



Farm-level full GHG accounting with COMET-Farm

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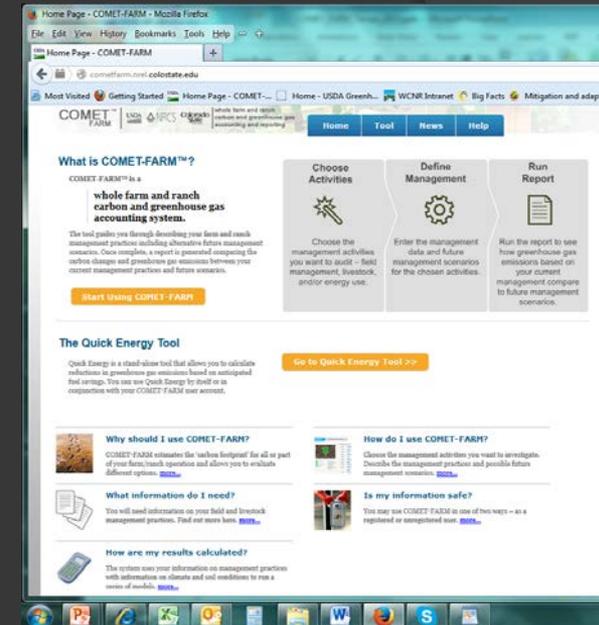
GHGs are becoming increasingly important for environmental BMPs – presenting a difficult challenge

- CA regs, voluntary offset markets, metrics for USDA programs, int'l efforts
- Like water quality & erosion, GHGs emissions/sinks are dispersed, non-point source & difficult to measure
- Direct measurement requires specialized equipment and training; too expensive for deployment in most mitigation projects.
- Model-based system provide the best alternative, but they need to incorporate local-scale variability in biophysical conditions and **field-specific practices**



Aim of COMET-Farm

- Provide a means for non-GHG specialists (farmers, consultants, NRCS field staff, etc.) to easily estimate farm-scale GHG emissions and to explore alternative management and land use strategies.
- Employ state-of-the-art methods/models based on USDA Guidelines and consistent with US national GHG inventory
- Further development of previous COMET-VR and COMET2.0 tools.
- Free access on the internet

