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## **Corn Residue Harvest and Inefficient Groundwater Extraction**

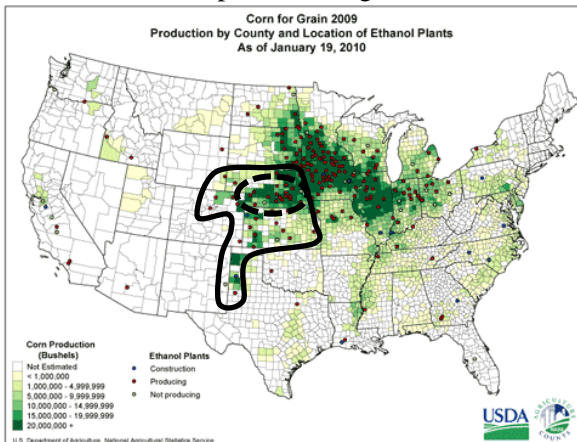
Juan Sesmero and Aaron Cook

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## Motivation

- Corn residue promising feedstock to meet RFS cellulosic requirement.
- Irrigated corn belt candidate area: high yields/continuous corn
- Removal of stover decreases soil moisture (e.g. Doran et al., 1984; Power et al., 1998) which reduces yield unless more irrigation is applied.
- Concern about pressure on groundwater.



## Theory

- Inefficient over-extraction occur in common access resources.
- Welfare losses due to over-extraction can be empirically negligible depending on aquifer properties (Gisser-Sanchez)
- Welfare losses of over-extraction (if any) should be included in “social costs” of stover-based energy.

## Research question

- What are the likely welfare losses associated with groundwater over-extraction caused by corn residue harvesting?

## Model

- Farmer maximizes present value of future stream of profits subject to soil water dynamics and groundwater stock dynamics.

$$\text{Max}_{\{h_t, w_t\}} \int_0^{\infty} e^{-rt} (g_t p_y + [g_t h_t (p_h - c_h^b) - c_h^a] - (c_0 + c_1 H) w_t)$$

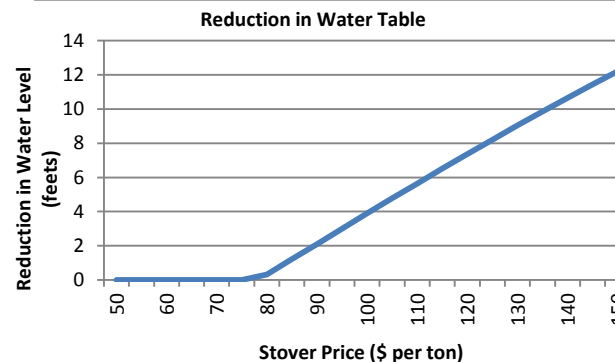
$$\dot{I}_t = I_o + dg_t(1 - h_t) - I_t$$

$$\dot{H}_t = \frac{1}{AS} \left[ R + (\gamma - 1) \left( w_t + \sum_{j \neq i} w_j(H) \right) \right]$$

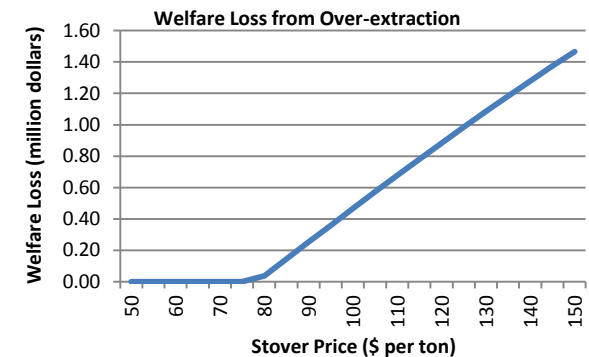
$h_t$ : stover harvest rate  
 $g_t$ : yield  
 $p_y$ : net revenue/bu corn  
 $p_h - c_h^b$ : net revenue/ton stover  
 $H$ : water level  
 $w_t$ : irrigation rate

- **Feedback Nash Equilibrium (FE) in linear strategies** compared to **efficient** solution.
- Model calibrated with observed data and results of agronomic experiments.

## Preliminary Results (mean)



## Preliminary Results (mean)



## Conclusions

- Results suggest welfare losses of over-extraction may not be negligible in western Nebraska, Kansas, and Texas
- Under western NE conditions the FE supplies 112MGY at \$100 per dry ton. Efficient solution only for 2.56MGY. The efficiency loss associated with market supply is 600 million dollars

## Data Sources

- USDA – NASS
- Doran et al., 1984; Power et al., 1998

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