Methods and Tools for Quantifying Farm-Scale Greenhouse Gas Fluxes

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

Acknowledgements

- Project partner: ICF International, Diana Pape and team.
- Lead Authors: Stephen Ogle (CSU); Wendy Powers (MSU); Coeli Hoover (FS)
- Numerous authors, experts, contributors and reviewers.
- Tool Building: Colorado State University; U.S. Forest Service; NRCS

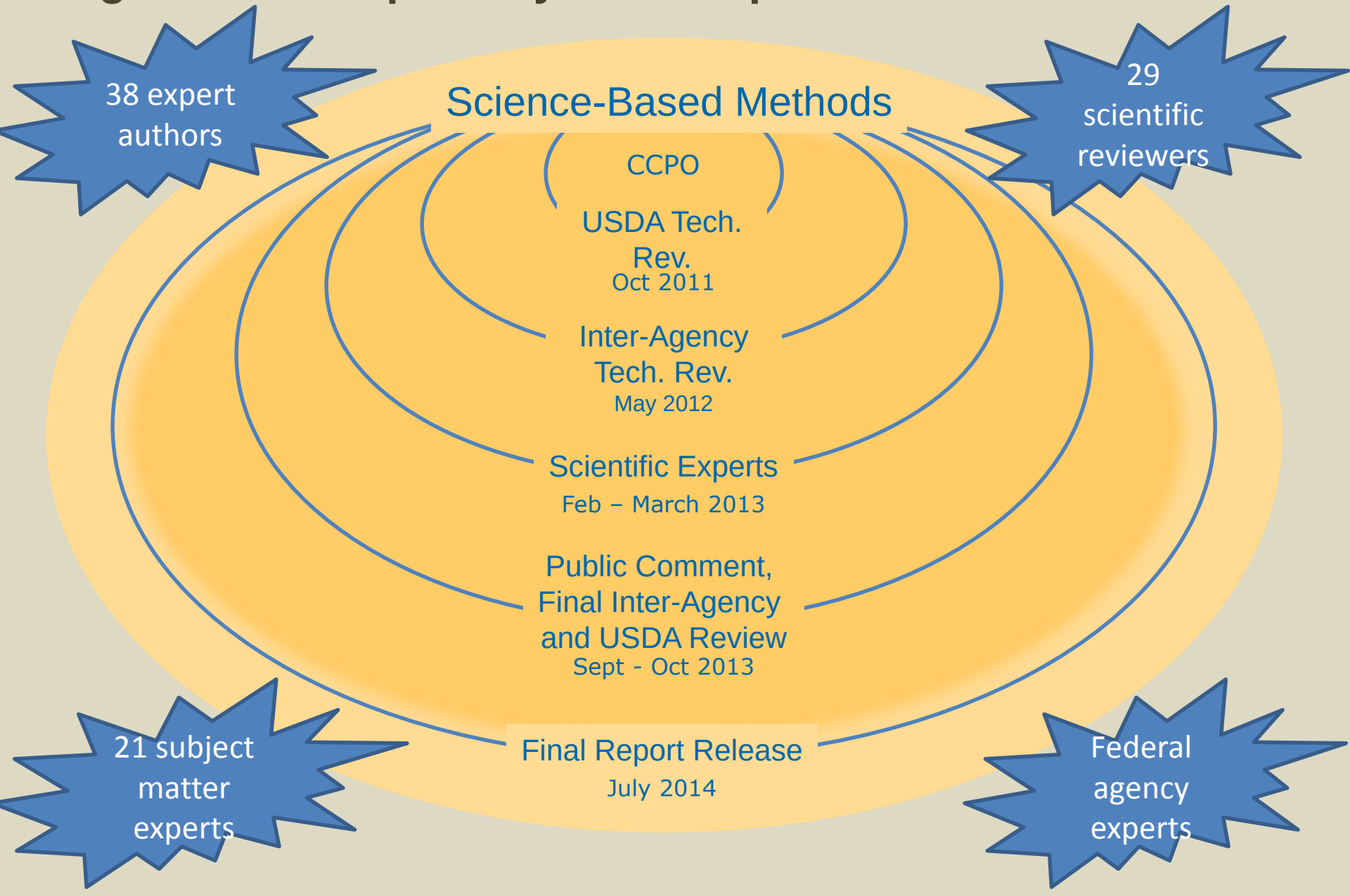
Quantifying Greenhouse Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory

Goal: To create a standard set of GHG quantification methods and tools for landowners, USDA, and other stakeholders.