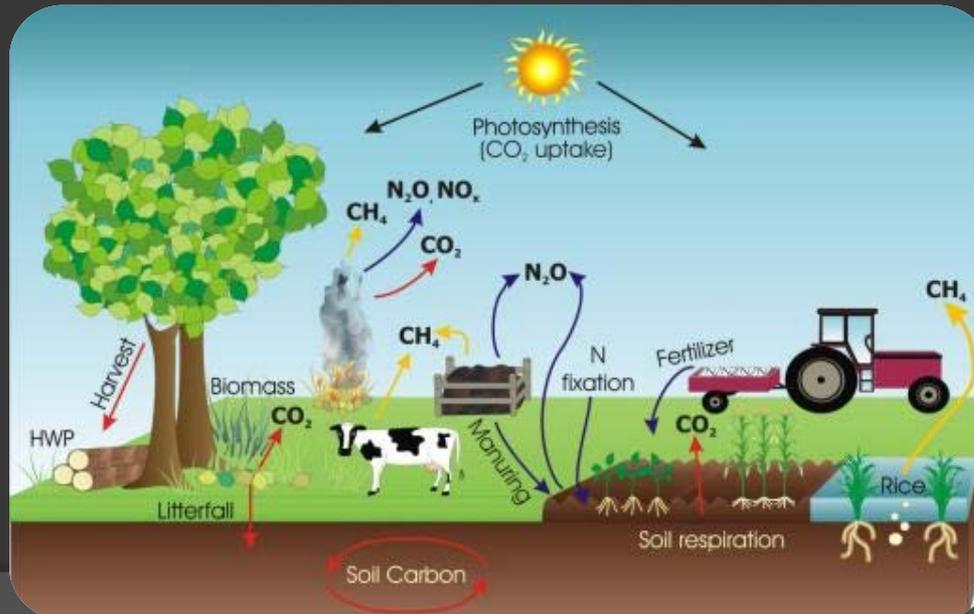


<http://cometfarm.colostate.edu/>

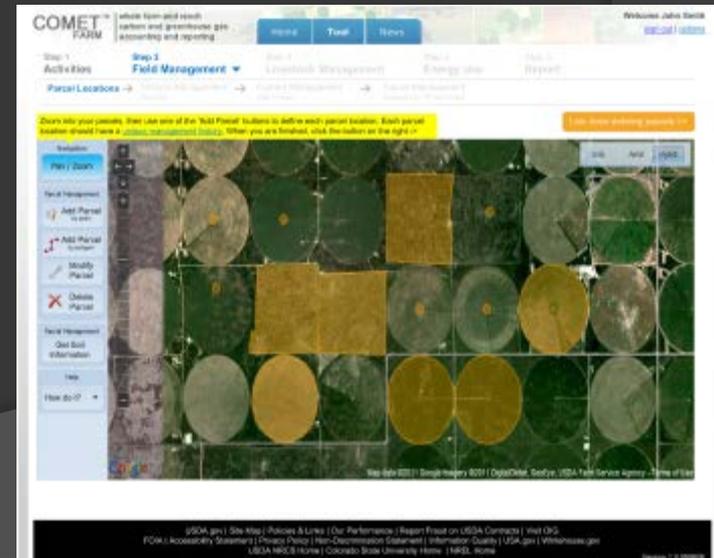
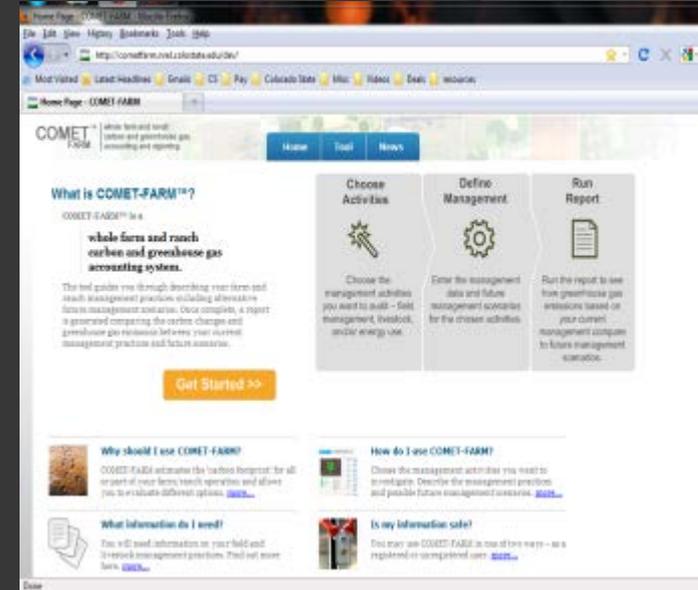
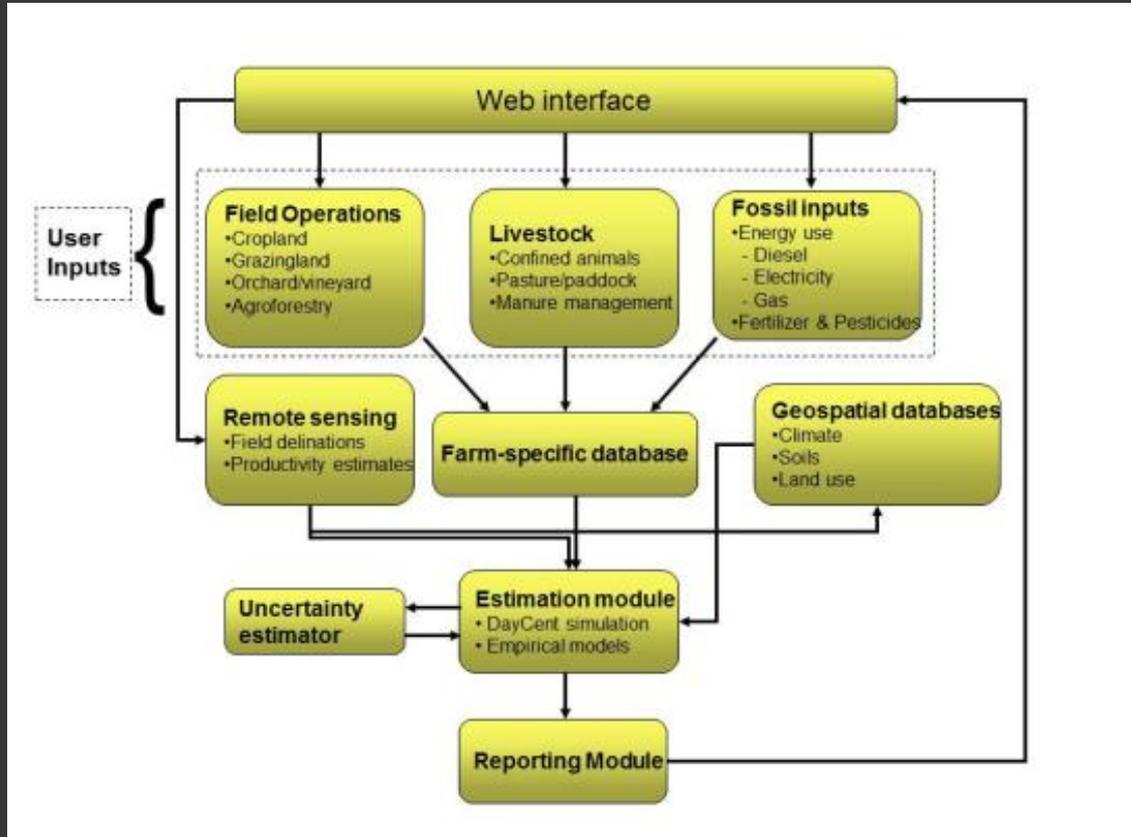
COMET-Farm

