71 bsh/acre avg yield

Cost Benefit Analysis

- Fully Irrigated Corn
  - Based upon historic average rainfall during the growing season, expected average use is 20.1 in.
    - Average water savings expected to equal 161.4 acre-inches. Average annual savings from reduced pumping cost expected to equal $1,210.50. Break even time is 3.27 years.
- Limited Irrigation Corn
  - Based upon historic average rainfall during the growing season, expected average use is 15.0 in.
    - Average water savings expected to equal 120.4 acre-inches. Average annual savings from reduced pumping cost expected to equal $903.00 per installation. Break even time is 4.39 years.
- Irrigated Wheat
  - Based upon historic average rainfall during the growing season, expected average use is 9.6 in.
    - Average water savings expected to equal 77.1 acre-inches. Average annual savings from reduced pumping cost expected to equal $578.25 per installation. Break even time is 6.85 years.
- Break even times will be longer if precipitation is above average and shorter if precipitation is below average.

Other Findings

- Installation of MDI on the inner spans increases the total water legally and physically available to the rest of the field. This should increase drought resiliency and overall profitability during drier years.
- Installation of MDI did not lead to increased yields during the project period. Rainfall was above average in each project year. It is likely that fields with MDI would have higher yields that similar fields without the technology during years where low rainfall creates water deficits in crops.

Recommendations

- Incorporate installation of MDI into the EQIP program.
  - MDI should be replacing nozzle packages that are over-applying water.
    - Well yield should be too low for inner nozzle packages to be efficient.
  - Producer should be required to schedule irrigation based upon soil moisture, crop moisture, or ET.
    - Tracking the effectiveness of irrigation cycles ensures that water is only applied when necessary.
    - Funding is already available in EQIP for soil moisture monitoring, so that cost may not need to be accounted for in the proposed payment for implementing EQIP.

Questions?