Evaluating Greenhouse Gas emissions and Carbon sequestration from Rice production in Eastern Arkansas using COMET-Farm™

M. Stermer[1], Easter M.[1], Swan A.[1], Paustian K.[1], Brown K.[1], Toureene C.[1], Ziegler J.[1], Marx E.[1], Pietz A.[1], Velayudhan S.[1], Chambers A.[2], Baranski M..[3]

[1]Natural Resource Ecology Laboratory—Colorado State University, [2]USDA Natural Resources Conservation Service, [3]USDA Office of the Chief Scientist

Introduction to COMET-Farm

COMET-Farm is an integrated web-based decision support tool developed to aid farmers, agricultural producers, land managers and conservationists.

COMET-Farm provides total farm greenhouse gas (GHG) accounting and carbon sequestration occurring from these practices:

- Cropland, Pasture & Rangeland
- Livestock
- Agroforestry
- Energy usage
- Forestry

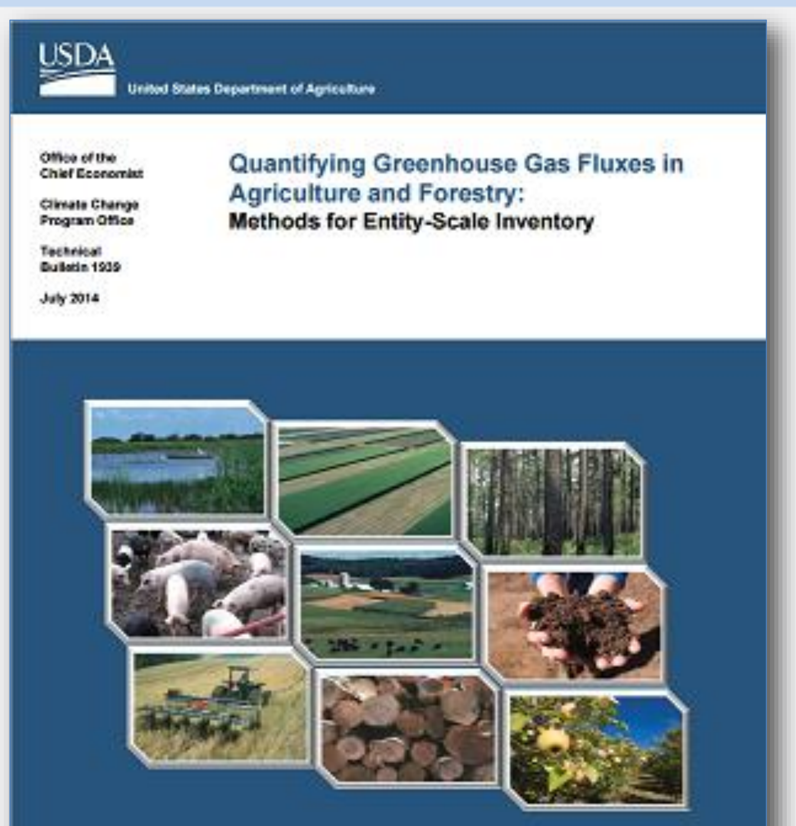
By generating reports from users' current and potential future management scenarios, COMET-Farm allows users to evaluate how conservation practices may reduce GHG emissions and sequester atmospheric CO_2.

Cropland, Pasture, Range

Photo courtesy of USDA Natural Resources Conservation Service

Agricultural soil management is the leading source of greenhouse gas emissions in the agricultural sector. Applying conservation practices can greatly reduce the amount of greenhouse gas released into the atmosphere and aid in building and storing soil carbon. COMET-Farm allows rapid assessment of conservation scenarios to aid in conservation planning.

Scientific Basis



COMET-Farm utilizes peer-reviewed greenhouse gas (GHG) inventory methods published by the USDA in *Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory* to assess the greenhouse gas balance of management at the field level.

Using COMET-Farm

Croplands Demo

This poster showcases the capabilities of the COMET-Farm Cropland, Pasture, Range module utilizing a typical rice-soybean rotation in Eastern Arkansas.