Scope and key features

- Full farm-level greenhouse gas accounting
 - Soil and biomass C stock changes
 - Soil N_2O and CH_4 emissions
 - Livestock – enteric CH_4 and manure CH_4 and N_2O
 - Energy – Fossil C emissions; on-farm renewables
 - Other emissions – burning, liming, ...



COMET-Farm system for farm-level GHG accounting



GHG estimation methods are based on the USDA 'Entity-scale' Inventory Guidelines released in July 2014



Office of the Chief Economist

Climate Change Program Office

Technical Bulletin 1539

July 2014

Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory



Current status of 'methods merge'

Completed	Underway	Planned	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Livestock Emissions
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Cropland Soils
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Agroforestry
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Energy
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Rice Methane
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Grazing Land Soils
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Biomass Burning
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Liming

Quick Demo Film

The screenshot shows a web browser window displaying the COMET-FARM website. The browser's address bar shows the URL cometfarm.nrel.colostate.edu. The website header includes the COMET-FARM logo, navigation links (Home, Tool, News, Help), and a sign-in/register link. The main content area is titled "What is COMET-FARM™?" and describes it as a "whole farm and ranch carbon and greenhouse gas accounting system." It features three main steps: "Choose Activities," "Define Management," and "Run Report." A "Quick Energy Tool" section is also visible. A video player overlay is centered on the page, titled "Welcome to COMET-Farm™". The video player shows a scene of a farm with people and the text "COMET FARM" and "www.comet-farm.com". Below the video player, there is a "Close" button. The website footer contains a FOIA notice, navigation links for USDA NRCS, Colorado State University, and NREL, and a version number "v 1.4.5326-14842 (01-Aug-2014)". The Windows taskbar at the bottom shows the time as 9:40 PM on 12/4/2014.

Home Page - COMET-FARM x +

cometfarm.nrel.colostate.edu

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COMET-FARM

Home Tool News Help

(Sign in or Register)

What is COMET-FARM™?

COMET-FARM™ is a whole farm and ranch carbon and greenhouse gas accounting system.

The tool guides you through describing your farm and ranch management practices including alternative future management scenarios. Once complete, a report is generated comparing the carbon changes and greenhouse gas emissions between your current management practices and future scenarios.

