Integrity and Agricultural Landowner Behavior in Afforestation for Carbon Sequestration as part of a Carbon Pricing Program

David Haim & Eric M. White

EMAGG workshop, ERS, August 8th 2013

Introduction – Carbon Markets

- Regional markets in the US
  - Regional Greenhouse Gas Initiative (RGGI)
  - Cap-and-trade program in California
- European Union Emissions Trading System
- Carbon price projections: rise to $20-$80 per CO2e by 2030 with further increases by 2050 (IPCC, 2007)
- Agricultural and forest sectors potential to serve as carbon offset providers
  - American Clean Energy and Security Act
  - Control land use emissions and increase land use sinks (Reilly & Asadoorian, 2007)

Objective

Quantify leakage behavior and investigate permanence issues of agricultural land afforestation under simulated national and region-specific carbon offset markets

Agricultural Afforestation Importance

Agricultural sector activities for GHG mitigation include:

- Conversion of cropland to grasses
- Adoption of conservation tillage practices
- Change in fertilizer regimes
- Manure management
- Afforestation

Agricultural Afforestation Integrity

Intensification within the agricultural sector:

- Reduction in idle agricultural land
- Adoption of more intense management practices
- Conversion of pasture to cropland

Leakage:

- Emissions displacement in time and space outside the afforestation program's boundaries
- Intensification of agricultural production within the afforestation program's boundaries

Previous leakage estimates: Murray et al, (2004)

Approach

- Extend and apply FASOM-GHG to model agricultural afforestation
- Complete regionally-explicit model runs for the conterminous U.S.
- Run the model for the period between 2010 and 2080
- Examine carbon prices of $30 & $50 per tonne CO2e
- Include baseline Renewable Fuels Standard

FASOM-GHG

- An equilibrium linked model of U.S. agricultural and forest sectors
- Utilizes a dynamic optimization approach to simulate markets for agricultural and forest products
- perfect foresight regarding future demand, yields, technologies, and prices
- Regionally-explicit

FASOM-GHG

- Commodity and factor prices are endogenous
- Land conversion to develop uses
- Tracks a variety of agricultural and forest resource conditions and management actions
- International trade in both agricultural and forest products
- Includes GHG accounting and a bioenergy sector

GHG Accounting

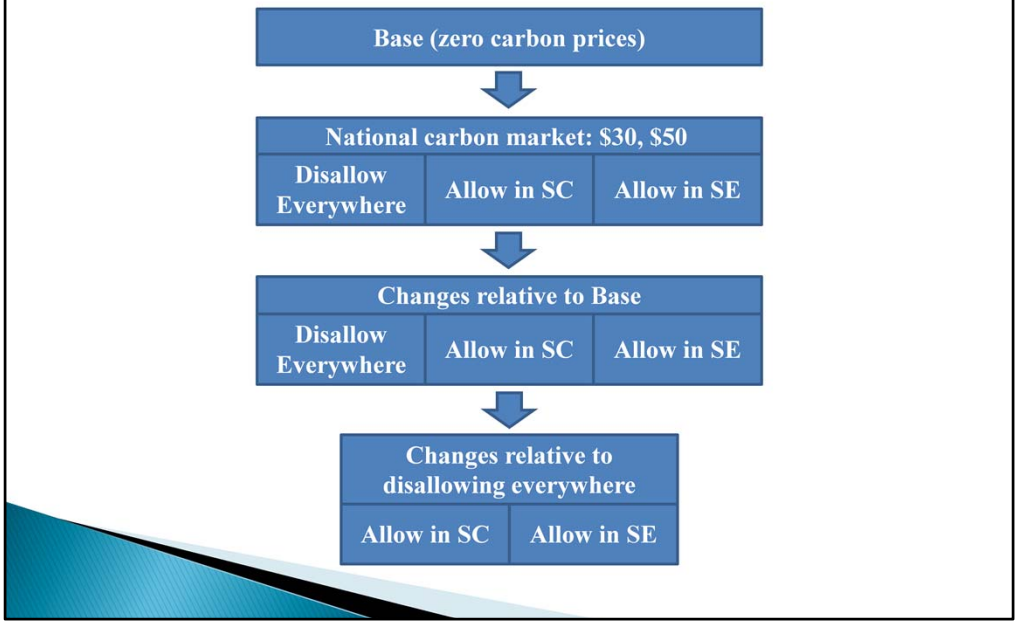
Land-based GHG accounting in agricultural and forest sectors from:

- Carbon in agricultural and forest biomass and soils
- Carbon change due to movement of land (afforestation/deforestation) between agriculture and forest
- Emissions from agricultural and forest production activities
- Emissions from livestock
- Carbon in wood products

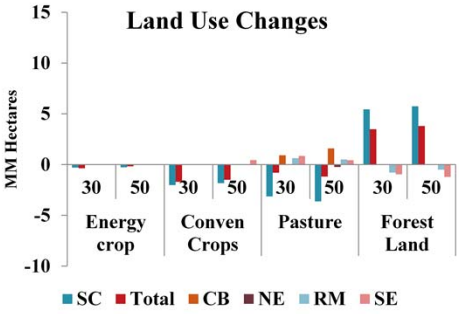
FASOM-GHG

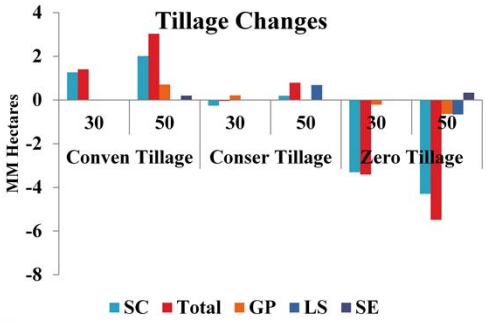

Pacific Northwest West East
Lake States
Great Plains
Northeast
Rocky Mountains
Corn Belt
Pacific Southwest
Southeast
South West
South Central

Simulations – Leakage

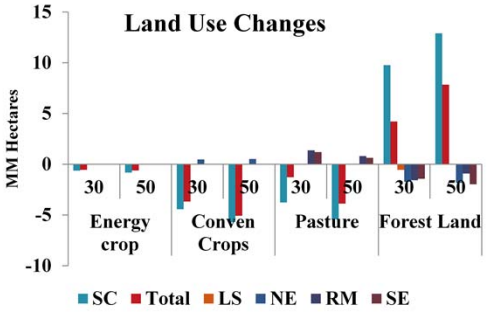


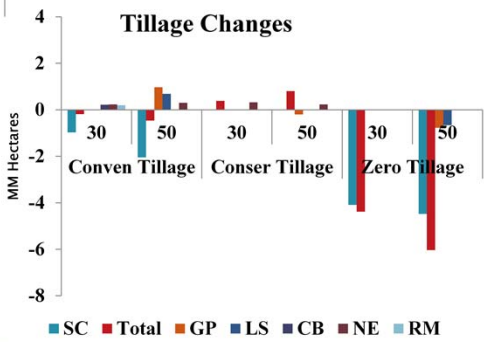
Land use and tillage changes – only SC (short-term)



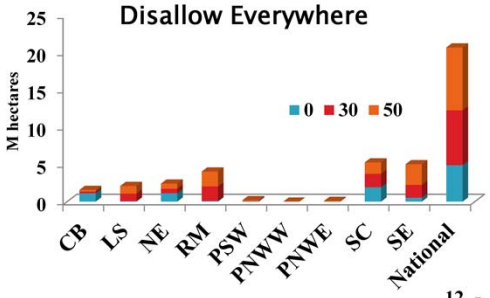


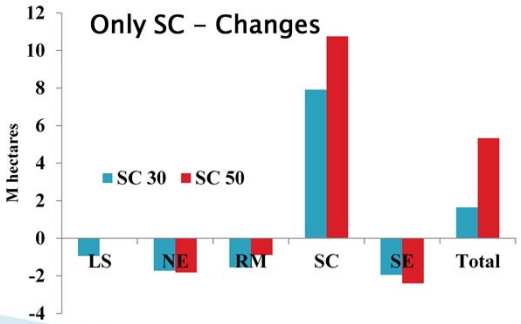
Land use and tillage changes – only SC (long-term)