- Phase 1: Report outlining comprehensive science-based methods for entity-scale GHG estimation.
- Phase 2: Develop a user-friendly tool that follows the methods report to provide land owners and managers with reliable and understandable estimates of GHG emissions and C sequestration.

1. ***Transparency***
2. ***Consistency***
3. ***Comparability***
4. ***Completeness***
5. ***Accuracy***
6. ***Cost effectiveness***
7. ***Ease of use***

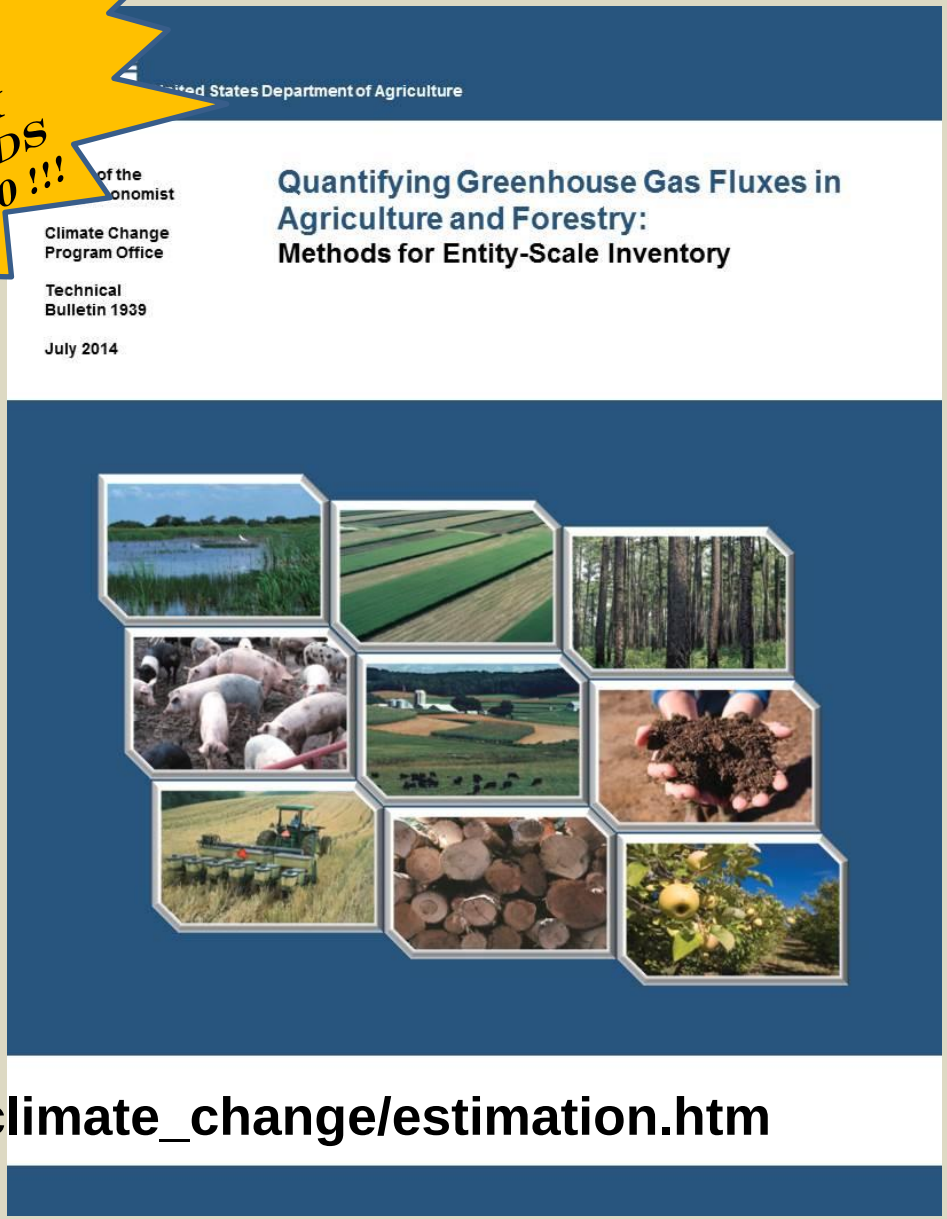
CHALLENGE: Vetting the methods. Establishing the rigor and transparency of the report.



