No-Till Farming

Summary:
No-till cropping systems sequester soil carbon that would otherwise be released to the atmosphere through conventional cultivation practices. No-till farming also reduces the amount of nitrogen-based fertilizer being applied therefore, providing reductions in nitrous oxide (N_2O) emissions. No-till also results in reduced time spent preparing the fields such that diesel fuel consumption is reduced and therefore, provides a third source of greenhouse gas reductions.

Goal:
Increase no-till acreage by approximately 22% to 1.8 million acres in 2020.

Implementation Period:
2013 to 2020

No-till Data Sources/Assumptions/Methods for GHG:
Total harvested cropland in Pennsylvania was estimated at about 2.3 million acres[1] in 2011. For the purposes of this analysis, only no-till acreage was considered, excluding other conservation tillage practices. Based on the policy design parameters, the schedule for acres to be put into no-till acreage cultivation is displayed in Table 1.

It is estimated that approximately 1.5 million acres of Pennsylvania cropland were cultivated using no-till practices in 2011.[42] Therefore, to reach the goal of 1.8 million total acres, 353,000 additional acres are needed. It is assumed that carbon is sequestered at a rate of 0.6 tCO_2/acre/year (404 kilograms of carbon per hectare per year [kg C/ha/year]) and that that this rate of accumulation occurs for 20 years, which extends beyond the policy period.

Additional GHG savings associated with fertilizer and diesel fuel use are identified in Table 1. Differences in the application of nitrogen (N) fertilizer and the estimated 10% volatization rate associated with N fertilizers yield incremental greenhouse gas reductions. Reduced diesel fuel consumption is estimated and multiplied by a life-cycle emissions factor of 12.6 metric tons per 1,000 gallons consumed to calculate the associated emissions reductions.

Data Sources/Assumptions/Methods for Costs:
Changes in equipment necessary to convert from conventional to no-till cultivation result in increased costs. These costs are estimated based on data from the Minnesota Agriculture Best Management Practices (AgBMP) Program.[2] This program provides farmers a low-interest loan as an incentive to initiate or improve their current tillage practices. The equipment funded is generally specialized tillage or planting implements that leave crop residues covering at least 15%–30% of the ground after planting. The average total cost for this equipment is $23,000, though the average loan for tillage equipment is $16,000. The average-size farm using an AgBMP loan to purchase conservation tillage equipment is 984 acres. The average loan size was determined based on the average size of a farm in Pennsylvania (124 acres),[3] and

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[1] USDA/NASS, 2012survey of tillage practices for major field crops
http://www.nass.usda.gov/Statistics_by_State/Pennsylvania/Publications/Survey_Results/tillage_practices12.pdf

[2] Minnesota Department of Agriculture, Agricultural Best Management Practices Loan Program State Revolving Fund Status Report, February 28, 2006.

[3] USDA, National Agricultural Statistical Service. Ag Census 2007, Table 1. Historical Highlights: 2007 and Earlier Census Years.

the amount of a loan per acre as estimated in the Minnesota AgBMP Program ($16.26/acre).[4] This put the average loan size at $2,016 to finance no-till/conservation tillage practices. This loan payment was applied to each new acre entering the program. The cost savings for this program come from a combination of carbon credits, nutrient reduction credits and reduced diesel fuel costs. Carbon credits can accrue through the increased accumulation of soil carbon sequestration as well as via decreased N_2O emissions from fertilizer application. Nutrient credits are available from reduced runoff of applied nitrogen and phosphorus fertilizers that enter waterways. Carbon and nutrient credit values were estimated at $3/metric ton and $3.50/metric ton, respectively. Diesel fuel savings were estimated using U.S. Department of Energy fuel price forecasts.[5] The cost-effectiveness for this work plan of –$86/tCO₂e was derived by dividing the cumulative discounted costs shown in Table 2 by the cumulative GHG reductions shown in Table 1.

Table 1. GHG Reductions from No-till Practices

Year	Acres Under No-till (%)	New Acreage Under No-till	Carbon Sequestered ($MMtCO_2e$)	Reduced Volatization from Nitrogen Fertilizer (MMtCO2e)	Avoided Diesel Emissions (MMtCO2e)	Total Annual GHG Reductions ($MMtCO_2e$)
2013	64%	44,125	0.03	0.01	0.002	0.04
2014	66%	88,250	0.05	0.02	0.004	0.07
2015	68%	132,375	0.08	0.03	0.007	0.11
2016	70%	176,500	0.11	0.03	0.009	0.15
2017	72%	220,625	0.13	0.04	0.011	0.19
2018	74%	264,750	0.16	0.05	0.013	0.22
2019	76%	308,875	0.19	0.06	0.016	0.26
2020	78%	353,000	0.21	0.07	0.018	0.30
					Total	**1.3**

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; tCO_2e = metric tons of carbon dioxide equivalent; gal = gallon.

