Grazing Land and Livestock Management GHG Methodology

Stakeholder Consultation Webinar
January 22, 2013

Outline

- Background, methodology structure, and FRAMEWORK module
  - *Nicholas Martin, ACR*
- Accounting for micro-scale impacts
  - *Nancy Harris, Winrock International*
- Accounting for small and large-scale impacts on enteric, manure, fertilizer emissions and biotic sequestration
  - *Tim Pearson, Winrock International*
- Accounting for leakage
  - *Lauren Nichols, ACR*
- Q&A

Webinar logistics

- To ask questions:
  - Type questions into '**Chat**' box near bottom of your webinar pane
  - '**Raise Hand**' (in vertical bar at left of your webinar pane) to hold your place in line to ask a question

- GLLM methodology is open for public comment through January 31, 2013
  - All public and webinar comments will be addressed and posted with methodology

- Webinar will be recorded and posted shortly to www.americancarbonregistry.org

American Carbon Registry

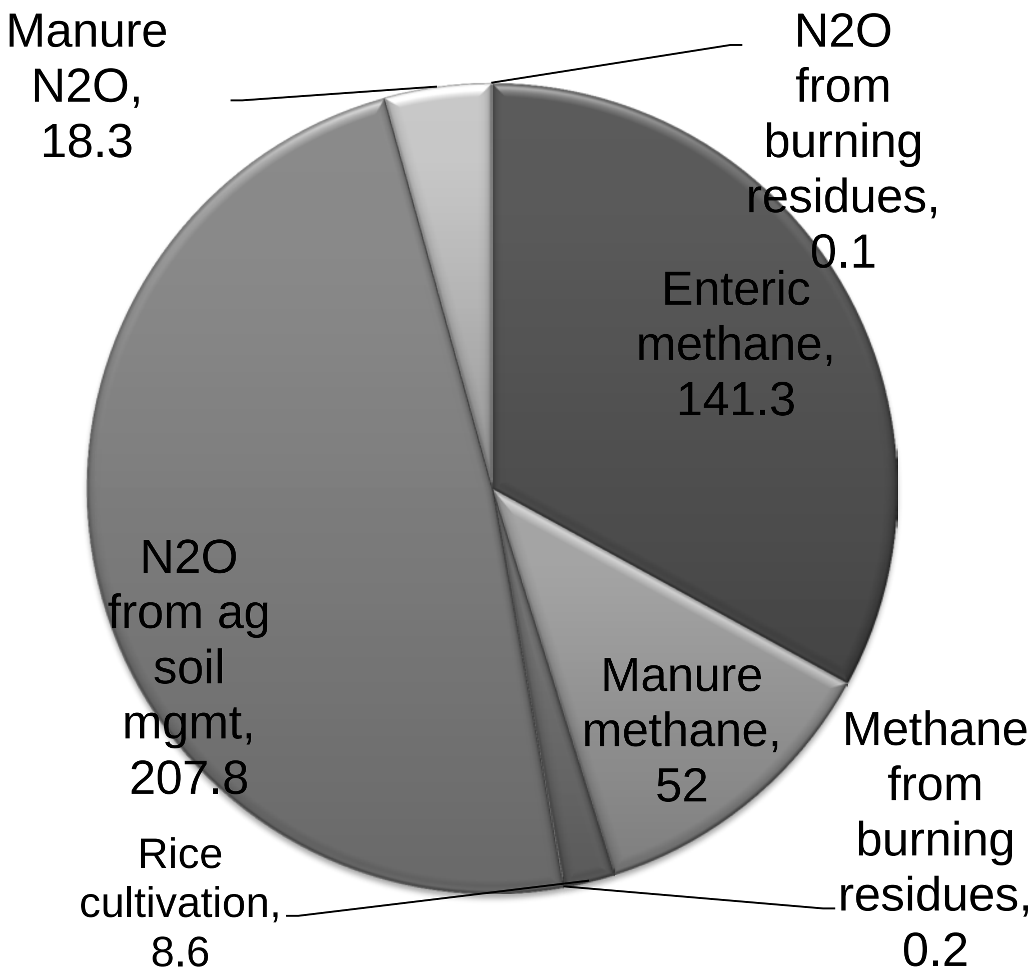
- **First U.S. voluntary carbon registry**
  - 37.5 MMT CO_2e verified carbon reductions since 1996
  - Non-profit organization
- **Registry roles:**
  - Develop and approve carbon protocols
  - Review and register projects
  - Oversee independent verification
  - Transparently track transactions and retirements
  - Support California compliance market, both as OPR and with new protocols
- **2011**: 2.9 million ERTs sold, retired or contracted at average price of $5.51/tCO2e (range $1-14)

Winrock International Institute for Agricultural Development

Non-profit organization that works in the U.S. and around the world to empower the disadvantaged, increase economic opportunity, and sustain natural resources

- 1985 merger of Winrock Int'l Livestock Research & Training Center, International Ag Development Service, and Ag Development Council
- Rockefeller family tradition of agricultural research and extension, yield improvement, global food security
- Seeking ways to connect farmers and ranchers to new markets, enhance competitiveness, maintain/increase yields

Methane and N_2O emissions from U.S. agriculture (MMT CO_2e, 2010)



- Agriculture = 428 MMT CO_2e or 6.3% of US GHG emissions
- Livestock = 210 MMT CO_2e
  - 141 MMT from enteric CH_4
  - 70 MMT from manure
  - Mostly beef and dairy cattle
  - Additional N_2O from feed production