Baseline Scenario

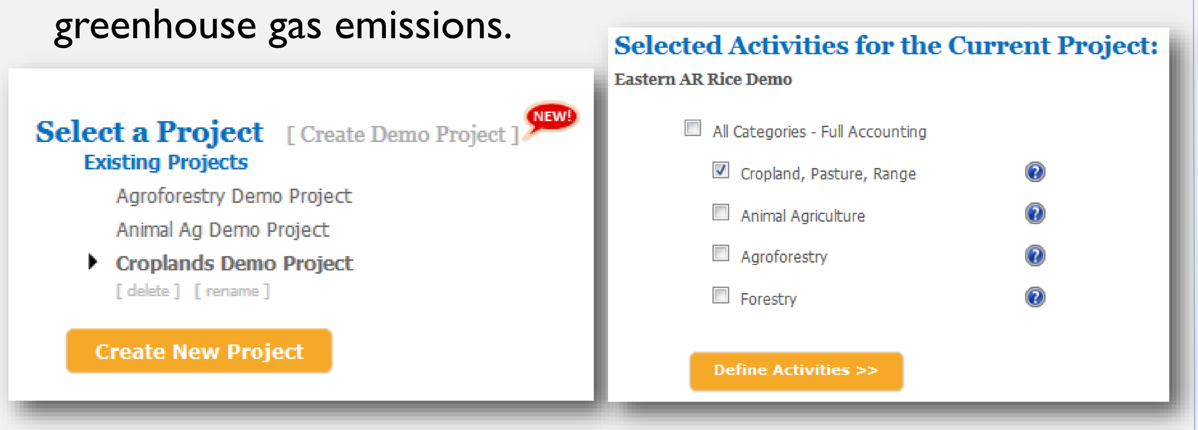
- Rice-Soybean rotation
- Rice is intensively tilled with the addition of 225 lbs. N/acre Urea prior to flooding, 100 lbs. N/acre Ammonium Sulfate pre-emergent, and 70 lbs. N/acre Urea at mid season. The field is flooded in the first part of June and levels are maintained through the growing season. The field is drained in early August. Crop residue is burned after harvest.
- Soybeans are intensively tilled and no nitrogen fertilizer is applied.
- For both crops, no manure, compost, or lime was applied.

Future (Conservation) Scenario:

- Two alternate wetting and drying (aeration) events during the growing season were implemented to reduce methane emissions.
- All other management practices remain the same.

Getting Started

Creating a cropland project in COMET-Farm is easy. Simply create and name your customized project and begin to define activities. Methods have been implemented to quantify emissions from a wide range of cropland categories. For the purpose of this poster we showcase how to model a typical rice-soybean rotation with conservation measures to reduce greenhouse gas emissions.

