FACTSHEET FOR PARTNERSHIP FIELD VALIDATION TEST

Partnership Name	Southwest Regional Partnership on Carbon Sequestration		
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Field Test Information: Field Test Name	Terrestrial Sequestration Programs – (1) Regional Terrestrial and (2) Local Terrestrial Sequestration (Combined With Enhanced Coalbed Methane Sequestration)		
Test Location	Entire Region (Regional Program); San Juan Basin (Local Pilot Test)		
Amount and Source of CO_2	Tons: N/A	Source: Atmospheric	
Field Test Partners (Primary Sponsors)	USDA Natural Resources Conservation Service USDA Agricultural Research Service		

Summary of Field Test Site and Operations

Regional Terrestrial Sequestration Program

We are developing a carbon reporting system that functions consistently across hierarchical scales and is compatible with the existing technology underlying the DOE Voluntary Greenhouse Gas Emission Reduction (1605b) reporting system. To accomplish this at the individual field and farm scale, the COMET VR tool will be validated and refined for arid and semi-arid rangelands and croplands. The primary area of investigation on arid rangelands is the mesoscale spatial distribution in response to shrub grass patterns. On croplands, the primary area of investigation is determining how tillage patterns can be characterized. Both of these areas of investigation are focused on describing management practices that greatly affect ecological processes that regulate carbon dynamics in agricultural ecosystems.

At the Major Land Resource Region scale, an inventory system that can be updated with existing information (NASS, NRI) will be constructed so that individual states or groups may report larger scale changes. Accomplishing this objective will require linking remotely sensed imagery to changes in carbon at the field scale.

The basis for this system will be 1) improved technologies and systems for direct measurements of soil and vegetation carbon at reference sites 2) development of remote sensing and classification protocols to improve mesocsale (km^2) soil and vegetation carbon estimates 3) integration of available information at a sub-MLRA scale into a regional inventory system. This regional inventory system can be used to estimate carbon change at a small scales (projects) using existing models and can also be used to make program and policy decisions.

San Juan Basin (Local) Terrestrial Sequestration Pilot

In conjunction with the Southwest Partnership's enhanced coalbed methane – sequestration test, a terrestrial pilot test will be conducted. ECBM operations are notorious for producing huge volumes of water. We propose to desalinate produced water from our ECBM pilot and use this water for irrigating a riparian restoration project, forming a combined ECBM – terrestrial sequestration project. The BLM and Burlington are both interested in making beneficial and environmentally-friendly use of the produced water

Rangelands in the San Juan Basin of New Mexico are a potentially large reservoir for carbon, in addition to their value as recreational lands. The challenges to achieving their potential lie primarily in the limited growing conditions (erratic precipitation) and reduced capacity for recovery (ongoing disturbance and poorly developed soils). Optimizing carbon storage in soils and vegetation while increasing the value of other ecosystem services requires a two-pronged strategy: enhancing existing and reintroducing woody plant species along riparian areas and reestablishing native grasses and shrubs in upland areas. The limiting factor in both cases is water, both quality and quantity. A reliable source of water of sufficient quality for agricultural irrigation could provide the necessary base for the reestablishment of native vegetation with a host of environmental benefits in addition to carbon sequestration. The water produced during ECBM production should provide that source.

Research Objectives of Regional Terrestrial Program

Objective 1: *Develop improved technologies and systems for direct measurements of soil and vegetation carbon at reference sites selected within Southwest Carbon Partnership region*

The purpose of Objective 1 is to use advanced instrumentation on the ground to identify and characterize the distribution of soil carbon, then to relate these distributions to the land use practices implemented at the site. Advanced techniques for measuring soil carbon and other nutrients are needed. We will address three tasks for Objective 1:

Objective 2: *Develop remote sensing and classification protocols to improve mesocsale (km^2) soil and vegetation carbon estimates*

The purpose of this objective is to identify and refine existing techniques in remote sensing that can detect and link changes in vegetation and soil properties that reflect soil C at a scale consistent with the output from Objective 1. While remotely sensed imagery has been valuable in natural resource management as a tool for inventory and large-scale production estimation, there has been little, if any, application to site-specific management such as land use and management change related to carbon sequestration.

Objective 3: *Construct ecological process (State and Transition) models that reflect soil/vegetation changes resulting from current land use and land use associated with implementation of programs to sequester carbon or reduce carbon losses*

The purpose of this objective is to integrate existing qualitative knowledge about soil/vegetation change in response to management and climate variability and quantitative information gained as a result of Objective 1 into State and Transition Models (STMs) appropriate for the regions represented by our study sites, link to objective remotely sensed land attributes (Objective 2) and provide inputs to improve model estimates (Objective 4).

Objective 4. *Develop a regional inventory and decision support tool that integrates information gathered during the course of the Phase I investigation and from Objective 1-3 above*.

The purpose of this objective is the development of a tool that will allow the integration of the spatial and carbon sequestration potential data developed under Phase I of this partnership along with the information and data gathered as part of Objectives 1,2, and 3 of this effort into a decision support framework that can be used by landholders, service agencies (NRCS), and policy makers.

Summary of Modeling and MMV Efforts

Modeling:

Validating and refining the CENTURY soil carbon prediction model by including field based estimates of soil carbon from existing research sites that represent significant areas of soil/vegetation/management combinations that currently have a high level of uncertainty associated with model estimates.

Measurement

Adapting existing technologies such as Laser Induced Breakdown Spectroscopy (LIBS) and Near Infrared Spectroscopy (NIRS) to more efficiently and accurately measure soil carbon.