Thanks to:

- David & Lucile Packard Foundation
- GLLM Technical Advisory Committee:
  - Shawn Archibeque, Colorado State University
  - Richard Conant, Colorado State University
  - Gustavo Cruz, UC Davis
  - David Diaz, The Climate Trust
  - Alan Franzluebbers, USDA – Agricultural Research Service
  - Stephen De Gryze, Terra Global Capital
  - Karen Haugen Kozyra, Prasino Group / BIGGS project
  - Ermias Kebreab, UC Davis
  - April Leytem, USDA – Agricultural Research Service
  - Arvin Mosier, USDA – Agricultural Research Service (ret'd)
  - Matt Sutton-Vermeulen, Prasino Group / BIGGS Project
  - Juan Tricarico, Dairy Management Institute

Objectives

- Develop a comprehensive methodology to unlock large-scale GHG reductions in the beef and dairy sectors
  - Enteric, manure, fertilizer, fossil fuel emission reductions and enhanced biotic sequestration in soil and plants
  - Flexible modular structure
  - Tiered GHG accounting methods
- Conduct economic and spatial analysis of beef and dairy operations to identify regions and mitigation practices with significant uptake potential
- Field test methodology on dairy and beef operations across U.S.
  - Currently identifying pilot producers and conducting focus groups
- Inform development of regulatory protocols

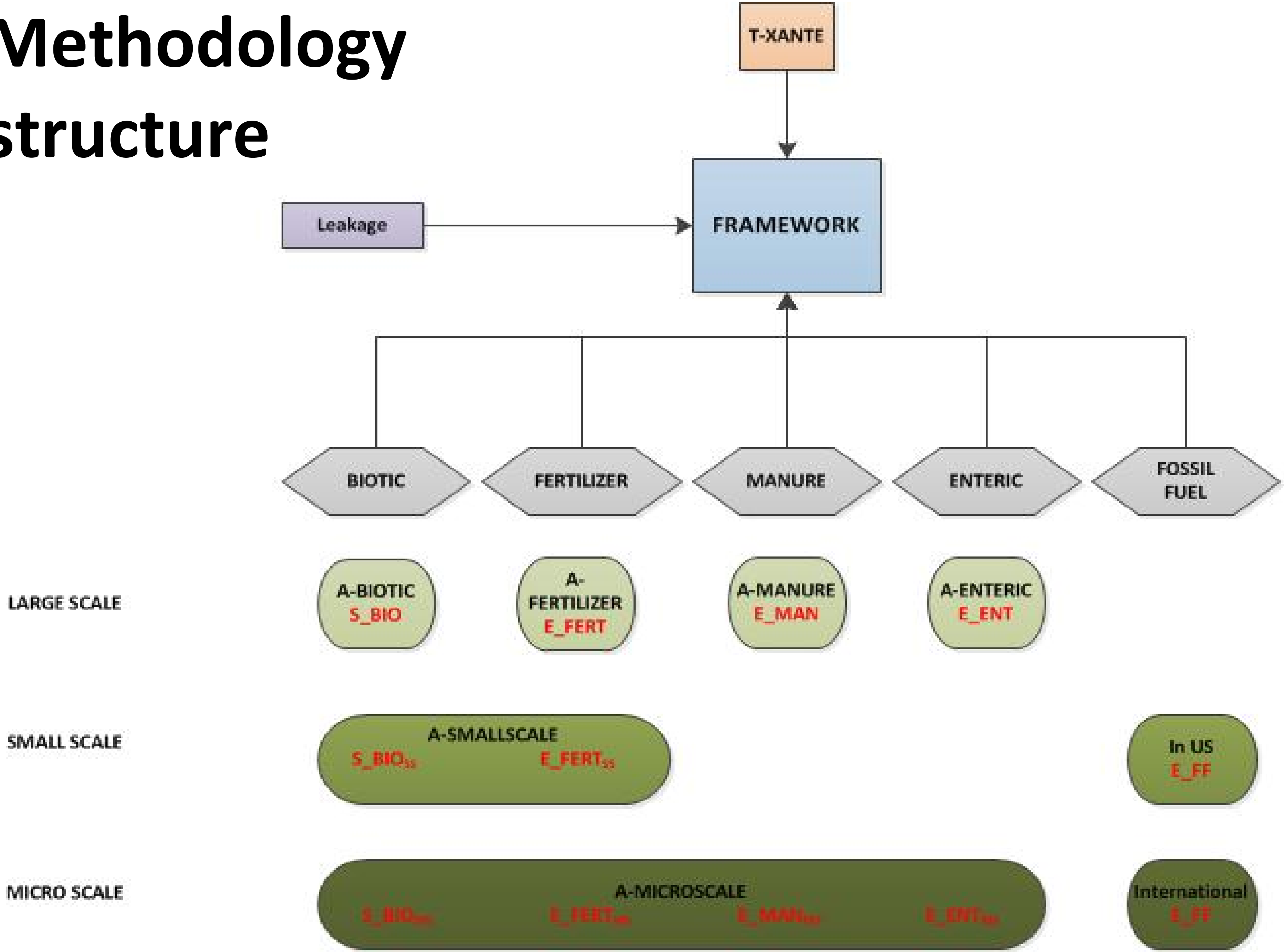
Modular structure, many eligible practices

- Flexibility to edit and update components without affecting the rest of the methodology
- Facilitates expanding potential accounting and project interventions
- Simplifies project development as users can focus only on applicable modules depending on which sources/pools they will affect and scale of impacts

Example practices:

- Rotational and management intensive grazing in beef and dairy
- Dietary changes, feed additives to suppress enteric CH_4
- Reduce fertilizer and natural gas emissions embedded in feed
- Change manure management system
- Tree planting (silvopasture)
- Fertilize or irrigate pasture
- Convert cropland to pasture
- Etc.