REPORT LAYOUT AND CONTENT

RELEASED JULY 31; OVER 570K DOWNLOADS BY SEPT 30 !!!

- Executive Summary
- Introduction
- Considerations
- Crop and Grazing Lands
- Wetlands
- Animal Systems
- Forest lands
- Land Use Change
- Uncertainty Assessment



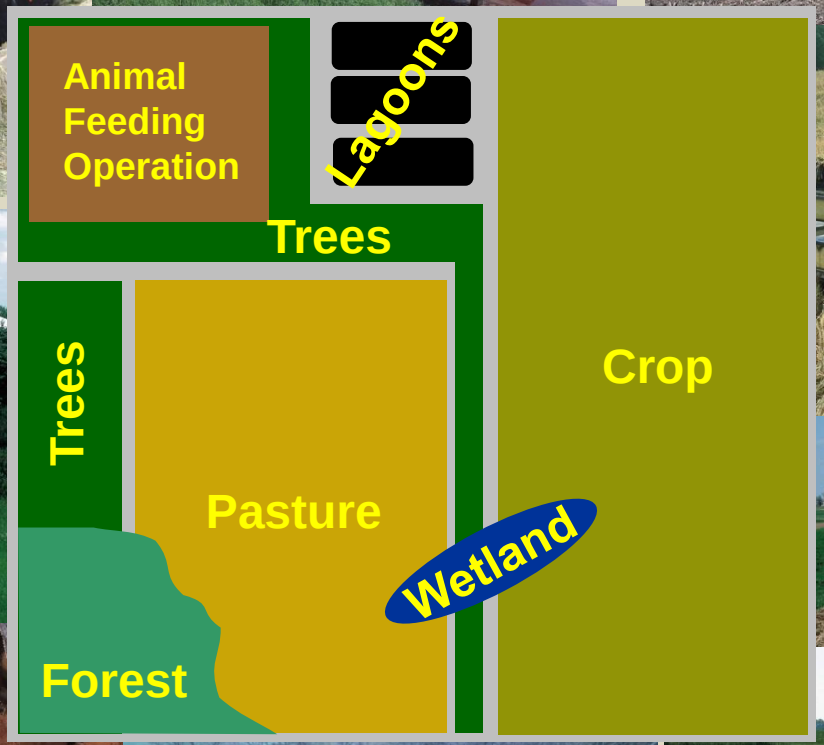
http://www.usda.gov/oce/climate_change/estimation.htm

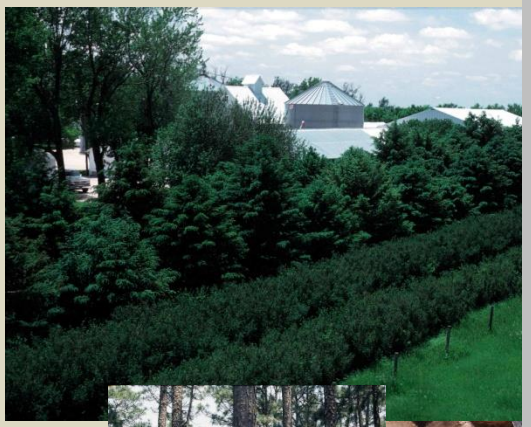
THE USDA GHG METHODS

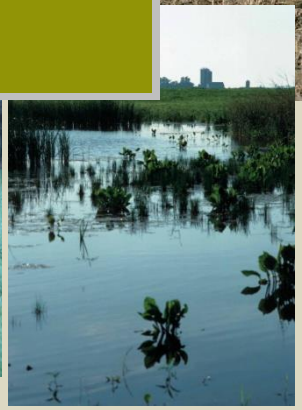
The Methods Report is designed to be:

- A scientifically vetted means for USDA to provide local-scale, standardized and transparent estimation of GHG fluxes
- Consistent with the USDA and EPA national GHG inventories
- Aligned with NRCS's COMET Farm and other USDA GHG tools.
- Coordinated with water quality or other tools to assess environmental services benefits

The entity - combining a landowner's crop, livestock and forestry activities into one seamless GHG estimate.







