Water Quality and Economic Incentives in Crop Production

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October 18, 2019 - Lake City, Iowa

Overview

1. Motivation: Optimal Nitrogen use
2. Reflection: Why higher N rates?
3. Extension: framework to analyze farmers incentives
**Corn Nitrogen Rate Calculator**

- **Maximum return to N (MRTN)** for selected prices of N and corn
- Based on research trials conducted with:
  - spring sidedress applied N
  - or split preplant/sidedress applied N

**Corn Nitrogen Rate Calculator**

- http://cnrc.agron.iastate.edu/nRate.aspx

**Optimal N use: Corn following Soy**

Corn price $3.80/bushel; N price $0.40/lb

- **MRTN**: 138 lb N/acre
- Profitable Range: 124-150 lb N/acre
- % of Maximum Yield: 99%
Why higher N rates?

1) Corn following corn requires more N
2) Corn price uncertainty
3) Local availability of manure
4) N cost-effective to \( \uparrow \) yields & \( \downarrow \) their variability:
   - Bragging rights
   - Higher Revenue Guarantee in Crop Insurance
   - Government Payments based on Yield History
   - Land value

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1) Corn following Corn

Corn price $3.80/bushel; N price $0.40/lb

**MRTN: 188 lb N/acre**

Profitable Range: 175-203 lb N/acre

% of Maximum Yield: 99%
1) Corn following Corn

- **Corn on Corn Acres**
- **Corn on Corn as % of Total Corn & Soy Area**

- **Ethanol Plants in Iowa**

Corn following corn area: A. Plastina’s estimations based on NASS data

2) Corn price uncertainty

- Corn prices $3.75, $4.00, $4.25, $4.50; N price $0.40/lb

- **Corn following Soybeans**
  - MRTNs: 137, 140, 141, 143 lb N/acre

- **Corn following Corn**
  - MRTNs: 185, 188, 190, 192 lb N/acre
3) Local availability of manure

Percent of Crop Nitrogen Removal Met by Manure

Source: Iowa State Manure and Nutrient Management Lab (2014)

4) N relative cheap way to protect / increase corn yields

Source: ISU Ag Decision Maker Files C1-10 and A1-20
4) N relative cheap way to protect / increase corn yields

Source: USDA/NASS and ISU Ag Decision Maker File A1-20

Crop Insurance: higher APH yield, higher revenue guarantee

A dime in premiums buys $9.7 extra of Revenue Guarantee
Extension: a simplified framework to evaluate incentives

1) How are costs shared between farmers and others?

Conservation practices:
- Cover Crops
- No-till / reduced till
- Prairie strips
- Grassed waterways
- Sedimentation ponds
- Bioreactors
- Terraces
- Etc.

Water Quality Impacts:
- Nitrate leaching
- Soil erosion & sediments
- Phosphorous load
- Other chemicals loads

Source: Alejandro Plastina
Extension: a simplified framework to evaluate incentives

2) What incentives do farmers face?

A) FARMERS: Production Costs
B) FARMERS: Conservation Costs
C) FARMERS: Soil & Nutrient Loss

Conservation practices:

Example: Cover Crops

Water Quality:

C) FARMERS: Soil & Nutrient Loss

What can farmers do different to minimize their short-term costs?

- Save on inputs ↓ A
- If ROI in Conservation Practices is LOW, B=0
- C may be hard to change anyway

Example: Cover Crops

Source: Alejandro Plastina

Extension: a simplified framework to evaluate incentives

2) What incentives do farmers face?

A) FARMERS: Production Costs

B) FARMERS

What can farmers do different to minimize their short-term costs?

- Save on inputs ↓ A
- If ROI in Conservation Practices is HIGH, Invest in Conservation Practices
- C ↓

Example: Terraces

Source: Alejandro Plastina
Extension: a simplified framework to evaluate incentives

3) How about Social Costs?

TAXPAYERS

Conservation practices:

Corn and soybeans:

Water Quality Impacts:

Social Costs are External to the Farm. A business will NOT internalize those costs unless:

a) Mandated to do so.

b) Farm Market Segmentation on Sustainable Standards → Expected ROI > 0

Example: Cover Crops Programs sponsored by General Mills, Unilever, etc.

Source: Alejandro Plastina

4) What about Long Term Benefits for Farmers?

D) Long Term Benefits for Farmers:

- Soil Health → Higher Land Values
- Carbon Sequestration → $ C market
- Farm resiliency to weather variability
- …many more

C) FARMERS: Soil & Nutrient Loss

Water Quality:

B) FARMERS: Conservation Costs

A) FARMERS: Production Costs

Source: Alejandro Plastina
Extension: a simplified framework to evaluate incentives

A) FARMERS: Production Costs

B) FARMERS: Conservation Costs

C) FARMERS: Soil & Nutrient Loss

CERTAIN and FRONTLOADED COSTS

BENEFITS UNCERTAIN and DISTANT IN THE FUTURE

5) Aren’t Long Term Benefits attractive enough to change practices?

D) Long Term Benefits for Farmers:
- Soil Health → Higher Land Values
- Carbon Sequestration → $ C market
- Farm resiliency to weather variability
- …many more

Further problems with Long-Term Benefits in Iowa

- Land is NOT traded on Soil Health, but acreage and CSR2
- No current market for Soil Health
- Incipient market to sell sequestered carbon credits (Indigo, SHI, etc.), but potential for Iowa may be limited (tiling, cornstalks harvested, no summer cover crops, etc.)
- 95% of Iowa farms use Crop Insurance (80%-85% coverage levels) to manage weather & price risks

Source: Alejandro Plastina
Concluding comments

• Temporary land retirement from production (CRP) is popular but expensive
• Limited adoption of other voluntary conservation programs (e.g. cover crops 4% of arable land in Iowa)
• Big transfers to farmers to incentivize conservation practices might become unpopular among urban taxpayers
• Mandatory programs (regulation & enforcement) are unpopular among farmers

Thank you for your attention!

Questions? Comments?

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