[Start Using COMET-FARM](#)

Choose Activities

Choose the management activities you want to audit – field management, livestock, and/or energy use.

Define Management

Enter the management data and future management scenarios for the chosen activities.

Run Report

Run how emissions and management scenarios to future.

The Quick Energy Tool

Quick Energy is a stand-alone tool that allows you to calculate reductions in greenhouse gas emissions based on anticipated fuel savings. You can use Quick Energy by itself or in conjunction with your COMET-FARM user account.

[Go to Quick Energy Tool >>](#)

Why should I use COMET-FARM?

COMET-FARM estimates the "carbon footprint" for all or part of your farm, ranch operation and allows you to evaluate different options. [more...](#)

What information do I need?

You will need information on your field and livestock management practices. Find out more here. [more...](#)

How are my results calculated?

The system uses your information on management practices with information on climate and soil conditions to run a series of models. [more...](#)

How do I use COMET-FARM?

Choose the management activities you want to inventory. Describe the management practices and possible future management scenarios. [more...](#)

Is my information safe?

You may use COMET-FARM in one of two ways – as a registered or unregistered user. [more...](#)

Comet overview video

Click [show me](#) to view the Comet introductory video.

Welcome to COMET-Farm™

Greetings,

The COMET-Farm™ tool enables farmers and ranchers to estimate carbon sequestration and greenhouse gas emissions related to annual crop production, livestock and on-farm energy use. It provides a convenient yet rigorous way to evaluate the benefits of various conservation practices in reducing greenhouse gas emissions. The short video below gives an introduction to the COMET-Farm™ tool.

COMET-Farm™ strives to continually meet the needs of our audience. Future versions, to be released later this year, will include enhanced user inputs as well as pasture and range management options, agroforestry, and orchard and vineyard crops.

Regards,
The COMET-FARM™ Team

[Close](#)

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v 1.4.5326-14842 (01-Aug-2014)

9:40 PM
12/4/2014

COMET Quick Energy Tool

User inputs

Home Page - COMET-FARM x COMET-Energy - COMET-F... x

cometfarm.nrel.colostate.edu/QuickEnergy

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COMET FARM USDA NRCR Colorado State whole farm and ranch carbon and greenhouse gas accounting and reporting Home Tool News Help

What are the annual emissions reductions associated with your annual fuel savings?

In what zip code is your operation located? In what units do you want your emissions reported? PROJECT NAME:

	Enter Annual Fuel Savings	Greenhouse Gas Emissions (lbs.)					Air Pollutants (lbs.)	
		MMBtu	CO ₂ ¹	N ₂ O	CH ₄	Total CO ₂ -Equivalent	SO ₂	NO _x
Liquid								
No. 2 Diesel	<input type="text" value="200"/> gal	27.80	4,475.38	0.10	0.56	4,517.12	0.06	3.60
Gasoline	<input type="text" value=""/> gal	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Biodiesel B2	<input type="text" value=""/> gal	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SVO	<input type="text" value=""/> gal	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas								
Propane	<input type="text" value="500"/> gal	45.80	6,327.25	0.20	1.00	6,410.25	0.05	5.00
Natural Gas	<input type="text" value=""/> CCF	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	<input type="text" value=""/> CCF	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Electricity								
Electricity ²	<input type="text" value="1000"/> kWh	3.41	1,896.74	0.03	0.02	1,906.27	1.87	2.42
Total		77.01	12,699.37	0.33	1.58	12,833.64	1.98	11.02

¹ Totals in this column include CO₂ emissions from petroleum-based fuels only.
² Emissions from electricity are based on the zip code entered above.

Summary Your annual greenhouse gas emissions were reduced by an estimated **12,833.64 pounds CO₂-Equivalent / year** (5.82 tonnes / year). Of these emissions, fossil fuels accounted for 12,833.64 pounds CO₂-Equivalent / year (5.82 tonnes / year) and biogenic-origin fuels accounted for 0.00 pounds CO₂-Equivalent / year (0.00 tonnes / year).