Cropland

- Fertilizer management
- Tillage management
- Crop rotations
- Cover cropping
- Water or residue mgmt in cultivated rice
- Drainage
- Irrigation
- Biomass burning

Grazing Land

- Fertilizer management
- Grazing management
- Species enhancement
- Drainage
- Irrigation
- Prescribed burning

Livestock

- Animal housing
- Feeds and additives
- Feeding management
- Manure collection and storage
- Composting
- Land application of manure

Forestry

- Thinning and harvest
- Fertilizer management
- Species management
- Irrigation
- Biomass burning
- Planting/re-establishing
- Clearing and/or land conversion

Agroforestry

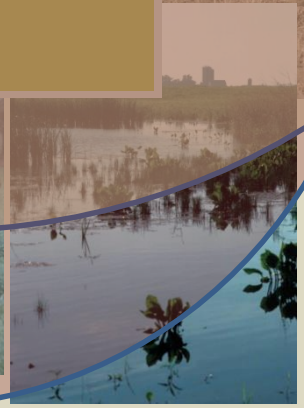
- Windbreaks
- Alley cropping
- Silvopasture
- Riparian forest buffers
- Forest farming
- Species selection/mgmt
- Cropping system/mgmt

Managed Wetlands

- Species mix
- Biomass management
- Water management

USDA Scientifically Vetted and Transparent Entity-Scale GHG Methods

ARS Tools like DairyGEM, the work of Rotz and others



Animal Feeding Operation

Lagoons

Trees

Other equations, emission factors, or new hybrid approaches.

