Trade-Offs of Carbon Sequestration through Land Retirement versus Working Land

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Background

- Current
  - Land retirement (CRP) $1.6 billion/yr
  - Working land conservation (EQIP) $0.11 billion/yr
  - LR:WL funding is 15:1
- Farm Bill proposed increase
  - Land retirement (CRP,WRP) $11 billion/10yrs
  - Working land conservation (CSP, EQIP,…) $3 billion/10yrs
  - increase in LR:WL funding is 4:1

What does it mean for carbon sequestration?

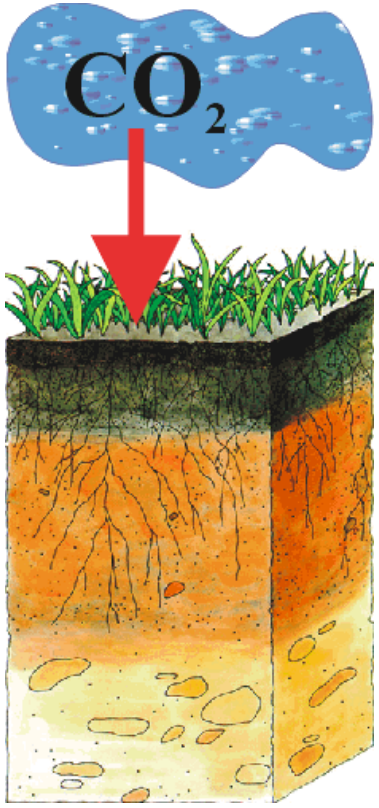
- Land retirement
  - More carbon, 1.1MT/ha/yr (Lal et al, 1998)
  - More expensive $127.4/acre (IA, this study)
- Green subsidies for conservation tillage
  - Less carbon, 0.5MT/ha/yr (Lal et al, 1998)
  - Less expensive $12.6/acre (IA, this study)

Our Paper

- Data
  - ~13,000 1997 NRI points, cropland in Iowa
- Models
  - per acre cost of conservation tillage adoption c_i^{wl}
  - per acre cost of land retirement c_i^{lr}
  - Per acre carbon benefits (EPIC) $b_i^{wl}, \quad b_i^{lr}$
- Adoption models and EPIC runs predict at NRI points
- Policymaker's problem: given a budget, maximize the amount of carbon benefit by selecting points into either program
  - No pre-fixed split of the total budget between LR and WL
  - LR and WL shares of budget are fixed

Potential cost of carbon

- Land Retirement, c_i^{lr} / b_i^{lr}
  - Average = 217.9 $/MT/yr
  - Min = 47.2 $/MT/yr
  - Max = 3,061.0 $/MT/yr
- Working Land, c_i^{wl} / b_i^{wl}
  - Average = 33.0 $/MT/yr
  - Min = 6.4 $/MT/yr
  - Max = 2,155.9 $/MT/yr



Optimal allocation of total budget

- For each parcel i, choose

$$\left(b/c\right)_i^* = \max\left\{ b_i^{wl}/c_i^{wl},\ b_i^{lr}/c_i^{lr} \right\}$$

- Rank order $\left(b/c\right)_i^*$ from highest to lowest

- Enroll from the top into the program that provides the highest benefit per $ until total budget is exhausted

Fixed share of funding:
Budget = Budget ^{LR} + Budget ^{WL}

- Sequential selection: Enroll parcels for the LR first. After the LR budget is exhausted, enroll parcels for the WL program.

- Simultaneous selection: Enroll parcels for either the LR or the WL based on carbon performance as long as the budgets are not exhausted. If one budget is completely spent, enroll for the other practice until the other budget is exhausted.

- In the past: sequential
- Now: more like simultaneous

Fixed shares, Budget = Budget ^{LR} + Budget ^{WL}, **simultaneous selection**

- For each parcel i, choose $\left(b/c\right)_i^* = \max\left\{b_i^{wl}/c_i^{wl},\ b_i^{lr}/c_i^{lr}\right\}$
- Rank order $\left(b/c\right)_i^*$ from highest to lowest, enroll into the program that provides the highest benefits per $ until one of the budgets is exhausted
- After one budget is exhausted, rank order the remaining list by the other benefit per $
- Enroll from the top of the remaining list until second budget is exhausted

Fixed shares, Budget = Budget ^{LR} + Budget ^{WL}, **sequential selection, e.g., LR goes first**

- Rank order b_i^{lr} / c_i^{lr} from highest to lowest, enroll into LR until the LR budget is exhausted
- After the LR budget is exhausted, rank order the remaining list by b_i^{wl} / c_i^{wl}
- Enroll from the top of the new list until second budget is exhausted

Simulation results, $100 million/yr

Budget allocation	Total carbon, MMT/yr	Average cost,$/MT/yr
Optimal 100% WL : 0% LR	4.9	20.5
Sequential 50% WL : 50% LR	4.5	22.1
Simultaneous 50% WL : 50% LR	3.2	31.0
Sequential 10% WL : 90% LR	1.9	49.6
Simultaneous 10% WL : 90% LR	1.8	55.1

Final Remarks

- Relative results hold for other minimum conservation tillage payments ($15/acre, $20/acre)
- Results may change under different carbon accounting baselines
  - In this study, the benefits include all carbon (relative to conventional tillage)
- Co-benefits of carbon sequestration