Estimating the costs of continuous conservation tillage

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Acknowledgements

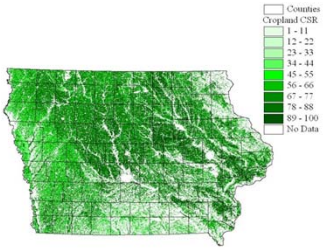
* Funding for this work was provided by USDA ERS Cooperative Agreements 58-6000-0-0056 and 58-6000-9-0083. The views expressed in this research are those of the authors and do not necessarily reflect those of the U.S. Department of Agriculture.

Rationale

- Land based carbon offsets:
  - A relatively low cost climate mitigation strategy,
  - Known technology – bridge role
  - Potentially high co-benefits
- Payments for Continuous Conservation Tillage (CCT) are appropriate for heavy production regions such as the corn belt.

Assumptions

* Farmers participate in the offset program if it offers as much as the crop rotation that maximizes their net returns
  * N application rate is variable
  * Optimal N depends on soil productivity, prices and yield drags
  * 6 year contracts



Corn yield function

* Corn yield is:

where $$y_{i,c,k}(t, r_N) = \alpha_i \tau_{c,k,t} (a_{0,i,k} + a_{1,i,k} r_N + a_{2,i,k} r_N^2)$$

* y is the yield in bushels per acre,
* subscripts i,c,k stand for the i-th parcel, corn, and the crop grown in previous year: corn ($k=c$) or soybeans ($k=s$),
* t is the tillage system used (1- conventional, 2- mulch, or 3- no-till),
* r_N is the rate of Nitrogen fertilizer in lb per acre,
* α_i is the parcel-specific yield multiplier,
* $\tau_{c,k,t}$ is the previous crop- and tillage-specific corn yield multiplier,
* $a_{0,i,k}$, $a_{1,i,k}$ and $a_{2,i,k}$ are the location- and previous-crop-specific parameters of the yield function

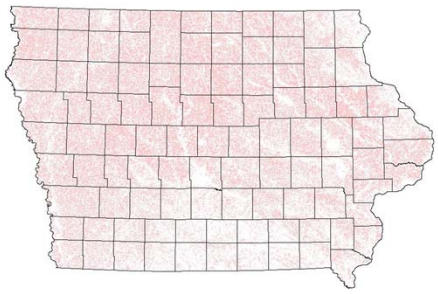
Assumptions

- Rotation and management choices:
  - CC conventional
  - CS conventional
  - CCS conventional
  - CS low till/mix till
- One off ex ante choice on the basis of expected prices – no renegotiation allowed
  - Penalties for early withdrawal assumed high
  - Monitoring (e.g. via remote sensing) assumed widespread and cheap

Assumptions

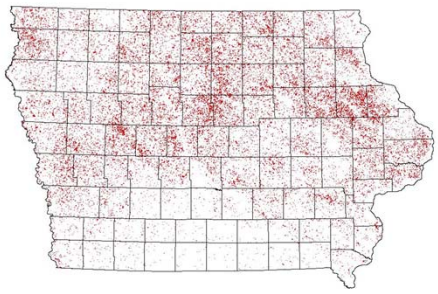
- At current input and output prices and the standard labor cost in the Iowa Extension budgets, the optimal choice is always CS conventional. We know that is not true…
- Though it is hard to tease this out of the ARMS data since the corn and soybeans years are out of sync, we know that Iowa farmers are planting
  - Using low till management
  - Continuous corn (just not together…)

Over 13 million acres in corn in Iowa in 2012



Constructed from the USDA NASS CDL dataset

Almost 3.5 million acres in corn on corn in Iowa in 2012-11-10-09



Constructed from the USDA NASS CDL dataset

Fitting the model

- We know farmers do not face identical output prices. Labor costs are also likely to vary
- To capture the uncertainty of the costs of the policy, we randomized corn and soybean prices and labor costs and run each scenario 100 times
- We also randomized the differential costs of no till. W/o this randomization, at current prices farmers would never choose to plant low till (even not continuously)
  - Even without yield drags the herbicide cost differential too high

Fitting the model - prices

Prices		
C	$/bushel	5.8
S	$/bushel	12.5
N	$/pound	0.58
Diesel price	$/gallon	3.25
LPG price	$/gallon	1.6
L costs	$/hour	12.25

Fitting the model baseline land use

	SC conventional Acres	CC conventional Acres	SC low till Acres	SC mixed till Acres
Average	13,634,539	5,542,245	2,732,575	1,753,859
SD	1,789,626	1,652,607	1,135,302	897,649
Max	17,862,489	10,478,867	6,943,668	4,213,958
Min	8,663,937	2,186,022	494,142	73,390