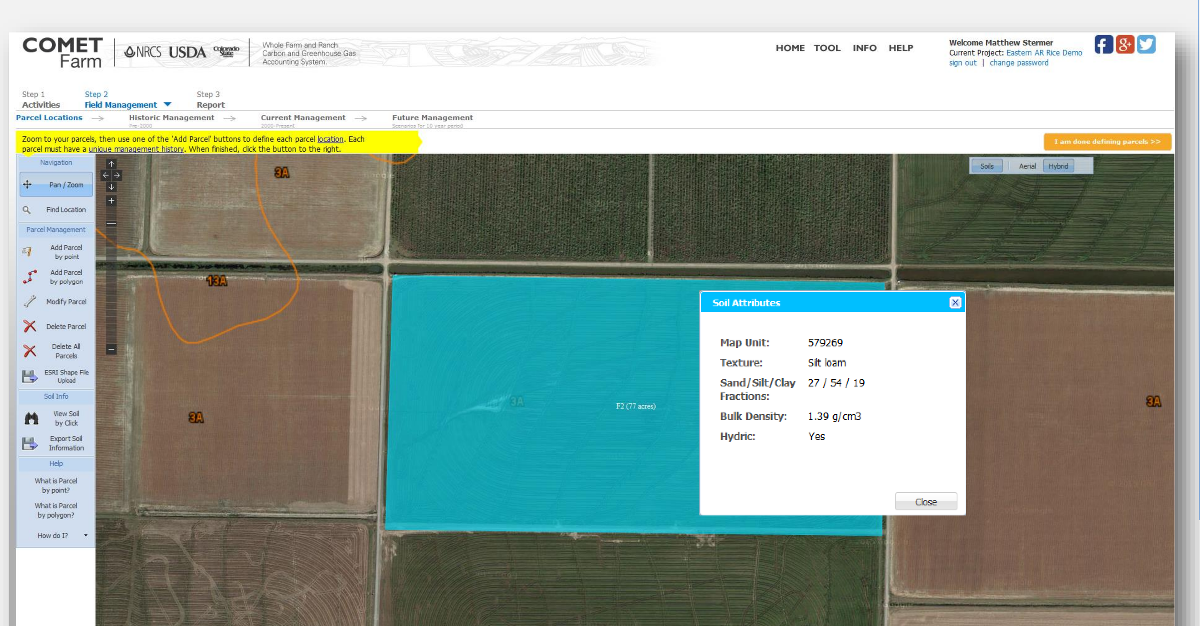


Parcel Location

COMET-Farm relies on site specific NARR climate and SSURGO soil data for the user-defined parcel.

Parcels can be defined by drawing a polygon around the field or selecting a point at the field center and entering the field acreage.

Parcels can also be uploaded using the ESRI Shape File upload feature.



Historic Management

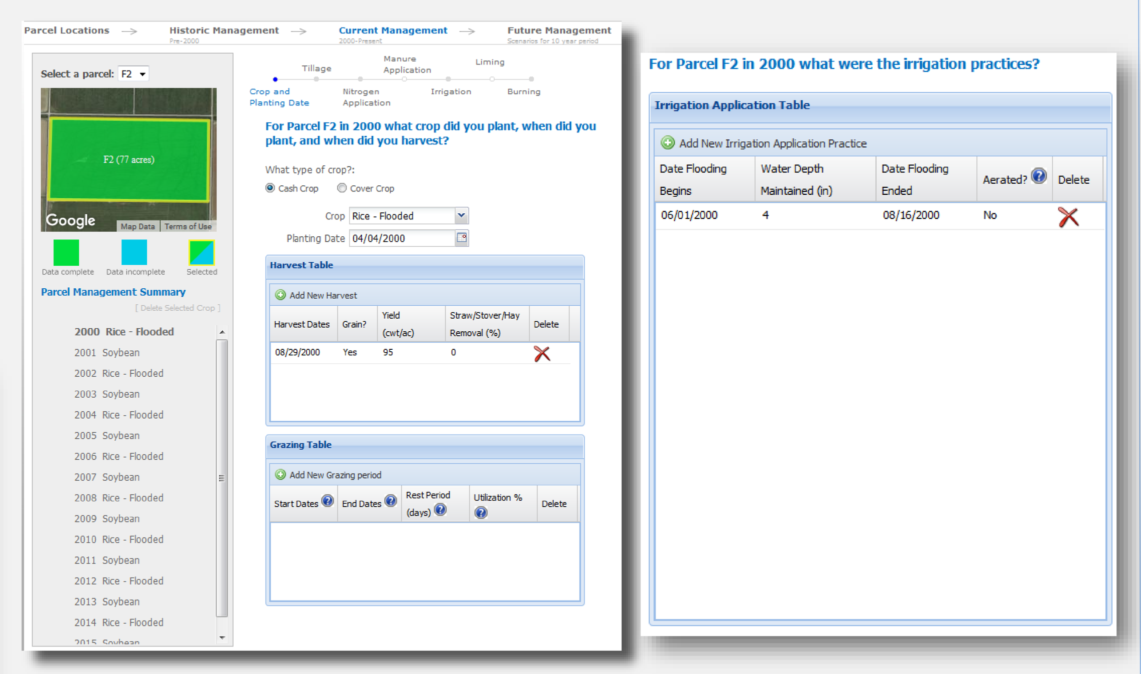
For the purpose of this demonstration we assumed the parcel was in a long-term non-irrigated, upland cropping system. Between 1980 and 2000, we assumed the system was an intensively tilled, non-irrigated corn-cotton rotation.

Historic management is necessary for the tool to accurately estimate carbon stocks and carbon stock changes.