Methodology structure



Tiered accounting methods

- Complexity and data requirements of required accounting method correspond to the scale of impacts expected in a particular SSR

T-XANTE	Ex ante estimate of net reductions directs user to A-MICROSCALE, A-SMALLSCALE, or full accounting module
A-MICROSCALE	Excel tool – simple emission factors, low data requirements when estimated impacts on a SSR are <5,000 tCO_2e/y
A-SMALLSCALE	Used in U.S. for biotic, fertilizer and fossil fuel impacts between 5,000 and 60,000 tCO_2e/y. Uses COMET v2.0.
A-ENTERIC	Used for impacts >5,000 tCO_2e/y
A-MANURE	Used for impacts >5,000 tCO_2e/y
A-FERTILIZER	Used in U.S. for impacts >60,000 tCO_2e/y and outside US for impacts >5,000 tCO_2e/y
A-BIOTIC	Used in U.S. for impacts >60,000 tCO_2e/y and outside US for impacts >5,000 tCO_2e/y
L-GLLM	Activity-shifting and market effects leakage emissions
T-RISK	Tool for calculating buffer contribution for biotic seq.

FRAMEWORK-GLLM

- Overall structure and functionality of methodology
- Guidance when other modules are required or optional
- Applicability conditions for the methodology overall
- Defining the project boundary (geographic boundary, temporal boundary, and GHG SSRs included/excluded from accounting)
- Demonstrating additionality
- Formula to calculate ERTs using output parameters of other modules
- Monitoring requirements
- Rules for aggregates and Programs of Activities

Applicability conditions

- Dairy and beef operations
- Project lands managed for grazing/livestock in the project scenario
- GLLM activities on public lands receive credit for biotic sequestration only if responsible agency cedes offset ownership and must make buffer contribution in non-project ERTs
- Projects on leased lands must demonstrate offset title and effective control of SSRs; owner agrees not to change land use for minimum project term
- >3% reduction in yield relative to baseline must use L-GLLM to deduct leakage
- Aggregates and PoAs must follow rules in Annex

Project boundary

- Facilities and lands where livestock are held, fed and grazed, in both the baseline and project scenarios
  - All entities over which Project Proponent has effective control; may span several commercial entities
  - May include analytical units corresponding to animal management rather than land areas
- May not exclude lands/facilities where emissions increase due to project activity
- May include multiple areas, facilities, owners, and start dates

Temporal boundaries

- **Start Date**: discrete date when project management diverges from baseline management, as defined in GHG Project Plan.
  - Multiple start dates for PoA
- **Crediting Period**: timeframe over which baseline is valid and credits generated. May be renewed.
  - 10 years for all impacts except biotic
  - 40 years for biotic sequestration
- **Minimum Project Term**: length of commitment by Project Proponent to monitoring and verification.
  - 40 years for projects claiming credit for biotic sequestration
  - No minimum term for irreversible enteric, manure, fertilizer, fossil fuel reductions

GHG boundary

Sources	Gas	Included/Excluded	Justification / Explanation of choice
Enteric emissions from dairy and beef cattle	CO_2	Excluded	Potential emissions are negligibly small
	CH_4	Included	Primary GHG affected by the project activity
	N_2O	Excluded	Potential emissions are negligibly small
Manure emissions from dairy and beef cattle	CO_2	Included	Primary GHG affected by the project activity
	CH_4	Included	Primary GHG affected by the project activity
	N_2O	Included	Primary GHG affected by the project activity
Combustion of fossil fuels	CO_2	Included	Must be included if emissions significantly higher than baseline.
	CH_4	Excluded	Potential emissions are negligibly small
	N_2O	Excluded	Potential emissions are negligibly small
Emissions from land application of organic and synthetic fertilizers	CO_2	Excluded	Potential emissions are negligibly small
	CH_4	Excluded	Potential emissions are negligibly small
	N_2O	Included	Primary GHG affected by the project activity

GHG boundary

Carbon pools	Included / Excluded	Justification / Explanation of choice
Aboveground	Included / Excluded	Must be included if ex ante estimate of baseline C stocks exceed project C stocks. May be included if project exceed baseline and PP wishes to claim credit.
Belowground	Included / Excluded	Must be included if ex ante estimate of baseline C stocks exceed project C stocks. May be included if project exceed baseline and PP wishes to claim credit.
Dead wood	Excluded	Changes in the dead wood pool are expected to be negligibly small over the Crediting Period.
Harvested wood products	Included / Excluded	Must be included if ex ante estimate of baseline C stocks exceed project C stocks. May be included if project exceed baseline and PP wishes to claim credit.
Litter	Excluded	Changes in the dead wood pool are expected to be negligibly small over the Crediting Period.
Soil organic carbon	Included / Excluded	Must be included if ex ante estimate of baseline C stocks exceed project C stocks. May be included if project exceed baseline and PP wishes to claim credit.