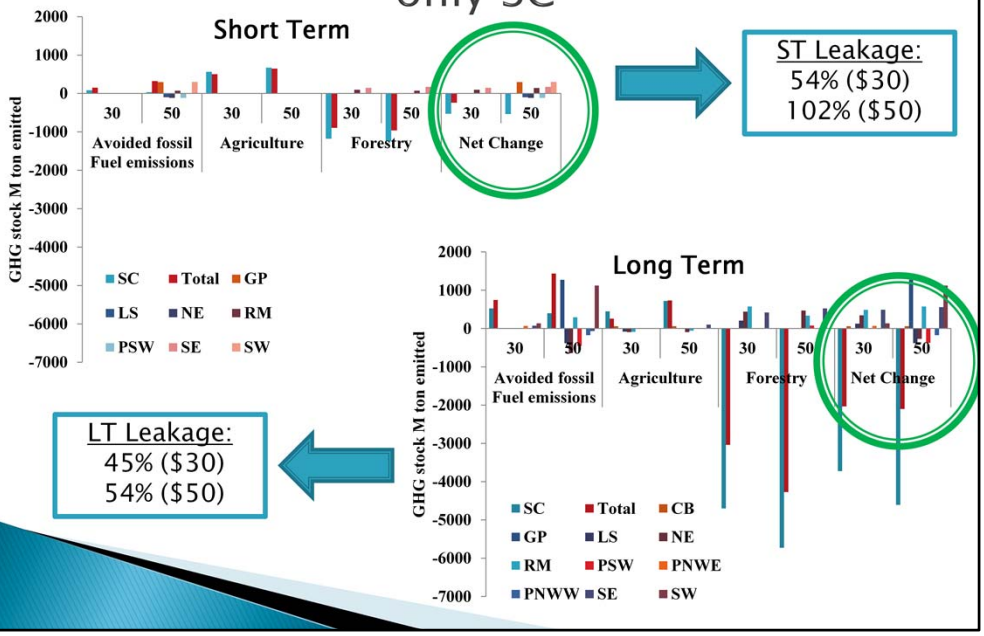


Afforestation – only SC (2010–2055)