Current Management

For the purpose of this demonstration we assumed the parcel was in a rice-soybean rotation:

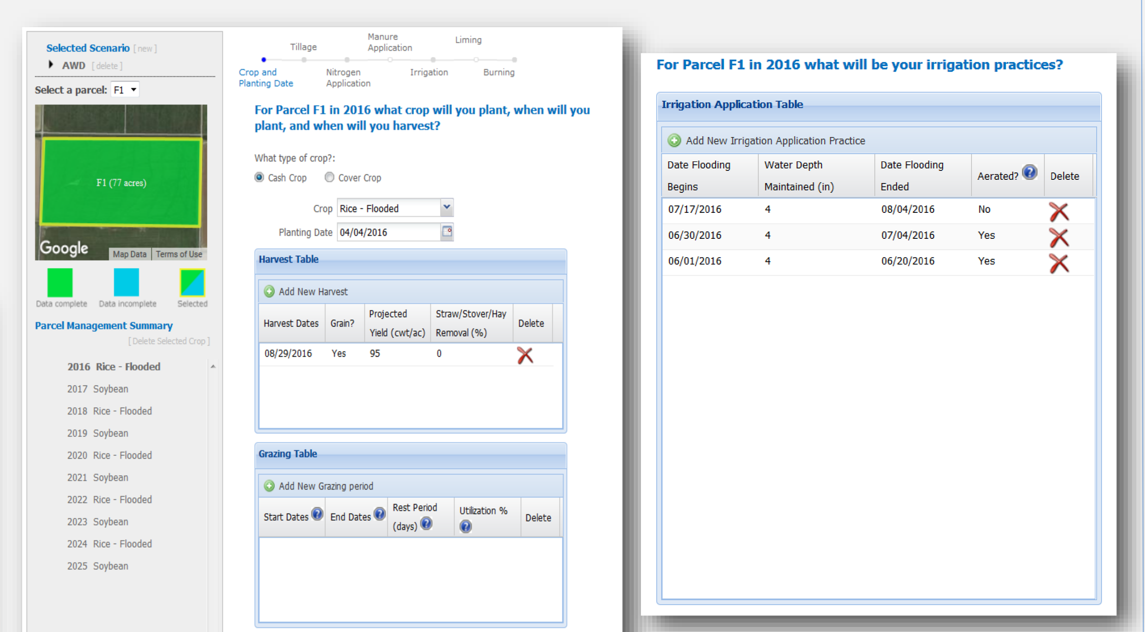
- Rice was intensively tilled with three Nitrogen application and flood was maintained through out the season. Residue was burned after the harvest.
- Soybeans were grown on a intensively tilled system.
- No manure or compost was applied.



Future Management

The hypothetical future scenario developed for the demo depicts implementing water management for flooded rice, which is alternating wetting and drying during the growing season.

All other management practices remained the same.