Your estimated annual energy savings is **77.01 MMBtu per year**.

If you would like to perform a full assessment of the operation's carbon footprint, that task can be performed in COMET-FARM™.

[Go to COMET-FARM™ >>](#)

Windows taskbar icons: Internet Explorer, File Explorer, VLC, Outlook, PowerPoint, Excel, Word, Adobe Reader, Skype, Firefox

'COMET-Planner'

Screening tool to provide a quick 'Tier 1' estimate of potential GHG reductions with implementation of NRCS Conservation Practices

- Provides empirical-based estimates for broad climate regions
- Intended as a complement to, and 'easy entry' to full COMET-Farm Tool

http://comet-planner.nrel.colostate.edu/

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COMET-PLANNER NRCS USDA Colorado State University
Carbon and greenhouse gas evaluation for NRCS conservation practice planning

This tool was developed with the generous support of the Retenbach Family Foundation

Evaluate potential carbon sequestration and greenhouse gas reductions from adopting NRCS conservation practices [Print page](#)

PROJECT NAME: Test2

State: IA

County: Hamilton

NRCS Conservation Practices - Select Your Practice(s)

Name
Grassed Waterway (CP412)
- Cropland to Woody Cover (7 Items)
Tree/Shrub Establishment - Farm Woodlot (CP612)
Windbreak/Shelterbelt Establishment (CP380)
Windbreak/Shelterbelt Renovation (CP650)
Riparian Forest Buffer (CP391)

Approximate Carbon Sequestration and Greenhouse Gas Emission Reductions¹
(tonnes CO₂ equivalent per year)

NRCS Conservation Practices	Enter Acreage	CO ₂	N ₂ O	CH ₄	Total CO ₂ -Equivalent
Tree/Shrub Establishment - Farm Woodlot (CP612) <small>[delete]</small>	40 ac	81.94	11.34	N.E. ²	93.28
Grassed Waterway (CP412) <small>[delete]</small>	10 ac	9.84	2.83	N.E. ²	12.67
Total		91.78	14.17	0.00	105.95

¹Negative values indicate a loss of carbon or increased emissions of greenhouse gases
²Values for this category were not estimated due to limited data on reductions of greenhouse gas emissions from this practice

How are your carbon sequestration and greenhouse gas

Carbon Sequestration and Greenhouse Gas Emission Reductions for NRCS Conservation Practices

Emission reduction coefficients were derived from recent meta-analyses and reviews. Coefficients were generalized at the national-scale and differentiated by dry and humid climate zones. Ranges for emission coefficients generally represent minimum and maximum values reported in meta-analyses and reviews. When ranges were not given, minimum and maximum values were calculated as +/- 100% of the emission coefficient. Emission coefficients, ranges, a short explanation estimation methods, and primary sources are presented in the following tables.

CROPLAND MANAGEMENT						
Practice	Climate zone*	Carbon Average (Range)	Nitrous Oxide Average (Range)	Methane Average (Range)	Explanation and Notes	Primary Sources
		Mg CO ₂ eq ha ⁻¹ y ⁻¹				
Conventional Tillage to No Till	Dry/semiarid	0.56 (0.04-1.34)	0.32 (0.14-0.50)	Not estimated	Carbon estimates represent averages of soil carbon change from recent reviews. The highest values for soil carbon were in corn systems with means of 1.03 and 1.48 Mg CO ₂ eq ha ⁻¹ y ⁻¹ in dry and humid climates respectively. Estimates for nitrous oxide emissions represent the effects of changing tillage only and assume N fertilizer rates do not change (Swan et al.).	Eagle et al. 2012, ICF International 2013, Ogle et al. 2010, Swan et al. (in prep)
	Moist/humid	1.03 (0.32-1.90)	-0.28 (-0.20- -0.39)	Not estimated		
Conventional Tillage to Reduced Till	Dry/semiarid	0.25 (0.1-0.47)	0.18 (0.0 - 0.36)	Not estimated	Carbon estimates represent averages of soil carbon change from recent reviews. Highest values for soil carbon were in corn systems with means of 1.03 and 1.48 Mg CO ₂ eq ha ⁻¹ y ⁻¹ in dry and humid climates respectively. Estimates for nitrous oxide emissions represent the effects of changing tillage only and assume N fertilizer rates do not change (Swan et al.).	
	Moist/humid	0.32 (0.05-0.54)	0.18 (0.0 - 0.36)	Not estimated		