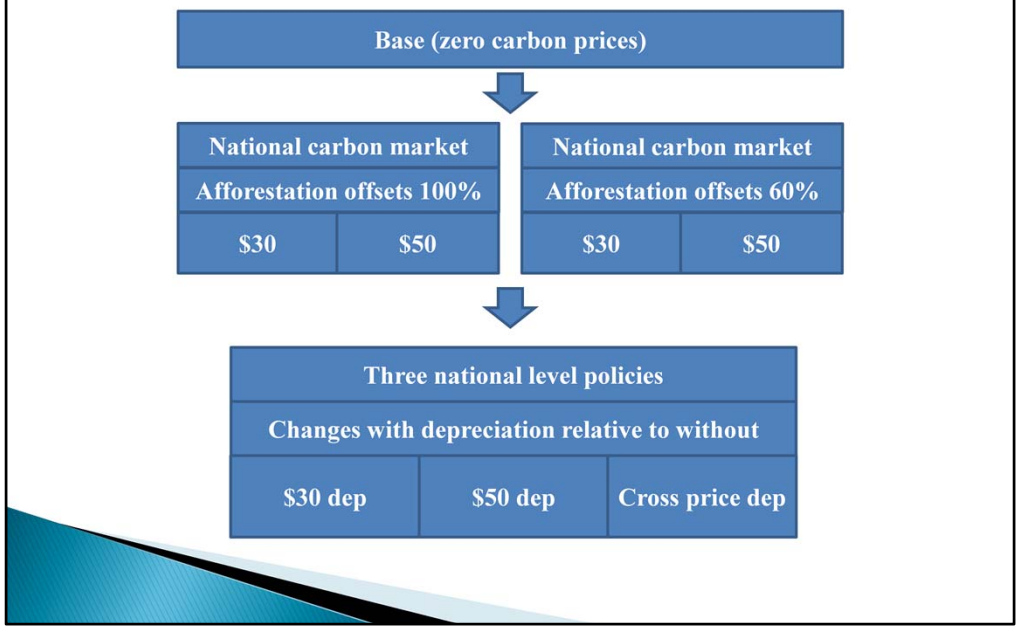




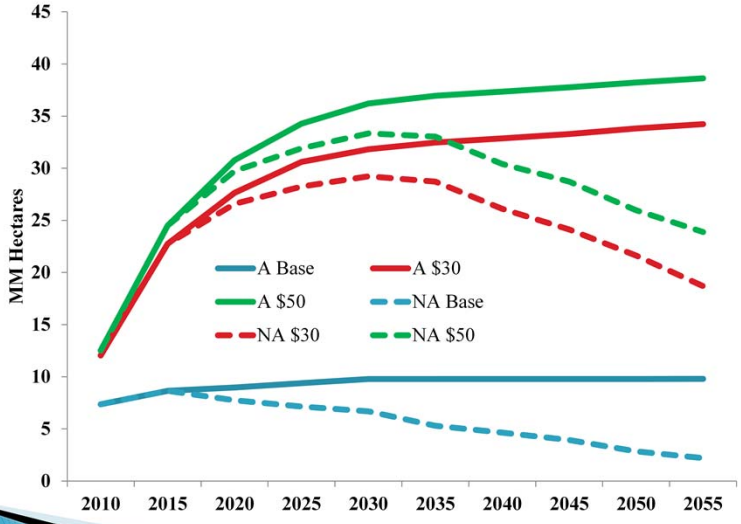
Changes in stocks of GHG emissions – only SC