Verification

Refining existing remote sensing technologies to differentiate 1) soil/vegetation combinations on rangelands that reflect significant changes in soil carbon and 2) tillage patterns that affect soil carbon on dryland croplands.

Research Objectives for Local Terrestrial Sequestration Pilot

Regulatory and permitting requirements will be addressed first. The terrestrial sequestration activities in this project will all take place on land administered by the BLM, who has an established permitting process for such activities. As a strategy of retrieving maximized CBM clean water for beneficial use and minimized wastewater for disposal, we developed and demonstrated a new method using zeolite RO membrane for produced water purification. The zeolite RO has advantages of organic solvent resistance and can separate salt and organics from produced water simultaneously. The molecular sieve MFI-type zeolite membrane can separate ion and organics from water with a high separation efficiency based on size exclusion mechanism because the hydrated ions and organics have effective sizes (0.8~1.0 nm) much larger than the uniform zeolite pore size (0.56 nm) while the dynamic size of water molecules (~0.29 nm) is much smaller than the zeolite pore size and therefore can transport freely. Recently, an overall 83.5% ion rejection was achieved for a real CBM produced water containing TDS of $\sim 1.86 \times 10^4$ mg/l on a MFI zeolite membrane.

Desalinated produced water will be applied to 5 linear km of second order or higher stream where riparian vegetation is currently degraded. Frequency of applications of water will be determined by the amount of water available, for one week, monthly, April-November; and one week every other month December through March. To assess the impact on vegetation, standard indicators of rangeland riparian ecosystems will be measured at the beginning of the project and seasonally thereafter. Water will be applied to at least 100 ha of upland soils, reseeded with drought tolerant native grasses at least three times per year to simulate 2.5 cm of natural precipitation. Impacts of the upland reseeding and irrigation will be determined by application of rangeland health monitoring standards.

Accomplishments to Date:

1. Applied pattern recognition technology to remotely sensed imagery to classify rangeland plant communities.

2. Identified soil/vegetation combinations that have a high level of uncertainty in the initial model runs and acquired soils for testing for use in calibrating the model.

3. Presented results of Phase I modeling exercise to state level conservation organizations for use in designing programs

Completed initial field tests of LIBS instrument as a lab and field based measurement technology.

Summarize Target Sink Storage Opportunities and Benefits to the Region:

We have identified specific soil/climate/management system combinations that have the greatest potential to sequester carbon across the region (converting cropland to perennial cover > adoption of reduced tillage > improved rangeland management) and the potential land area for each practice. Adopting these as a part of existing conservation programs can increase carbon storage and aid in achieving various environmental co-benefits across the region.

Cost:

Total Field Project Cost: $1,315,000

DOE Share: $1,050,000 80%

Non-Doe Share: $265, 000 20%

Field Project Key Dates: na

Baseline Completed: 1/2008

Drilling Operations Begin: N/A

Injection Operations Begin: N/A

MMV Events: 1/2006

Field Test Schedule and Milestones (Gantt Chart)

The riparian restoration (local terrestrial pilot) test will begin in July, 2007, in tandem with the combined enhanced coalbed methane.

	2006	2007	2008	2009
Task 1: Surface Carbon Measurements				
Subtask 5.1.1 Calibrate and test the newly developed Laser-Induced Breakdown Spectroscopy (LIBS) instrument along with portable Near Infrared Spectroscopy (NIRS) for soil carbon measurements				
Subtask 5.1.2 Determine near land surface patterns of soil carbon in a spatially extensive manner				
Subtask 5.1.3 Relate near land surface patterns of soil carbon to associated soil profiles, site inventories, and management practices				
Task 2 - Remote Sensing Classification Protocols				
Subtask 5.2.1 Using results of the spatial characterization of carbon at the selected study sites in Objective 1, determine remote sensing technology(ies) capable of providing appropriate scale and frequency of imagery that could be useful in assessing changes in carbon stocks				
Subtask 5.2.2 Integration of remote sensing data identified in Task 1 above into the state and transition models and regional inventory and decision support tool (Major Task 5, Task 4)				
Task 3 - Ecological Process Models				
Subtask 5.3.1 Develop State and Transition Models (STMs) for the range of soil/vegetation combinations represented by the carbon management practices and land uses in the selected study areas				
Sutbtask 5.3.2 Distribute STMs across appropriate soil units within region				
Subtask 5.3.3 Integrate the STMs into the regional inventory and decision support system.				
Task 4 - Regional Carbon Inventory				
Subtask 5.4.1 Build a web-based tool, with a GIS framework, that incorporates the soil, climate, and land use data gathered and processed in Phase I along with the soil carbon, state and transition, and remote sensing data gathered in the Phase II efforts				
Subtask 5.4.2 Establish a linkage to the COMET VR tool that will allow the data fields required by COMET VR to automatically filled based on the latitude/longitude, premise boundary, or regional input				
Subtask 5.4.3 Build a State and Transition Interface that will allow users to examine carbon sequestration under various management practices, government programs, or land uses				
Subtask 5.4.4 Design display tools for mapping, data visualization, and `reporting in a spatially coherent manner				
Subtask 5.4.5 Improve the COMET VR tool for assessing carbon sequestration at the individual field and farm scale for arid and semi-arid rangelands and croplands				
Subtask 5.4.6 Develop protocols for updating the system with new data (NASS, NRI) and options for carbon sequestration so that the system will current with relevant government programs and incentives				