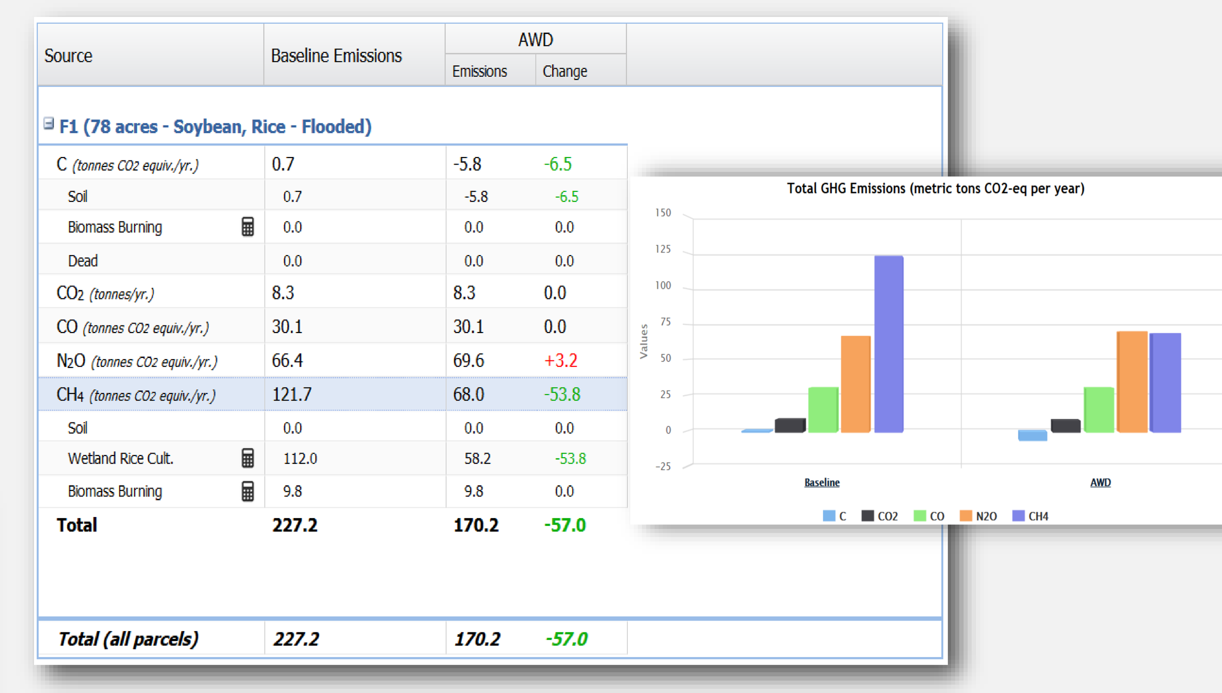


Scenarios

COMET-Farm allows users to automatically copy the crops and management from the Current Management (or any future management scenario) to a new future management scenario, to use as the basis for a management change (such as changing only tillage, or changing only fertilizer management, etc.). Any management practices that have been defined in current management can be changed in the future scenario. Scenarios provide users a "what if" option to see how adopting conservation practices can increase soil carbon and reduce greenhouse gas emissions on their enterprise.

Report

Using the DayCent simulation model in conjunction with the methods in the USDA methods document (*Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry)* COMET-Farm calculates potential changes in GHG emissions and carbon storage. Results are provided in easy to read, tabular and interactive graphical reports.



Source	Baseline Emissions	AWD	
		Emissions	Change
F1 (78 acres - Soybean, Rice - Flooded)			
C *(tonnes CO2 equiv./yr.)*	0.7	-5.8	-6.5
Soil	0.7	-5.8	-6.5
Biomass Burning	0.0	0.0	0.0
Dead	0.0	0.0	0.0
CO2 *(tonnes/yr.)*	8.3	8.3	0.0
CO *(tonnes CO2 equiv./yr.)*	30.1	30.1	0.0
N2O *(tonnes CO2 equiv./yr.)*	66.4	69.6	+3.2
CH4 *(tonnes CO2 equiv./yr.)*	121.7	68.0	-53.8
Soil	0.0	0.0	0.0
Wetland Rice Cult.	112.0	58.2	-53.8
Biomass Burning	9.8	9.8	0.0
Total	**227.2**	**170.2**	**-57.0**
Total (all parcels)	***227.2***	***170.2***	***-57.0***

The detailed tabular report allows users to explore each GHG source category in detail. The interactive graphical report allows users to click an emission category and see a detailed breakdown of the GHG emissions.

In this example, implementing alternating wetting and drying on the 78 acre field resulted in an estimated 5.8 metric tonnes CO_2-eq of carbon sequestration and reduced methane emissions by 53.8 tonnes CO_2-eq per year.

The change caused a small increase of 3.2 metric tonnes CO_2-eq in nitrous oxide emissions, yet the overall GHG reduction is 57.0 tonnes CO_2-eq/yr.

Conclusion

COMET-Farm estimates the 'carbon footprint' for all or part of the producers farm/ranch operation and allows users to evaluate options for reducing GHG emissions and maximizing carbon sequestration. Users are able to create up to ten future conservation scenarios with varying conservation practices to compare GHG mitigation strategies. COMET-Farm is a powerful tool designed to help agricultural producers make on-farm decisions to reduce energy costs, reduce GHG emissions and build soil health.

Acknowledgements

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Contact us at: www.comet-farm.com @CometFarm facebook.com/COMETFarmTool appnrel@colostate.edu