Nitrogen Cycling and Economic Viability of Corn Residue for Energy

Juan Sesmero and Ben Gramig


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Background

- RFS requires 36 billion gallon ethanol equivalent mandate of renewable transportation fuels per year by 2022.
- Corn residue was identified by EPA and USDA as the third feedstock in importance to meet the annual mandate.
- Due to high density and yields the bulk of corn residue is expected to come from the Corn Belt.

Limitations of Current Knowledge

- Previous literature assumes replacement of nutrients removed with residue (≈ 20% of harvesting cost) and exogenous crop rotation choice.
- Evidence suggests improvement in N cycling after harvest may reduce need for nutrient replacement.
- Positive net revenue from corn residue may affect optimal rotation choice triggering land cover changes.

Model

- Farmers choose rotation and stover harvest rate to maximize profits.
- Farmers choice is a function of prices (corn, soybean, and nitrogen) and agronomic parameters.
- Agronomic parameters capture yield and nutrient effects of rotation and harvest choice.
- Profit conditions determine price and agronomic thresholds triggering management practices.
- We construct profit conditions comparing four different management practices with the baseline (corn-soybean rotation without stover harvest):

  \[ V(CRCR) \geq V(CNS) \]
  \[ V(CRS) \geq V(CNS) \]
  \[ V(CCN) \geq V(CRCR) \]
  \[ V(CNCR) \geq V(CRCR) \]

Prices and management

\[ \frac{P_c}{P_b} \]

Conclusions

- Nitrogen replacement and hence cost of harvesting stover may be overestimated.
- Increases in stover price may trigger changes in land cover (rotation and residue coverage).
- We find lower cost of harvesting stover. This is because:
  1) Stover removal enhances N-cycling
  2) High stover price increases corn planting density and stover harvesting density.

Data Sources

- Own simulations with Daycent
- Coulter and Nafziger, Pantoja et al., Maskina et al., Power et al., Coulter et al. 2010

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