Additionality

- **Start Date**: if >1 year before submission of GHG Project Plan, provide evidence of GHG mitigation objective
- **Regulatory Surplus**: review applicable regulations and demonstrate project activity is not mandated
- **Performance Standard**: option of a "positive list" of practices at very low baseline adoption rates that are deemed additional
- **Three-Prong Test**: show regulatory surplus, not common practice, and faces at least one implementation barrier, using an ACR-approved additionality tool

Early adopters

- Activities with <5% adoption in industry may use a common practice baseline
  - Assess baseline adoption rate through surveys of available data, or expert opinion
  - Set baseline based on practices of non-adopters
  - No renewal of Crediting Period (10 years) if adoption remains below 5% → early adopters incentive not working
- Activities with >5% adoption must demonstrate project-specific additionality and use a project-specific baseline
  - Set baseline based on own operations
  - May be renewed only until adoption reaches 50%

ERT calculation

$$ERT\_GLLM_t = E\_ENT + E\_MAN + E\_FERT + E\_FF + (S\_BIO * (1 - Buffer\%)) - E\_LK$$

- *E_ENT*, *E_MAN* etc. come from applicable module (large, small or micro scale)
- *Buffer%* comes from T-RISK tool and is a deduction from biotic sequestration only
- *E_LK* comes from L-GLLM and includes both activity-shifting leakage (if required) and market leakage
  - Generally a positive number though could be negative
  - "Positive leakage" may only be credited if PP can demonstrate to ACR and VVB that the same reductions may not be claimed by other producers

Monitoring & Verification

- Monitoring period 1-5 years
- Field verification every 5 years; may do desk audits between
- Validation once per Crediting Period
- What to monitor:
  - All parameters listed in relevant accounting module
  - Project boundaries and implementation
  - Field data, collected using SOPs with QA/QC plan
- Stratification recommended
  - Relatively homogenous managed land areas, animal populations
- Conservativeness

Aggregates and PoAs

- Aggregate: multiple Project Participants grouped as one registered project, coordinated by an aggregator. Overall project boundary, single Start Date and Crediting Period.
  - Single GHG Project Plan
  - Reduce transaction costs of project development, validation and verification; reduce uncertainty

- PoA: multiple Cohorts (each an Aggregate) incrementally added to project over time. Overall project baseline, additionality and monitoring methodology. Multiple cohort Start Dates and Crediting Periods.
  - Single GHG Project Plan with initial Cohort (full validation); subsequent Cohort Descriptions (abbreviated validation)

Aggregates and PoAs

- Aggregate:
  - Boundaries, baseline, additionality, accounting thresholds, uncertainty requirements applied at Aggregate level
- PoA:
  - Clear criteria for addition of Cohorts
  - Clear documentation control for multiple Cohorts and Crediting Periods
  - Procedure to avoid double inclusion
  - No planned exceedance of accounting thresholds with later Cohorts
- No de-bundling allowed
  - Splitting project participants from Aggregate, or Cohorts from PoA, to stay below SSR accounting thresholds

Scaled Approach to GHG Accounting

The magnitude of estimated GHG impacts determines the accounting approach

Need an accounting approach before you know the magnitude of estimated GHG impacts

start here

MICRO SCALE

< 5,000 t CO_2e

< 5,000 t CO_2e

SMALL SCALE

5,000 to 60,000 t CO_2e

AND

Direct Emissions < 60,000 t CO_2e

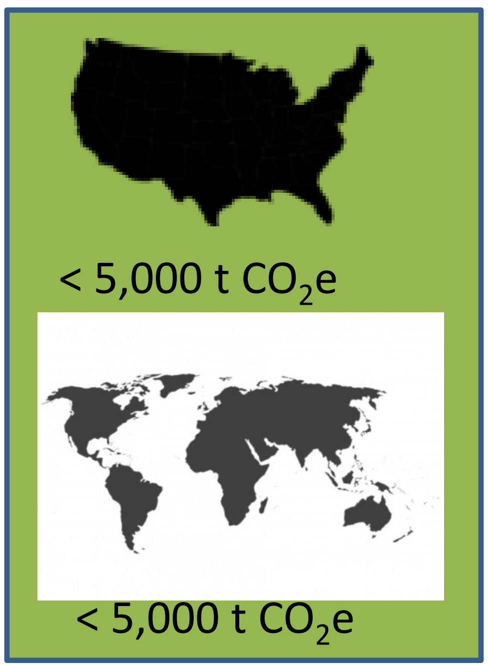
LARGE SCALE

> 60,000 t CO_2e

> 5,000 t CO_2e

A-MICROSCALE

MICRO SCALE



- Excel spreadsheet-based tool
- Simplified, automated GHG accounting procedures applied
- Provides a preliminary estimate of expected emission reductions from each source category:
  - Biotic Sequestration (S-BIO)
  - Enteric Fermentation (E-ENT)
  - Manure Management (E-MAN)
  - Fertilizer Use (E-FERT)
  - Fossil Fuel Use (E-FF)
- Output is based on data inputs provided by user for baseline and project scenarios
- Results of A-MICROSCALE → T-XANTE

Biotic Sequestration

- Based on IPCC Tier 1 accounting methodology

A-MICROSCALE

American Carbon Registry

WINROCK INTERNATIONAL
Putting Ideas to Work

Parameter Name:	S_BIO	
Parameter Description:	Net microscale biotic sequestration/emissions (t CO_2e)	
Calculated value:	33,229	t CO_2e yr^{-1}

Instructions: Enter data into the light blue cells for both baseline and project scenarios. Use the unit converter box in the upper right as needed.