Cropland to Herbaceous Cover						
Practice	Climate zone*	Carbon Average (Range)	Nitrous Oxide Average (Range)	Methane Average (Range)	Explanation and Notes	Primary Sources
		Mg CO ₂ eq ha ⁻¹ y ⁻¹				
Conservation Cover (Retiring Marginal Soils and Establishing Permanent Grass Cover)	Dry/semiarid	2.59 (1.69 - 3.45)	0.20 (0.0 - 0.37)	Not estimated	Soil carbon estimates are based on studies of cropland converted to grassland in the U.S. (Ogle et al. 2010). Nitrous oxide estimates are based on weighted average fertilizer rates for major crops (USDA-ERS 2014) and emissions factors from Ogle et al. 2010 for direct and indirect emissions, and the assumption that herbaceous cover is unfertilized. Range for nitrous oxide is based on range of average fertilizer rates reported in ARMS (USDA-ERS 2014).	Ogle et al. 2010, USDA-ERS 2014
	Moist/humid	2.43 (1.58 - 3.30)	0.70 (0.0 - 1.24)	Not estimated		
Forage and Biomass Plantings - Full Conversion	Dry/semiarid	0.67 (-0.86 - 2.00)	0.24 (0.0 - 0.48)	Not estimated	T-AGG (Eagle et al. 2012) analysis of impacts on soil organic carbon literature data for North America. Reduction in nitrous oxide is based on assumptions of lower N fertilizer and/or introduction of legume forages. Nitrous oxide ranges are +/- 100% of value reported.	Eagle et al. 2012
	Moist/humid	0.67 (-0.86 - 2.00)	0.24 (0.0 - 0.48)	Not estimated		
Forage and Biomass Plantings - Partial Conversion	Dry/semiarid	0.52 (-0.01 - 1.20)	0.03 (0.0 - 0.06)	Not estimated	T-AGG (Eagle et al. 2012) analysis of impacts on soil organic carbon literature data for North America. Reduction in nitrous oxide is based on assumptions of lower N fertilizer and/or introduction of legume forages. Nitrous oxide ranges are +/- 100% of value reported.	Eagle et al. 2012
	Moist/humid	0.52 (-0.01 - 1.20)	0.03 (0.0 - 0.06)	Not estimated		
Herbaceous Wind Barriers	Dry/semiarid	2.59 (1.69 - 3.45)	0.20 (0.0 - 0.37)	Not estimated	Soil carbon estimates are based on studies of cropland converted to grassland in the U.S. (Ogle et al. 2010). Nitrous oxide estimates are based on weighted average fertilizer rates for major crops (USDA-ERS 2014) and emissions factors from Ogle et al. (2010) for direct and indirect emissions, and the assumption that herbaceous cover is unfertilized. Range for nitrous oxide is based on range of average fertilizer rates reported in ARMS (USDA-ERS 2014).	Ogle et al. 2010, USDA-ERS 2014
	Moist/humid	2.43 (1.58 - 3.30)	0.70 (0.0 - 1.24)	Not estimated		

Other COMET-related developments

- Collaboration with CIG projects on GHG mitigation – included ‘off-ramp’ from COMET-Farm for users of DNDC-model based protocols
- Integration with NRCS LMOD database – option for user to select predefined management scenarios, by crop mgmt zones, as rapid entry point to full COMET-Farm system
- ‘COMET-Mondial’ - Collaboration with International scientists through a FACCE-JPI grant (joint funding from EU, Brazil and Australia, US sources) to extend COMET-Farm platform to other countries
- Discussions with Field-to-Market, Fertilizer Institute and International Plant Nutrition Institute on potential system integration for soil GHG emission estimation



Visit COMET-Farm at:
<http://cometfarm.nrel.colostate.edu>

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