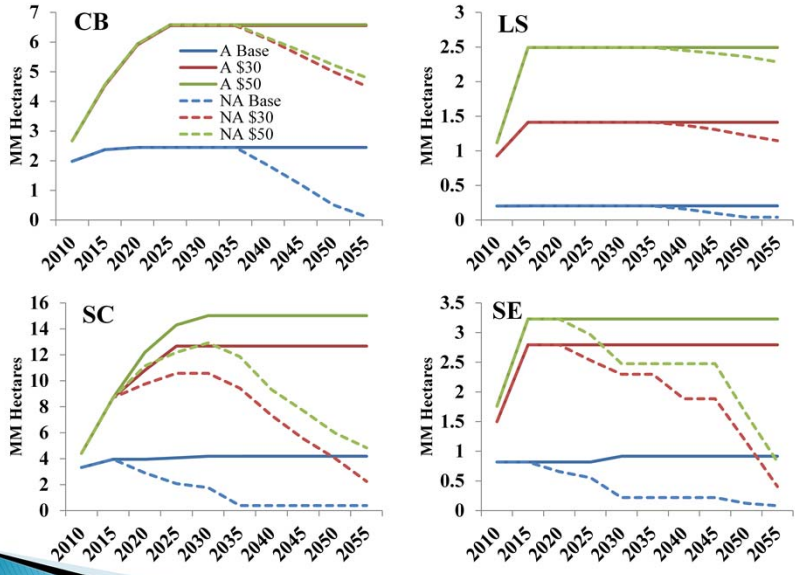
Simulations – Permanence



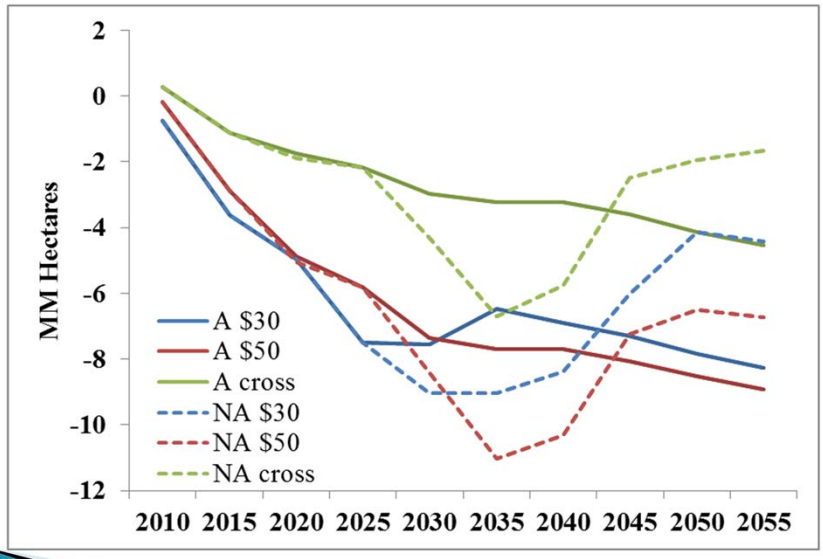
Cumulative Afforestation and Net Afforestation Levels: Unmodified Carbon Market (National)



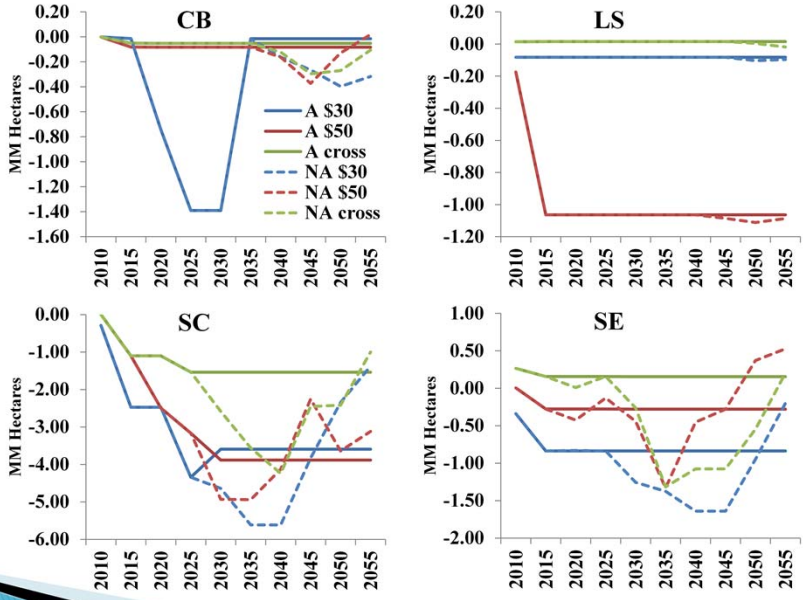
Cumulative Afforestation And Net Afforestation Levels: Unmodified Carbon Market (Regional)



Changes in Cumulative Afforestation and Net Afforestation: Depreciated Afforestation Offsets (National)



Changes in Cumulative Afforestation and Net Afforestation: Depreciated Afforestation Offsets (Regional)



Discussion (leakage)

- Net gains are much greater in the long-term
- Intensified agricultural production in the GP and LS regions in the short and long terms
- Could result in as much as an additional 400 million tonnes annual-average GHG stored. Equals to 6% of US GHG emissions in 2010 (EPA, 2012)
- Leakage from the regional SC allowance program is in the range of 45-55% in the long term but could be as high as 100% in the short term.
- For the SE regional allowance program: land use changes are smaller and leakage is always greater than 100%

Discussion (permanence)

- Most of the afforested area in the Midwest regions remains unharvested in the long term. The opposite is true for the Southern regions
- A permanence value reduction promotes the harvesting of afforested stands in the Southern regions
- Mixed results in terms of carbon price levels

THANK YOU