Crop

Trees

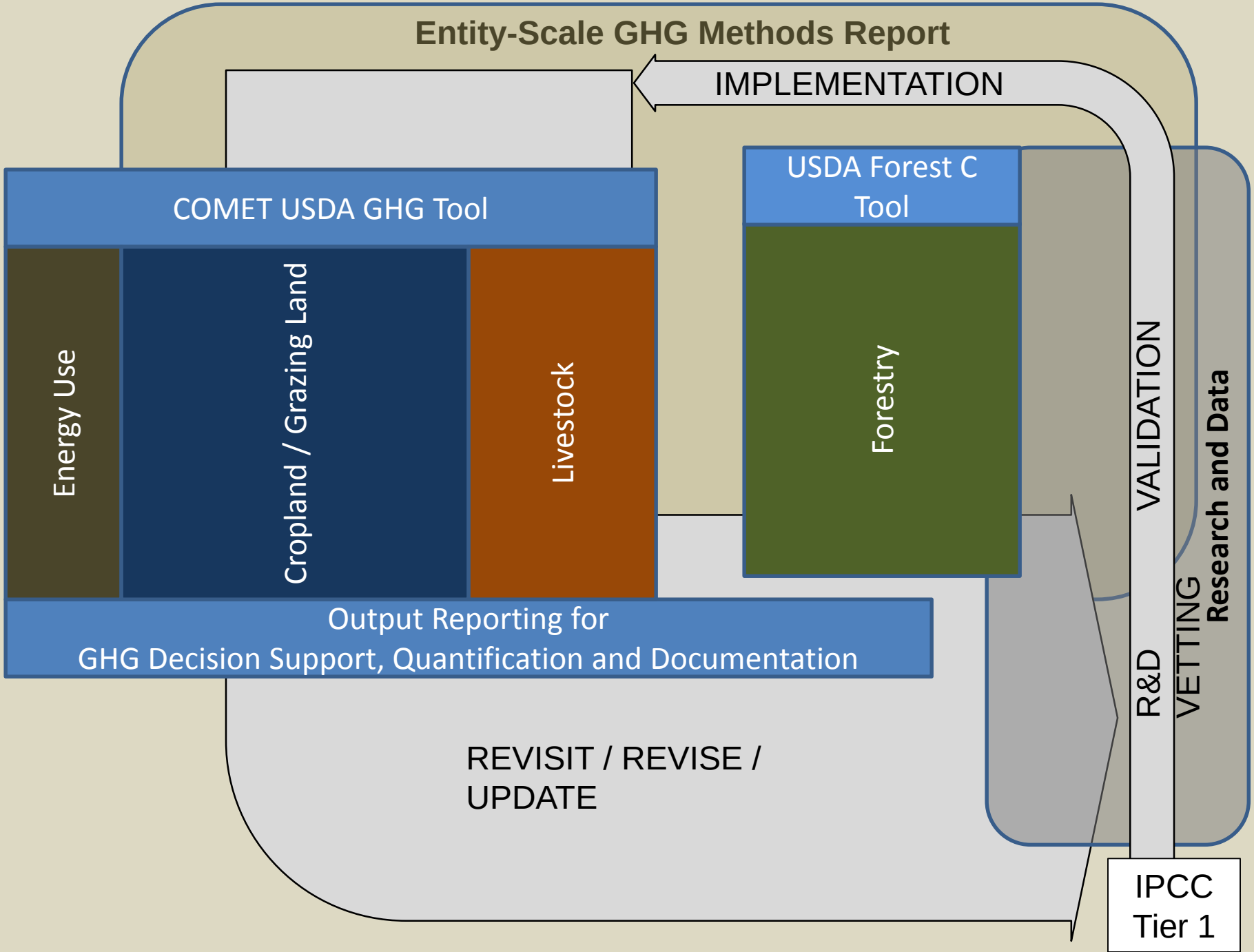
Pasture

Wetland

Forest

USFS Tools like FVS, FOFEM, and iTree

NRCS Tools like COMET and Daycent


Entity-Scale GHG Methods Report
IMPLEMENTATION
COMET USDA GHG Tool
Energy Use
Cropland / Grazing Land
Livestock
USDA Forest C Tool
Forestry
Output Reporting for
GHG Decision Support, Quantification and Documentation
VALIDATION
R&D
VETTING
Research and Data
REVISIT / REVISE / UPDATE
IPCC Tier 1

Integrating the methods into COMET-Farm . . .

Activities | Management | Report

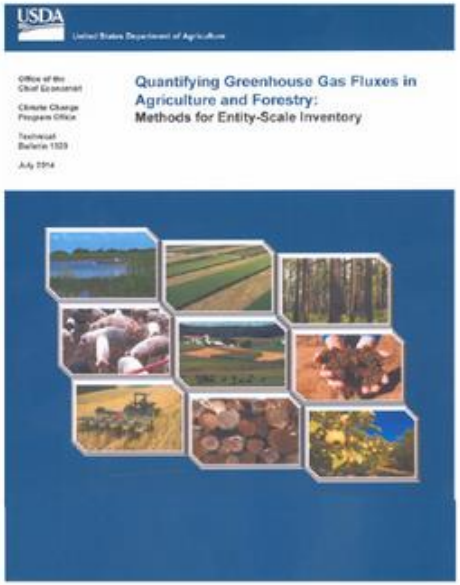
Welcome to COMET-Farm™

Integration of new USDA GHG methods into Comet-Farm!

The newly released USDA entity-scale GHG inventory methods are being integrated into the COMET-Farm tool. An initial release of an updated COMET-Farm with new methods for several emission categories is scheduled for Oct. 2014.