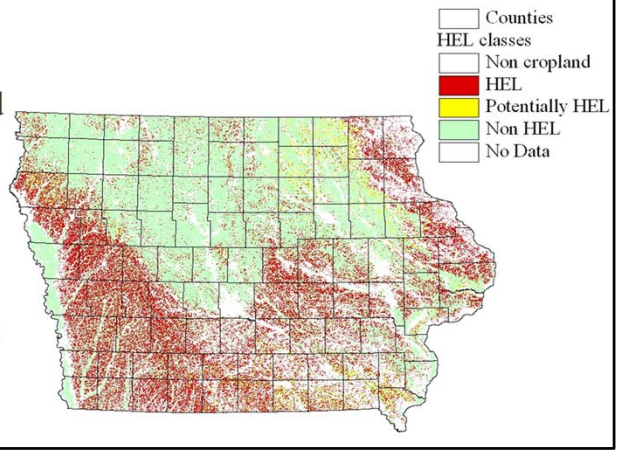
CCT costs

- How much would it cost to move the whole state into CCT?
- If farmers were willing to switch without any extra compensation & the regulator knew their opportunity costs (program costs = social costs)…

Average	307,908,815
SD	71,999,865
Max	514,213,716
Min	155,485,352

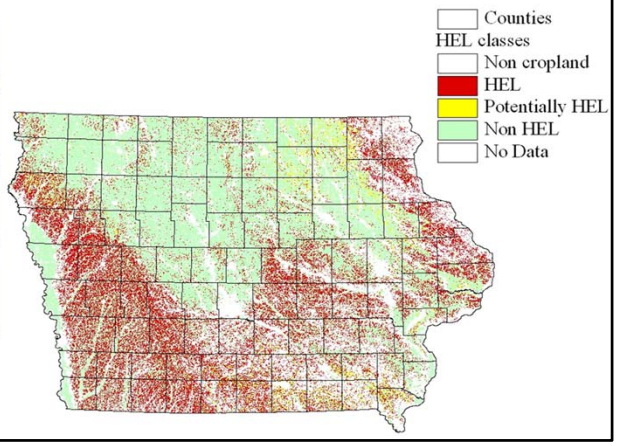
CCT costs

- We can use this set up to look at possible targeting schemes as well
- E.g. - how much would it cost to move the almost 8 million acres of cropland HEL/potential HEL to CCT
  - What is the social cost of conservation compliance



CCT costs

Average	$57,429,092
SD	12,055,312
Max	$105,259,449
Min	$29,940,151



Scenario 1
25% higher energy costs

	SC conventional Acres	CC conventional Acres	SC low till Acres	SC mixed till Acres
Average	14,312,410	3,201,939	3,667,794	2,477,208
SD	1,621,564	1,182,333	1,228,819	1,022,189
Max	18,662,038	7,355,709	6,892,575	5,797,609
Min	9,794,528	605,054	743,699	773,179

Scenario 1
25% higher energy costs

- Substantially lower CCT costs – on average $197 million ($307 million in the baseline) for the whole state
- Targeting HEL/potential HEL would cost $38 million ($57 million in the baseline)
- The reason is that higher energy costs make low till more attractive – lower opportunity costs

Scenario 2
Higher relative corn prices

* Based on the OCE Outlook prices for next year – corn at $7.6/bushel and soybeans at $14.9/bushel

Scenario 2
Higher relative corn prices

	SC conventional Acres	CC conventional Acres	SC low till Acres	SC mixed till Acres
Average	6,461,906	14,917,362	1,523,795	756,306
SD	1,306,483	1,506,619	821,435	522,912
Max	10,329,148	18,194,811	4,485,158	2,062,030
Min	2,720,747	10,056,380	169,301	1,799

Scenario 2
Higher relative corn prices

- Converting all of Iowa into low till would cost well over a billion dollars
- Targeting HEL/potential HEL would cost over $179 million ($57 million in the baseline)
- The reason is that these prices bring about a huge shift towards continuous corn

Scenario 3
Fixed $20/ac subsidy w/baseline prices

	SC conventional Acres	CC conventional Acres	SC low till Acres	SC mixed till Acres
Average	0	3,662,496	19,996,855	0
SD	0	1,267,054	1,267,054	0
Max	0	6,999,445	22,360,166	0
Min	0	1,299,185	16,659,906	0

Scenario 3
Fixed $20/ac subsidy w/baseline prices

- The conversion is relatively cheap – it would cost $400 million (S.D. 25 million)
  - It essentially moves all of the SC conventional acres into no till, though the most productive land stays in continuous corn
- Targeting the payments to HEL only would cost around $150 million (S.D. 5 million), and would move around 7.5 million acres into SC no till

Extensions in the works

- How to allocate a given budget – targeting
  - We can go back to the georeferenced data – targeting can be spatially explicit e.g. proximity to bodies of water and/or enrollment limits by county
- Tracking nitrogen inputs to look at potential co-benefits

Conclusions

- Ethanol policies and any policies/shocks that increase the relative price of corn increase dramatically the costs of offsets
- A carbon tax on the other hand would reduce the costs of a CCT offset policy
- May be best to look at mitigation polices in bundles to avoid unintended consequences