[4] Minnesota Department of Agriculture, Agricultural Best Management Practices Loan Program State Revolving Fund Status Report, February 28, 2006.

[5] AEO 2012 early release

Table 2. Costs/Cost Savings of No-till Program

Year	Cost of Funding No- till Equipment ($million)	Reduced Fertilizer Application Savings ($million)	Soil Carbon Offsets ($million)	Reduced Fertilizer Application Savings ($million)	N2O Fertilizer Offsets ($million)	Nutrient Credits ($million)	Diesel Saved ($million)	Net Costs/Cost Savings ($million)	Discounted Costs of Program (5%, 2010$)
2013	$0.717	0.96	0.08	0.96	0.026	0.003	3.67	-$4.02	-$3.47
2014	$1.435	1.92	0.16	1.92	0.052	0.005	7.75	-$8.45	-$6.95
2015	$2.152	2.88	0.24	2.88	0.078	0.008	12.12	-$13.18	-$10.32
2016	$2.870	3.84	0.32	3.84	0.104	0.010	16.43	-$17.83	-$13.30
2017	$3.587	4.80	0.40	4.80	0.130	0.013	20.96	-$22.71	-$16.14
2018	$4.305	5.76	0.48	5.76	0.155	0.015	25.33	-$27.44	-$18.57
2019	$5.022	6.72	0.56	6.72	0.181	0.018	29.84	-$32.29	-$20.81
2020	$5.740	7.68	0.64	7.68	0.207	0.020	34.38	-$37.19	-$22.83
								Total	-$112.40

Table 3 provides an assessment of the cost-effectiveness of this initiative, as expressed in 2010 dollars and assuming an annual discount rate of 5 percent. While the GHG reductions in 2020, as noted in Table 1 and summarized below are modest this initiative is estimated to provide a cost savings of approximately $76 per ton of CO2 reduced. Carrying forward this effect is projected to result in a cumulative cost-effectiveness of -$85.97 (savings) per ton of CO2.

Table 3. Annual and Cumulative (2013 – 2020) Cost-Effectiveness

Annual 2020			Cumulative 2013-2020		
GHG Reductions (MMtCO2e)	Cost ($ MM)	Cost-effectiveness ($/tCO2e)	GHG Reductions (MMtCO2e)	NPV (2010 $MM)	Cost-effectiveness ($/tCO2e)
0.30	($22.83)	($76.39)	1.31	($112)	($85.97)

<u>Additional Costs/Benefits:</u>

- Reduction in nitrogen runoff.
- Reduction in erosion of soil by wind and water.
- Better water and nutrient holding capacity, which can lead to reduced synthetic fertilizer use, better water quality, better performance during droughts, and generally “healthier” soil.
- Increased water infiltration.
- Crop profitability is higher in a continuous no-till system.
- No-till provides the most cost-effective solution for reducing erosion and sediment loss.

<u>Implementation Steps:</u>

- Reaching the 80% goal will be primarily market-driven, but will be greatly assisted by continuing to offer Resource Enhancement and Protection Program (REAP) tax credits for no-till planting equipment, cost-share incentives for first-time no-tillers, and technical assistance to first-time and inexperienced no-tillers.
- Work with PA NASS to revise its survey processes to capture additional information regarding no-till practices, including a methodology to define and capture data on continuous no-till acres and cover crops.
- Encourage the PA No-Till Alliance to learn more about the opportunities of carbon offsets and nutrient credits and how no-till farmers can best access these markets.

- Coordinate a state Continuous No-Till action plan between the PA No-Till Alliance, the Pennsylvania State University Cooperative Extension Service, USDA NRCS, the State Conservation Commission, County Conservation Districts, farm organizations, and conservation/environmental groups.
- Utilize the First Industries Fund (FIF) and REAP tax credits to help farmers purchase no-till equipment. FIF is administered by the PA Department of Community and Economic Development with assistance from the PA Department of Agriculture and the PA Grows Program. REAP is administered through the State Conservation Commission.
- Implement a Core 4 approach to conservation in Pennsylvania. Core 4 is a common-sense approach to improving farm profitability while addressing environmental concerns. The approach is easily adaptable to virtually any farming situation and can be fine-tuned to meet the farmer's unique needs. The net result is better soil, cleaner water, and greater on-farm profits. No-till is a key component of Core 4.
- Secure a National No-Till Conference for the Pennsylvania Farm Show Complex.
- Host a No-till conference highlighting the many benefits and other aspects at the Pennsylvania Farm Show.

By crediting farmers for "carbon-positive" (sequestering) practices, the policy increases the potential for significant biological soil improvement that can, over time, both sequester carbon and reduce soil erosion, which is considered to be another major source of agriculturally released CO_2. Increasing soil carbon greatly improves a soil's ability to absorb and hold water, dramatically increasing yield potential during drought and decreasing flood potential.

Potential Overlap:
None.