Select from drop-down menus.

Geographic Region:	North America	
Climate Region:	Warm Temperate Moist	
Soil Type:	Low Activity Clay	
Size of Project Area:	5,000	ha

	BASELINE DATA	PROJECT DATA
Land Cover Type	Long Term Cultivated Crop	Grassland
Grassland Management	N/A	Improved
Grassland Inputs	Medium	High
Cropland Management	Full Tillage	N/A
Cropland Inputs	Medium	N/A
Are you planting trees in the project area?		No

Land Cover Type
LT Cultivated Crop: Continuously managed >20 yrs with annual crops.
ST Set Aside: Temporary set aside of annual crop or other idle cropland.
Grassland: Ranges from extensively managed rangelands to intensively managed continuous pasture and hay land.

Enteric Fermentation

Parameter Name:	E_ENT	
Parameter Description:	Net microscale enteric emissions (t CO_2e)	
Calculated value:	0	t CO_2e yr^{-1}

INSTRUCTIONS: Enter data into LIGHT BLUE CELLS for both baseline and project scenarios. Change values in gray cells only if you have project specific data, otherwise leave existing default values as they appear in the cell.

Geographic Region: North America

BASELINE DATA

Click on category to see description. -->	Dairy Cows	Mature females	Mature Males	Calves on forage	Growing heifers/ steers	Replacement /growing	Feedlot cattle
Number of Animals Produced Per Year	1,000	[illegible]	[illegible]	75	300	150	300
% of Females that give birth in a year:	90	[illegible]	[illegible]	0	0	0	0
Feeding Situation: Enter the % of the year under each feeding situation per animal category.							
Stall-fed/Confined (tethered, pen, barn)	80	[illegible]	[illegible]	80	80	80	80
On pasture (confined in areas with sufficient forage)	20	[illegible]	[illegible]	20	20	20	20
Grazing large areas (i.e., rangeland)	0	0	0	0	0	0	0
Average Live-Weight of Animal (kg)	600	500	800	185	265	375	415
Average Daily Weight Gain (kg day^{-1})	0.0	0.0	0.0	0.9	0.7	0.4	1.3
Total Annual Milk Production (kg cow-1 yr^{-1})	8,395	1,205	0	0	0	0	0
Fat content of milk: (%)	4.0	4.0	0	0	0	0	0

Cows used to produce offspring for meat OR cows used for more than one production purposes: milk/meat

PROJECT DATA

	Dairy Cows	Mature females	Mature Males	Calves on forage	Growing heifers/ steers	Replacement/growing	Feedlot cattle
Number of Animals Produced Per Year	1,000	900	40	75	300	150	300
% of Females that give birth in a year:	90	80	0	0	0	0	0
Stall-fed/Confined (tethered, pen, barn)	80	80	80	80	80	80	80
On pasture (confined in areas with sufficient forage)	20	20	20	20	20	20	20
Grazing large areas (i.e., rangeland)	0	0	0	0	0	0	0
Average Live-Weight of Animal (kg)	600	500	800	185	265	375	415
Average Daily Weight Gain (kg day^{-1})	0.0	0.0	0.0	0.9	0.7	0.4	1.3
Total Annual Milk Production (kg cow-1 yr^{-1})	8,395	1,205	0	0	0	0	0
Fat content of milk: (%)	4.0	4.0	0	0	0	0	0

Feeding Regime: Enter the type and % of each feed in the total annual diet of each animal category.

Select feed name from drop down menu.

% of total diet (Baseline)

Feed Name	Int'l Feed #	Dairy Cows	Mature females	Mature Males	Calves on forage	Growing heifers/ steers	Replacement /growing	Feedlot cattle
Corn, distiller's grains w/ solubles, dried	5-28-236	50	50	100	0	100	100	100
Grasses, intensively managed pasture	1-02-244	50	50	0	100	0	0	0
		0	0	0	0	0	0	0
		0	0	0	0	0	0	0
		0	0	0	0	0	0	0
		0	0	0	0	0	0	0
		0	0	0	0	0	0	0

(Project)

Feed Name	Dairy Cows	Mature females	Mature Males	Calves on forage	Growing heifers/ steers	Replacement/growing	Feedlot cattle
Corn, distiller's grains w/ solubles, dried	50	50	100	0	100	100	100
Grasses, intensively managed pasture	50	50	0	100	0	0	0
	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
	0	0	0	0	0	0	0

Manure Management

A-MICROSCALE

American Carbon Registry

WINROCK INTERNATIONAL
Putting Ideas to Work

Parameter Name:	E_MAN	
Parameter Description:	Net microscale manure emissions (t CO_2e)	
Calculated value :	402	t CO_2e yr^{-1}

Instructions: Enter data into light blue cells for both baseline and project scenarios.

