3.2. TERRESTRIAL SEQUESTRATION
3.2.1 LAND MANAGEMENT
3.2.1.1 CROPLAND MANAGEMENT AND PRECISION AGRICULTURE

Technology Description

Cropland management practices can increase the amount of carbon stored in agricultural soils by increasing plant biomass inputs or reducing the rate of loss of soil organic matter to the atmosphere as CO_2. Precision agriculture is a form of site-specific management used to increase productivity. This approach can be adapted for improving soil carbon sequestration through a customized carbon sequestering management plan.

System Concepts

- Each production system will have its own particular set of practices that optimize carbon sequestration while maintaining profitable crop production.
- Precision agriculture can be used to develop the most appropriate suite of technologies for specific sites.
- Most agricultural soil management practices that promote carbon sequestration provide additional environmental and yield benefits.
- Use of genetically modified crops to enhance yields and reduce fertilizer use.
- Use of genetically modified microorganisms to enhance carbon uptake.

Representative Technologies

- Conservation tillage, especially no-till.
- Residue management.
- Reducing fallow.
- Cover crops.
- Nutrient management.
- Manure and organic matter additions.
- Water management.
- Erosion control.
- Apply advanced information technologies (e.g., global positioning systems, remote sensing, computer modeling) for efficient application of management treatments.
- Herbicide-tolerant crops that advance conservation tillage.
- Genetically modified crops that increase utilization of soil nutrients and/or fertilizer.
- Technologies that increase agricultural productivity (e.g. by increasing yields, minimizing crop losses, minimizing spoilage and increasing shelf life, because each would minimize area under cultivation).

Technology Status/Applications

- Each of these technologies and management practices has been researched and implemented for purposes other than carbon sequestration (for soil conservation, erosion control, and crop yield increases).
- Soil carbon data has been collected from hundreds of long-term field studies and used to estimate the soil carbon sequestration potential of different management practices.
- Additional studies are underway to explicitly investigate the potential of various management practices to sequester soil carbon.
- Technical support is available on how to implement these technologies for conservation and yield-enhancing purposes.
- Specialized equipment for implementing management practices (no-till drills, global positioning systems, etc.) is commercially available.

Current Research, Development, and Demonstration

RD&D Goals

- Quantify the carbon sequestration potential of each technology and management practice for various crop production systems, climates, and soils.
- Develop the combinations of practices that optimize soil carbon sequestration, crop production, and profits for various crop production systems; soil types; and geographical areas.

- Determine the applicability of precision agriculture for enhancing carbon sequestration.
- Develop decision support tools for farmers, other land managers, and policy makers that provide guidance for land-management decisions. For example, create databases that answer questions about how changing from one land-use practice to another will affect carbon sequestration, production, and profits.

RD&D Challenges

- Measuring and monitoring procedures need to be improved for accurate, low-cost, more-efficient determination of cropland soil carbon status.
- Increasing cropland soil carbon without increasing emissions of other greenhouse gases, especially nitrous oxide and methane.
- Research on the effect on carbon sequestration of specific management practices, climate and weather factors, soil properties, and cropping systems is needed to develop recommendations and improve models and decision support tools.

Recent Progress

- Research programs have been established in the USDA (Carbon Cycle Component of Agriculture Research Service's Global Change National Program), Consortium for Agricultural Soils Mitigation of Greenhouse Gases, DOE Office of Science (Carbon Sequestration in Terrestrial Ecosystems project - CSiTE), DOE Office of Fossil Energy, and U.S. Geological Survey to conduct research on soil carbon sequestration.
- More data are becoming available to improve the quantification of the cropland carbon sequestration.
- Preliminary models and decision support systems have been developed.
- Research on precision agriculture has been initiated.

Commercialization and Deployment Activities

- Carbon sequestration markets are being developed.

Market Context

- Ranges from 10%-80 % of cropland acreage.