Soil Carbon Sequestration and Carbon Credits

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What is Soil Carbon Sequestration

- Transfer of atmospheric $CO_2$ to the soil through land management practices.

Goal:

- Offset $CO_2$ emissions to atmosphere from fossil fuel combustion.
- This offset can be sold as a carbon credit.
380 ppm
What’s the Potential for Soil Sequestration of $\text{CO}_2$

- The USDA estimates that U.S. Farms and Rangeland could sequester 12-14% of current U.S. $\text{CO}_2$ emission.

- Much of this $\text{CO}_2$ will be sequestered through the reversal of soil carbon losses from:
  - Cultivation
  - Overgrazing
Soil Organic Carbon in Oklahoma

- Presettlement there were approximately 2.3 billion tons of carbon in Oklahoma Soils
- We have lost ~114 million tons of Carbon through cultivation:
  - (38% of C in top 6 in)
Why do we lose Carbon after cultivation.

- Cultivation aerates the soil and breaks up soil aggregates.
  - Aeration increases microbial respiration
    - Organic Carbon is utilized for energy
Soil respiration is equal or greater than plant residue deposition.

Net loss of Carbon
Magruder Plots, Stillwater: Soil Carbon loss after 110 years of Continuous Wheat

- Initial C was 1.8%
- Lost 46 to 70% of the initial C.
- ~28-42 Mt CO$_2$/acre
- 2300 to 3400 gal of gasoline/acre!
Reversing Soil Carbon Losses

- Eliminate whole field tillage from our croplands
  - No-till management
  - Grass plantings
Soil respiration is reduced and organic carbon accumulates.
Other Factors influencing soil Carbon Sequestration

- Crop Residue input into soil system
- Crop Residue Quality
The rate of Carbon Sequestration is also Impacted by Residue Input

Soil Organic Carbon

Carbon storage

Soil Respiration

Atmosphere

CO₂

Photsynthesis

Carbon storage is reduced

Living biomass

Carbohydrates

Plant Respiration

Plant Residue

Soil Environment

Plant residue deposition is reduced
Alterations in residue input

- In a given field, residue input can be increased through:
  - Increased crop rotation intensity (maybe)
  - Optimization of crop yield (crop management)
  - Crop type (Wheat vs Soybean)

- Residues can be decreased by:
  - Burning
  - Forage harvest
  - Long fallow periods
Dryland crop rotations
12-years, No-till
Eastern Colorado
0-4 inches
Sherrod et al. (2003)
Residue Quality influences Carbon Sequestration

- Residues with Low C/N ratios decompose rapidly
  - Soybean 15/1, Hairy Vetch 12/1
- Residues with high C/N ratios decompose slowly.
  - Wheat straw 80/1, Corn stover 60/1
Lets come back to Carbon Credits

- Soil carbon sequestration can offset CO$_2$ emissions
- This offset generates a Carbon Credit?
Carbon Credits

- Carbon Credits can be traded as a Commodity
  - Carbon credits are purchased by entities who are interested in reducing net CO$_2$ emission
- Can provide an external revenue stream for landowners
No-till Crop Management

- Current estimate of CO₂ sequestration in OK is:
  - 0.2-0.6 Mt of CO₂/acre/year
- Sequestration rate is highly dependent on rainfall
  - 0.6 Mt in NE OK
  - 0.2 Mt in SW OK
Some No-till Guidelines:

- Implements acceptable for use include:
  - No-till planter/drill
  - Subsurface disturbance implements:
    - Anhydrous applicator
    - Manure knife applicator
    - Subsoiler/ripper

- Residues cannot be burned.

- Follow periods are restricted.
Grassland Establishment

- Conversion of cultivated cropland to grassland
  - Harvests will be limited

- Current estimate of CO$_2$ sequestration in OK is:
  - Most of Oklahoma
    - 1.0 Mt CO$_2$/acre/year
  - SW Oklahoma
    - 0.4 Mt CO$_2$/acre/year
How are Carbon Credits Marketed?

- Chicago climate exchange?
- Members can buy and sell carbon credits
- Agricultural carbon credits must be combined and sold as large individual units.
  - They are combined by Aggregators
Aggregators:

- Oklahoma Carbon Initiative.
  - www.okcarbon.com
- North Dakota Farmers Union
  - www.carboncredit.ndfu.org
- Agragate
  - www.agragate.com
How much is this deal worth?

- The Market has fluctuated drastically in the past year!
Revenue per Acre of No-till

- **Current Price:**
  - ~$1.20/Carbon Credit
- **Aggregator Handling Fee:**
  - ~20%
- **No-till sequesters:**
  - 0.2-0.6 Mt/acre
- **At current price the Revenue is:**
  - $0.20-.60 /acre
The Oklahoma Conservation Commission provides certification of Aggregators operating in the state.

- This is not mandatory
  - State certification provides a level of protection against fraudulent aggregators

- Certification provides assurance that land practices are followed to sequester carbon
Potential impact of Cap and Trade?

- System in which CO$_2$ emissions are capped
- Example:
  - CO$_2$ emission from a coal fired electric power plant will be restricted
  - They can buy carbon credits to offset emissions
- There are other alternatives such as some form of carbon tax.
- Currently, carbon credits are purchased voluntarily
Potential impact of Cap and Trade?

- Europe has a cap on emissions
- Carbon Credits in Europe are worth $20.30 per Mt
- This equates to $3.25-9.75/acre for No-till
Currently, the value of carbon credits is low

- Oklahoma Carbon Initiative is working to get a premium for agricultural carbon credits in OK
  - Talk to your local Conservation District Office.
- Cap and trade will dramatically influence value
- Be cautious about signing long-term contracts
Question?