Geographic Region:	North America	
Average Annual Temperature:	18	° C

Manure Management System	% of manure managed under each system: Baseline	Project
Pasture/Range/Paddock	0	0
Daily Spread	0	0
Solid Storage	100	0
Dry Lot	0	0
Liquid/Slurry with crust	0	0
Liquid/Slurry without crust	0	0
Uncovered anaerobic lagoon	0	0
Pit storage <1 month	0	100
Pit storage >1 month	0	0
Anaerobic digester	0	0
Burned for fuel	0	0
Deep bedding <1 month, no mixing	0	0
Deep bedding <1 month, active mixing	0	0
Deep bedding >1 month, no mixing	0	0
Deep bedding >1 month, active mixing	0	0
Composting - In-Vessel	0	0
Composting - static pile	0	0
Composting - intensive windrow	0	0
Composting - passive windrow	0	0
Aerobic treatment	0	0

Based on IPCC Tier 2 methodology → different manure management systems specified

Fertilizer Use

UNIT CONVERTER			
	pounds	=	kilograms (kg)
	acres	=	hectares (ha)

A - MICROSCALE

Parameter Name:	E-FERT	
Parameter Description:	Net microscale fertilizer emissions (t CO_2e)	
Calculated value:	-193	t CO_2e yr^{-1}

Instructions: Enter data into light blue cells for both baseline and project scenarios.

	Baseline			Project		
Synthetic Fertilizer Application:	**Total Weight Applied (kg yr^{-1})**	**%N**	**Area of Land Where Fertilizer is Applied (ha)**	**Total Weight Applied (kg yr^{-1})**	**%N**	**Area of Land Where Fertilizer is Applied (ha)**
Anhydrous Ammonia (NH_3) "Ammonia"	15,000	82	5,000	15,000	82	5,000
Ammonium Sulfate [$(NH_4)2SO_4$]		21	5,000		21	5,000
Monoammonium Phosphate (MAP)		11	5,000		11	5,000
Diammonium Phosphate (DAP)		18	5,000		18	5,000
Ammonium Nitrate (NH_4NO_3)		34	5,000		34	5,000
Calcium Ammonium Nitrate (CAN)		26	5,000		26	5,000
Urea Application:						
Amount of urea fertilization (kg yr-1)	0		5,000	0		5,000
Organic Manure Application:						
% of managed manure applied to fields:	100			100		

Fossil Fuel Use

A-MICROSCALE

Parameter Name:	E_FF
Parameter Description:	Net microscale fossil fuel emissions (t CO_2e)
Calculated value:	**153** t CO_2e yr^{-1}

Instructions: Enter data on annual fuel quantities into the light blue cells.

	Baseline	Project	Fuel Units
Ethane	0	0	Gallons
Propane	0	0	Gallons
Butane	0	0	Gallons
LPG	0	0	Gallons
Motor Gasoline	20,000	5,000	Gallons
Aviation Gasoline (avgas)	0	0	Gallons
Other Kerosene	0	0	Gallons
Gas/Diesel Oil	10,000	8,000	Gallons
Biodiesel	0	0	Gallons
Biogas	0	0	Gallons
Other Liquid Biofuels	0	0	Gallons

If necessary, change units using drop-down menus.

T-XANTE

- Fully automated
- Uses results from A-MICROSCALE to display which modules should be used

Is your project located within the continental United States? **yes**

MODULE SELECTION FOR YOUR PROJECT:

	Emission Category	Module Selection
	Biotic Sequestration:	*A-SMALLSCALE*
<5,000 t CO_2e	*Enteric Fermentation:*	*A-MICROSCALE*
	Manure:	*A-MANURE*
<5,000 t CO_2e	*Fertilizer:*	*A-MICROSCALE*
<5,000 t CO_2e	*Fossil Fuel:*	*A-MICROSCALE*

Navigating Through the Modules

MICRO SCALE

< 5,000 t CO_2e

< 5,000 t CO_2e

SMALL SCALE

5,000 to 60,000 t CO_2e

AND

Direct Emissions < 60,000 t CO_2e

LARGE SCALE

> 60,000 t CO_2e

> 5,000 t CO_2e

Navigating Through the Modules

SMALL SCALE

Applicable for:

- Biotic Sequestration
- Fertilizer emissions
- Fossil fuel emissions

5,000 to 60,000 t CO_2e

AND

Direct Emissions < 60,000 t CO_2e

NOT applicable (yet) for:

- Enteric emissions
- Manure Emissions

A-SMALLSCALE Data Inputs

- Historic land management
- Planned project land management
- Soil type
- Fertilizer inputs
- Fossil fuels used

Model

- Uses **COMET 2.0**, a "user-friendly, web-based tool that provides estimates of carbon sequestration and net greenhouse gas emissions from soils and biomass for US farms and ranches"
- Uses IPCC Tier 2 methods for estimating emissions
- In the future we will be able to switch to COMET-FARM which will have the capability of also calculating manure emissions and enteric fertilizer emissions

A Decision Support Tool for Agricultural Producers, Land Managers, Soil Scientists, and Agricultural Research. Funded by USDA Natural Resoures Conservation Service.

Mon Aug 6 13:06:31 EDT 2012 | Session will expire in 45 minutes if not active | Reset Session Timer

Support Tool for Agriculture, Range & Agroforestry

Step 1. Enter the State and County Information: Select the State and County where the parcel is located.

Open Help

State/County Selection: Alabama

Select a State: ALABAMA ?

Select a County: Autauga ?

NEXT

Internet Explorer Version: 9.0

Current Session: 1011366995 Current RunID: 1

Selection

Location Information:

- **State:** Alabama
- **County:**
- **Fips:**
- **Pita Code:**
- **MLRA:**
- **LRR:**

Parcel Information:

Soil Information:

Management History:

Nutrient Information:

Session Information: ?

