Down to Earth Carbon Science

Mitigating Climate Change with America's Farms and Forests

Agricultural, forest, and other working lands, when properly managed, provide low-cost, viable options for reducing greenhouse gas (GHG) emissions while providing additional carbon (C) sinks and associated co-benefits.

Cropland in America, covering 406 million acres or 18% of the land base[1], has the potential to sequester 72 million metric tons (MMT) of carbon (264 MMT of CO_2) as follows:

- 50% - from conservation tillage & surface residue management
- 25% - improved cropping systems, BMPs
- 6% - supplemental irrigation
- 19% - other practices[2]

No-till farming, which leaves the soil intact and crop residues in the field, sequesters an average of 0.3 metric tons of carbon per acre per year.

Forests in America annually sequester approximately 200 million metric tons (MMT) of carbon (732 MMT of CO_2) in the soil and biomass[3], offsetting about 10% of U.S. emissions from burning fossil fuels[4]. Forests cover approximately 749 million acres or 33% of the land base[5] and contain about 71,000 million metric tons (MMT) of carbon (259,860 MMT of CO_2):

- 35% in living biomass
- 51% in soil
- 13% in dead material, including the forest floor[6]

In forests, living biomass accounts for the major portion of GHGs sequestered annually, with net sinks in living forest biomass equivalent to roughly 376 MMT CO_2 in 2005 alone[7].

Carbon Sequestration

Soil and plants are important sinks for atmospheric CO_2. Plants cultivated for food, feed, fiber, and fuel use CO_2 from the atmosphere and sunlight to grow during the process of photosynthesis. After a crop or forest is harvested, carbon from decomposing plant biomass and crop residues, left on the field or in the forest, is captured (sequestered) in the soil when converted into humus or soil organic carbon (SOC).

- U.S. working lands (agricultural, forest, other) have the capacity to sequester about 650 MMT of carbon dioxide (CO_2) in the soil alone every year, offsetting up to 11 % of U.S. GHG emissions[8].
- In addition to living biomass and soil, wood products from American forestry store carbon for the long-term and offer an alternative to other materials with higher manufacturing emissions.

Nitrogen Management

Plants need and absorb nutrients from the soil such as nitrogen (N) to grow. Soil is amended with N via animal manure, ammonium fertilizer, crop residues or with N-fixing legumes. During the cropping season, nitrous oxide (N_2O), a GHG, can be emitted. Though N_2O only makes up about 8% of the total GHG emissions[9], (CO_2 adds up to 75%), its radiative forcing is 300x that of CO_2, making it an important GHG to manage. Managing N to maximize nitrogen use efficiency (NUE) will reduce N_2O emissions from agricultural lands.

a. Nitrogen use efficiency is the proportion of all N applied to a crop which is present in harvested biomass contained in crop residue, or incorporated into soil organic matter, and inorganic N pools.

Agriculture & Forestry Offset Modeling and Verification

In the carbon marketplace, the buyer needs assurance that the domestic offsets purchased are real, quantifiable, affordable, and achieve the carbon goal. Under any program, establishment of on-the-ground reference plots which standardize the baseline using tested models such as CENTURY, EPIC, FORCARB2, etc., provides rigorous soil carbon baseline measurements and the ability to document additional carbon sequestration originating from a given sequestration practice.

GHG Markets

GHG markets offer farmers financial incentives to employ practices to manage GHGs while providing binding contracts to businesses that wish to voluntarily offset their emissions.

- The Chicago Climate Exchange (CCX), North America's only voluntary cap-and-trade system for all six greenhouse gases (CO_2, CH_4 - methane, N_2O and three groups of fluorinated gases), currently pays land managers between $2 and $3 per acre for sequestering CO_2 using no-till practices and/or planting grasses and trees.

- Aggregators, such as the North Dakota Farmers Union (NDFU), play a key role in assembling carbon credits produced by land managers to sell on the CCX.
- These groups can work with Certified Professional Agronomists, Crop Advisers, Foresters, and Soil Scientists, who have long-term, trusting relationships with producers and land managers, to ensure high-quality offsets, which address additionality, leakage, and permanence issues.

Together, these invaluable partners will enable American agriculture and forestry to be duly recognized for the important role they can play in climate change mitigation.

Verification Toolbox

Certified Professionals address the complexity of managed ecosystems using geographic mapping (GIS/GPS); manure, soil, and plant tests; conservation planning software; and best management practices.

Potential Agricultural BMP Offsets

- Reduced tillage
- Rotations
  - Reduced bare fallow
- Cover crops
- Fertility management
  - Nitrogen-use efficiency
- Water management
  - Irrigation management

Potential Forest Offsets

- Avoided conversion (change to another land use)
- Afforestation/reforestation
- Forest management
- Storage of long-lived wood products

Certified Professionals

Certified Crop Advisers (CCAs), Certified Professional Agronomists (CPAgs), and Certified Professional Soil Scientists (CPSS), certified by the American Society of Agronomy (ASA) and the Soil Science Society of America (SSSA) through meeting exam, education, experience and ethics standards, work closely with farmers and land managers to develop plans which estimate nutrient needs based on yield goals, while minimizing environmental risk.

Registered and Certified Professional Foresters are designated through membership in the Society of American Foresters (SAF) and licensing in the states in which they practice, or via membership in the Association of Consulting Foresters (ACF). Special training, provided by ANSI accredited verification bodies, is required to conduct verification for forest offset projects.

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Tool photo provided by Cesar Izaurralde.