Duke Guidelines for Quantifying Greenhouse Gas Emission Offsets Generated by Changing Land Management

Gordon Smith

February 29, 2008

Terrestrial Carbon Sequestration Opportunities in Colorado; the Science, the Policy and the Market
Brighton, Colorado

ecofor

ecofor

Why have offset guidelines?

- **Shape future regulatory programs**
- **Voluntary market**
  - Buyers know they are getting real benefits
  - Sellers get higher prices for quality products

ecofor

Participating without offsets

- **Sell low emission products**
  - Biomass fuel does not require expensive allowances to burn
  - Building with wood avoids emission costs of steel and concrete
- **Incentive programs**
- **Capped emitters**

ecofor

Reversibility

- **Carbon sequestration is reversible**
  Must monitor
- **Emission reductions are permanent**
- **Reversible offsets need not be held forever**
  But the market will price short-term offsets lower

ecofor

Many GHG mitigation products

- **Each market has its own rules**
  Compliance market rules set by regulator
  Bilateral trades can be anything
- **Prices vary by factor of 10**
  Lower demand, lower price
  Higher obligation of seller, higher price

ecofor

Creation of the Duke guidelines

- **Scientific Committee through Duke University Nicholas Institute**
- **Contributions by subject experts**
- **Technical editing to reconcile subject areas**
- **Editing for readability**
- **Peer review and Scientific Committee review**

ecofor

Scope of applicability

- **Forestry**
  - Afforestation
  - Forest management
  - Avoided deforestation
- **Soil carbon**
- **Manure management**
- **Soil nitrous oxide and methane**

ecofor

Subjects addressed

- **Identifying project activities**
- **Financial scoping**
- **Baselines and additionality**
- **Quantification of project GHG fluxes**
- **Leakage**
- **Verification and registration**

ecofor

Quantification strategies

- **Measure outcomes**
- **Project specific measurements**
- **Measurement options:**

1) Model using project inputs

Where measuring technologies not yet cost effective

If models are shown to be reliable

2) Sampling

Instead of measuring everything, recommend 90% statistical confidence that at least claimed benefit is achieved

ecofor

Typical quantification methods

- **Forest: Sampling with permanent fixed area plots (point plots acceptable)**
- **Soil: Coring to specified depth**
- **Manure: Measure manure volume or weight, sample solids content, measure biogas volume, sample biogas chemistry**
- **Soil methane and nitrous oxide: Estimate using provided equations**

ecofor

Quantification examples

- **Sample trees, soil**
- **Measure manure, biogas amounts**
- **Equations given for modeling soil methane and nitrous oxide**

  May model using project inputs, if models are shown to be reliable

  May model where measuring technologies not yet cost effective

ecofor

Baseline quantification

- **Measure project area under pre-project activity**
- **Measure change rate on lands with similar starting conditions**

  Concurrent or prior to project implementation

  Developers favor use of prior periods
- **Modeling outcomes of project inputs**

  Example: Model emissions of baseline manure handling practices, using measured amount of manure handled by project

ecofor

Compatibility with other guides

- **Boundary setting like WRI GHG Protocol and others**
- **Most systems recommend site-specific measurements and factors, like Duke**
- **Many systems use mean estimate, not 90% statistical confidence**
- **CDM & others have separate additionality tests**

ecofor

Aggregators

- **Bundle offsets created by many entities**
- **Can make process simple for offset producers**
- **Can achieve economies of scale, especially quantification & verification**
- **Can insure and market offsets**

ecofor

Thank you

Gordon Smith

Ecofor LLC
206.784.0209
13047 12th Ave NW
Seattle, WA 98177
USA

ecofor

Book citation

Smith, Gordon R., Bruce A. McCarl, Changsheng Li, Joel H. Reynolds, Roel Hammerschlag, Ron L. Sass, William J. Parton, Steven M. Ogle, Keith Paustian, James Holtkamp, and Wiley Barbour. 2007. *Harnessing farms and forests in the low-carbon economy: how to create, measure, and verify greenhouse gas offsets.* Edited by Zach Willey and Bill Chameides. Raleigh, NC: Duke University Press, Nicholas Institute for Environmental Policy Solutions. 229 p.

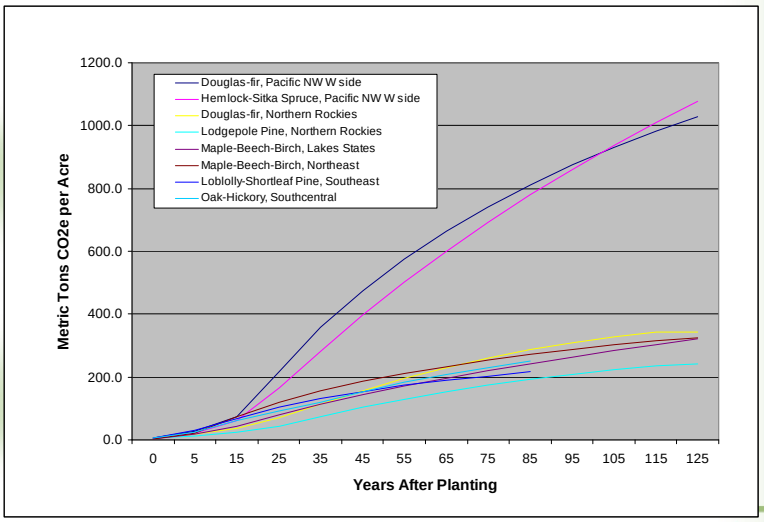
ecofor

Forestry GHG mitigation rates

- Afforestation: 3-8 Mg CO_2e ac^{-1} yr^{-1} but can be up to 25 Mg CO_2e ac^{-1} yr^{-1} in short rotation plantations for few years
- Forest management: depends on accounting rules; usually less than afforestation
- Avoided deforestation: depends on accounting rules
- Fuel wood: 1-8 Mg CO_2e ac^{-1} yr^{-1} forever

ecofor

Sequestration by forest type



Calculated from 1605(b) Forestry Guidelines, 2006

ecofor

Soil GHG mitigation rates

- **Reduce tillage: Sequestration rarely more than 1 CO_2e ac^{-1} yr^{-1} reaching new equilibrium in 10-20 years**
- **Restore grassland: 1.5-5 Mg CO_2e ac^{-1} yr^{-1} but up to 10 Mg CO_2e ac^{-1} yr^{-1} in tropics; only for 3-10 years**

ecofor

Manure GHG mitigation rates

- **Depend on baseline activity**
- **Up to 5 Mg CO_2e cow yr^{-1} for uncontrolled lagoons & digesters**
- **Generally <3 Mg CO_2e cow yr^{-1}**

ecofor

Other GHG mitigation rates

- **Soil N_2O from fertilizer: ≈ 1 Mg CO_2e per 170 lbs N reduced; permanent**
- **Reduce fuel use by no-till: 0.02-0.05 Mg CO_2e ac^{-1} yr^{-1} indefinitely & permanent**
- **Rice methane: 0.3-2 Mg CO_2e ac^{-1} yr^{-1} indefinitely & permanent**

ecofor