ID: 942879061_R1 PRINCE GEORGES, MARYLAND

ID: 942879061_R2 AUTAUGA, ALABAMA

Enter Session ID: Go

Current Session ID: 1011366995

Entity Summary Report

Toggle Selection

Support Tool for Agriculture, Range & Agroforestry

Go to | Reset | State/County | Entity | Parcel

Step 2 (B). This page displays the status of your carbon calculations for the parcels that you have defined.

Click the parcel button to enter the name and size of the parcel. Then CLICK the "NEXT" button to continue with the carbon analysis for the selected parcel.

Open Help

APPANOOSE County, Iowa Parcel Selection:

Select Parcel	Started?	Complete?	REDO?
PARCEL 1	✓		☐
PARCEL 2			☐
PARCEL 3			☐

Enter the information for PARCEL 1

Name: Parcel 1

Size: 20 Acres

BACK NEXT

Internet Explorer Version: 9.0

Current Session: 1011366995 Current RunID: 1

Selection

Location Information:

Parcel Information:

- **Report Date:** 8/6/2012
- **Parcel Number:** 1
- **Name:** Parcel 1
- **Size:** 1 Acres

Soil Information:

Management History:

Nutrient Information:

Session Information:

ID: 942879061_R1 PRINCE GEORGES, MARYLAND

ID: 942879061_R2 AUTAUGA, ALABAMA

Enter Session ID:

Go

Current Session ID:

1011366995

Entity Summary Report

Toggle Selection

Support Tool for Agriculture, Range & Agroforestry

Go to | Reset | State/County | Entity | Parcel | Soil |

Step 3. Enter the Soil Information: Select the dominant soil texture and hydric status for your parcel.

Open Help

APPANOOSE County, Iowa Soil Selection

Select the surface soil texture:

- clay
- clay loam
- loam
- loamy sand
- sand
- sandy clay
- sandy clay loam
- sandy loam
- silt
- silt loam
- silty clay
- silty clay loam

?

Is this a hydric soil? Select No or Yes:

No Yes ?

BACK NEXT

Internet Explorer Version: 9.0

Current Session: 1011366995 Current RunID: 1

Selection

Location Information:

Parcel Information:

Soil Information:

- **Texture:** clay
- **Hydric:** N

Management History:

Nutrient Information:

Session Information: ?

ID: 942879061_R1
PRINCE GEORGES, MARYLAND

ID: 942879061_R2
AUTAUGA, ALABAMA

Enter Session ID:

Go

Current Session ID:

1011366995

Entity Summary Report

Toggle Selection

APPANOOSE County, Iowa Management History for Parcel 1

Choose A Management System for each Time Period:

Historic Period: 1880 to 1970;
Selected System: LOWLAND CROPLAND (NON-IRRIGATED)

Modern Period: 1970s through Mid 1990s;
Selected System: CORN 2 YRS-GRASS HAY 4 YRS (NON-IRRIGATED), CRP: None, Tillage: Intensive

Current Period: Late 1990s to 2012;
Selected System: CORN 2 YRS-GRASS HAY 4 YRS (Non-Irrigated) , Tillage: Intensive

3. Current Period: ?

A. Select a management for the time period from any of the available tabs.
B. Choose a **Soil Disturbance** or tillage for this parcel. ?
C. Describe the woody landuse management, if applicable.

Crops | Grass/Hay | Pasture/Range | Agroforestry | Orchard/Vineyard | CRP

ROW : GRAINS : and OTHER CROP Non-Irrigated Managements

- Corn 2 Yrs-Grass Hay 4 Yrs (Non-Irrigated)
- Corn 2 Yrs-Grass Pasture 4 Yrs (Non-Irrigated)
- Corn 2 Yrs-Grass/Legume Hay 4 Yrs (Non-Irrigated)
- Corn 2 Yrs-Grass/Legume Pasture 4 Yrs (Non-Irrigated)
- Corn 2 Yrs-Legume Hay 4 Yrs (Non-Irrigated)
- Corn 2 Yrs-Legume Pasture 4 Yrs (Non-Irrigated)
- Corn 2 Yrs-Oat (Non-Irrigated)
- Corn-Oat-Grass Hay 4 Yrs (Non-Irrigated)
- Corn-Oat-Grass Pasture 4 Yrs (Non-Irrigated)
- Corn-Oat-Grass/Legume Hay 4 Yrs (Non-Irrigated)
- Corn-Oat-Grass/Legume Pasture 4 Yrs (Non-Irrigated)
- Corn-Sorghum (Non-Irrigated)

Sort List By:

Irrigation:
- Non-Irrigated
- Irrigated

Crop:
ALL

Select Tillage/Soil Disturbance:
- Intensive
- Reduced
- NoTill

NEXT PERIOD

APPANOOSE County, Iowa Management History for Parcel 1

Choose A Management System for each Time Period:

Historic Period: 1880 to 1970;
Selected System: **LOWLAND CROPLAND (NON-IRRIGATED)**

Modern Period: 1970s through Mid 1990s;
Selected System: **CORN 2 YRS-GRASS HAY 4 YRS (NON-IRRIGATED), CRP: None, Tillage: Intensive**

Current Period: Late 1990s to 2012;
Selected System: **CORN 2 YRS-GRASS HAY 4 YRS (Non-Irrigated) , Tillage: Intensive**

Projection Period: 2012 to 2022;
Selected System: **LIGHT USE; ROTATIONAL; UNFERTILIZED GRASS/LEGUME (NON-IRRIGATED), Tillage: Grazing**

4. Projection Period: ?

A. Select a management for the time period from any of the available tabs.
B. Choose a **Soil Disturbance** or tillage for this parcel.
C. Describe the woody landuse management, if applicable.