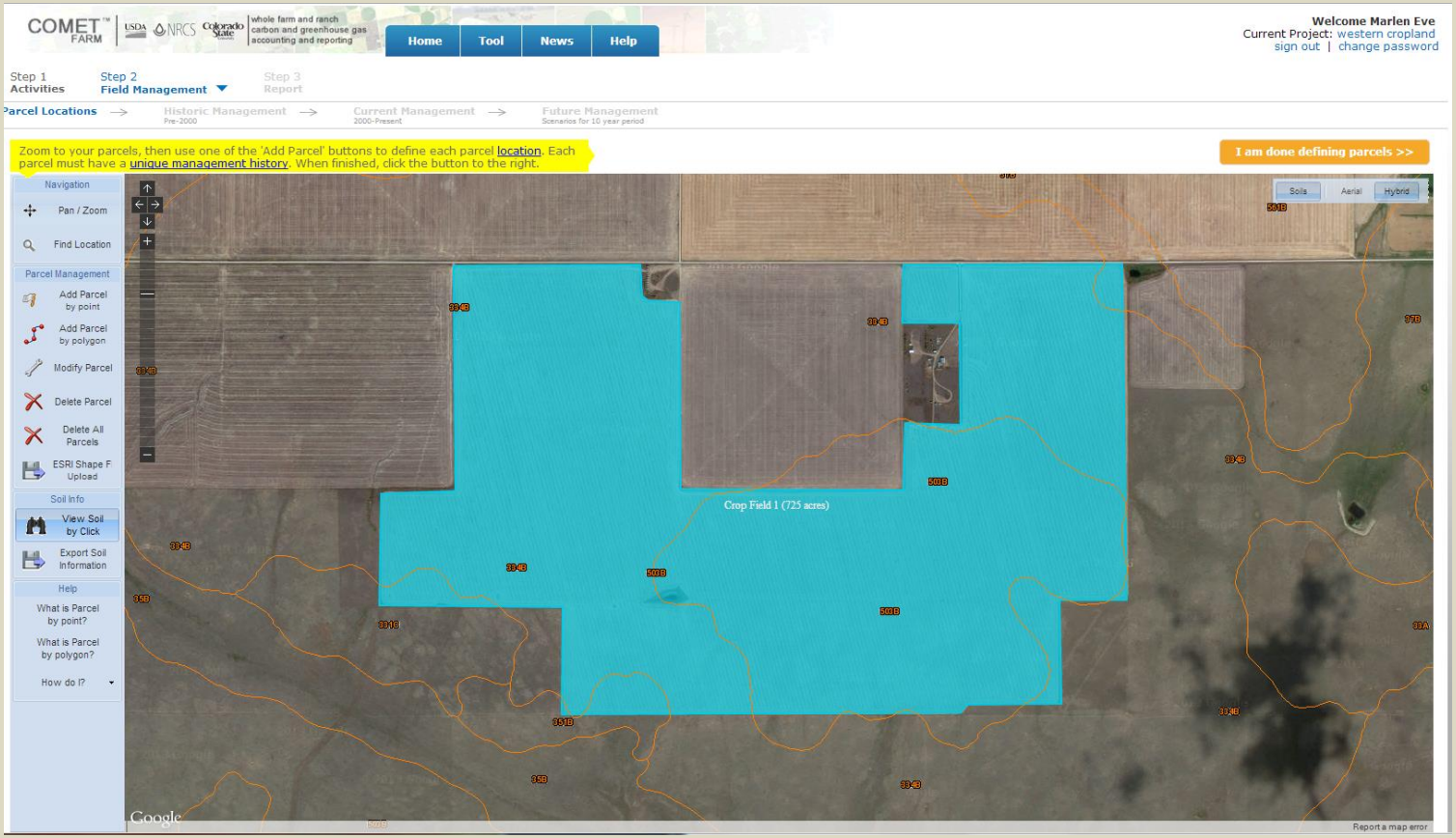
Update of emission source categories!

Completed	Underway	Planned	
☐	■	☐	Livestock Emissions
☐	■	☐	Cropland Soils
☐	■	☐	Agroforestry
☐	■	☐	Energy
☐	■	☐	Rice Methane
☐	☐	■	Grazing Land Soils
☐	☐	■	Biomass Burning
☐	■	☐	Liming



Integrating the methods into COMET-Farm . . .

Simplified Cropland Example



- Northern Plains
- Wheat/Fallow
- Intensive tillage
- 80 lbs anhydrous before planting
- Removing straw after harvest

What if I Continuous Crop Using No Till?

- Left fertilizer, yield, residue removal same
- Eliminated tillage
- Cropped every year

Choose Scenarios	Baseline (Hide)	Cont Crop No Till (Hide)		
Total all parcels (tonnes CO_2 equivalent/year) GRAPH	**94.2**	**-32.9**	**-127.1**	**Total all parcels (tonnes CO_2 equivalent/year)**
Crop Field 1 (726 acres) GRAPH	94.2	-32.9 (+/-0)	-127.1	**Parcel CO_2 Equivalent (tonnes/year)**
CO_2 Emissions (tonnes/year)	-20.4 (+-0)	-193.4 (+/-0)	-173.0	CO_2 Emissions (tonnes/year)
N_2O Emissions (tonnes CO_2 equivalent/year)	114.6 (+-0)	160.5 (+/-0)	45.9	N_2O Emissions (tonnes CO_2 equivalent/year)
Methane (CH_4) Emissions (tonnes CO_2 equivalent/year)	0.0 (+-0)	0.0 (+/-0)	0.0	Methane (CH_4) Emissions (tonnes CO_2 equivalent/year)

What if I Change My Nutrient Management?

- Left fertilizer, yield, residue removal same
- Eliminated tillage
- Cropped every year
- Applied side-dress UAN
- Because of increased NUE, reduced rate

Choose Scenarios	Baseline (Hide)	CC-NT-Nutrient (Hide)		Co (Hide)
Total all parcels (tonnes CO_2 equivalent/year)	94.2	-61.1	-155.3	-32.
Crop Field 1 (726 acres)	94.2	-61.1 (+/-0)	-155.3	-32.9
CO_2 Emissions (tonnes/year)	-20.4 (+-0)	-193.4 (+/-0)	-173.0	-193
N_2O Emissions (tonnes CO_2 equivalent/year)	114.6 (+-0)	132.3 (+/-0)	17.7	160.
Methane (CH_4) Emissions (tonnes CO_2 equivalent/year)	0.0 (+-0)	0.0 (+/-0)	0.0	0.0 (+/-0) 0.0 (tonnes CO_2 equivalent/year)

- Less nutrient loss in this scenario
- More C storage
- Ancillary benefits could include increased production, reduced labor inputs, improved water quality, improved habitat, etc.

REPORTING COMET-FARM RESULTS

Currently:

* Scenario comparison - what if's, decision support
* Graphs – comparison of baseline vs scenario

Coming soon:

* Three levels of reporting detail
  ~ Overview summary with graphs
  ~ Scenario comparison with graphics
  ~ Detailed annual inventory with graphics

COMING SOON . . .

Addition of a more detailed “inventory” style report format that will be useful for landowners engaging GHG registries, markets or supply chain initiatives.

NAME: Kevin Brown **RUNID:** 190_102_7085
PROJECT: Example for New Report **TIME:** 10/29/2014 9:54:08 AM
*All units reported in tonnes CO_2 equivalent per year.

USDA NRCS Colorado State University

Source	Years Prior to Mgmt. Change														Projected Emissions								
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Field 1 (100 acres - Corn)																							
C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Biomass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Litter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Liming	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urea Fertilization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drained Organic Soils	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N_2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wetland Rice Cult.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Biomass Burning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drained Organic Soils	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CH_4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wetland Rice Cult.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Biomass Burning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NOx	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Biomass Burning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (all parcels)	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***

BRAND NEW . . .

Brand new from NRCS.

- A planning tool for evaluating NRCS Conservation Practices
- For more rigorous quantification, a user would go to COMET-Farm

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 Rathmann Family Foundation and the Marin Carbon Project

Evaluate potential carbon sequestration and greenhouse gas reductions from adopting NRCS conservation practices

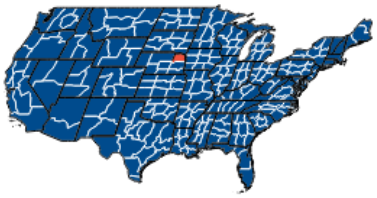
Print page

PROJECT NAME:

Nebraska notill example

State: NE

County: Cuming



NRCS Conservation Practices - Select Your Practice(s)

Name

+ Cropland Management (8 Items)

+ Cropland to Herbaceous Cover (10 Items)

+ Cropland to Woody Cover (7 Items)

+ Grazing Lands (4 Items)

+ Restoration of Disturbed Lands (5 Items)

Approximate Carbon Sequestration and Greenhouse Gas Emission Reductions[1] (tonnes CO_2 equivalent per year)

NRCS Conservation Practices	Enter Acreage	CO_2	N_2O	CH_4	Total CO_2-Equivalent
Conventional Tillage to Reduced Tillage (CPS345) [delete]	100 ac	13	7	0	20
Conventional Tillage to No Till (CPS329) [delete]	100 ac	42	N.E.[2]	0	42

www.comet-planner.com

NEXT STEPS

- Complete the cropland, grazing land and livestock updates to COMET-Farm
- Expand reporting capabilities
- Build out the tool for forest management
- Incorporate uncertainty assessment
- Regular revisions and updates

CONTACT INFORMATION

Thank you!

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Climate Change Program Office:
www.usda.gov/oce/climate_change

COMET-Farm:
www.comet-farm.com

USDA GHG Methods Report:
http://www.usda.gov/oce/climate_change/estimation.htm