Crops | Grass/Hay | Pasture/Range | Agroforestry | Orchard/Vineyard | CRP

RANGE : PASTURE Managements

Grass/Legume Hay/Pasture Mix/Continuous (Non-Irrigated)
Heavy Use; Seasonal; Fertilized Grasses (Non-Irrigated)
Heavy Use; Year-Round; Fertilized Grasses (Non-Irrigated)
Light Use; Rotational; Unfertilized Grass/Legume (Non-Irrigated)
Moderate Use; Rotational; Unfertilized Grass/Legume (Non-Irrigat
Moderate Use; Seasonal; Unfertilized Grass/Legume (Non-Irrigate

Sort List By:

Irrigation:

Non-Irrigated

Light Grazing Is Removing Generally Less Than 30 Percent Of The New Plant Production In The Year. Rotational Grazing Is Most Often A System Of HIGH Or Moderate Offtake For A Short Period Of Time Followed By Months Of Rest. When The Whole Year

Tillage Selection

Grazing

NEXT

Support Tool for Agriculture, Range & Agroforestry

Go to | Reset | State/County | Entity | Parcel | Soil | Management | Nutrient |

Step 7. Enter the Nutrient Management information for the Current and Projection periods by clicking on the BAR for either the Current or Projection Period: The following table represents the **year by year crops** in the selected management as it was modeled.

Open Help

APPANOOSE County, Iowa Nutrient Management History for Parcel 1

Current Period: Late 1990s to 2012;

Management: corn 2 yrs-grass hay 4 yrs (Non-Irrigated), Tillage: Intensive Tillage

Each table row represents the modeled year by year crops for your selected management system. For each CROP in this Management template Enter the **Fertilizer** and **Manure** values in pounds Nitrogen per Acre. Then select an **Application Time Period** from the drop down list and indicate if a **Nitrification Inhibitor** was used. Please provide values that most closely match your actual practice by fitting your practice into the year by year crop template provided. As in your choice in the management page, your actual practice may vary from the modeled management. After entering the input click on the **RUN MODEL** button located beneath the management template. You may need to scroll the WINDOW to see the RUN MODEL button. ?

YEAR	CROPS	Fertilizer N lb N/ac ?	Avg. N application lb N/ac	Manure N lb N/ac ?	Timing ?	Nitrification Inhibitor ?
1	corn	104	104	0	Spring	No
2	corn	104	104	0	Spring	No
3	grass hay	30	30	0	Spring	No
4	grass hay	30	30	0	Spring	No
5	grass hay	30	30	0	Spring	No
6	grass hay	30	30	0	Spring	No

Average yearly nitrogen value: 55 lb N/ac

RUN MODEL

More

Selection

Location Information:

Parcel Information:

Soil Information:

Management History:

Nutrient Information:

Session Information: ?

ID: 942879061_R1
PRINCE GEORGES, MARYLAND

ID: 942879061_R2
AUTAUGA, ALABAMA

ID: 532519261_R1

Enter Session ID:

Go

Current Session ID:

1011366995

Entity Summary Report

Toggle Selection

Parcel Description

Management Description

❶ Carbon Stock Changes and N_2O Emissions

SOURCE	BASELINE SCENARIO: Corn 2 Yrs-Grass Hay 4 Yrs (Non-Irrigated), Intensive Tillage		PROJECTION SCENARIO: Light Use; Rotational; Unfertilized Grass/Legume (Non-Irrigated) , Grazing	
	CARBON	UNCERTAINTY ?	CARBON	UNCERTAINTY ?
	tons/year	Avg. 95% CI	tons/year	Avg. 95% CI
Soil Carbon Change	0.533	19 %	12.8	Unknown %
	lbs N2O/year	Avg. 95% CI	lbs N2O/year	Avg. 95% CI
N2O Flux	46.2	Undetermined %	55.5	Undetermined %

Soil Carbon STOCK CHANGE/STORAGE: a positive value indicates carbon sequestration and a negative value indicates a LOSS of soil carbon.

"Unknown" % indicates that COMET2 is unable to determine an uncertainty value for the management options selected based on the current ground truth information.

"Undetermined" % indicates that all data is not yet available to allow COMET2 to determine an uncertainty value for computed N_2O fluxes.

❷ Emissions as CO_2 Equivalents ?

	BASELINE Senario	PROJECTION Senario
	CO_2 Equivalents tons/year	CO_2 Equivalents tons/year
Net Soil CO_2 Flux	-1.96	-47.1
N2O Flux	7.16	8.6
TOTAL	5.2	-38.5

Net Soil CO_2 Emissions or FLUX: a positive value indicates an EMISSION or ADDITION of greenhouse gas to the atmosphere and a negative value indicates a REMOVAL of greenhouse gas from the atmosphere.

One Ton of carbon is equivalent to 3.667 Tons of CO_2. To convert CO_2 to C, divide by 3.667.

The N_2O Flux is converted into Tons of CO_2 using the conversion constant value of 310 to calculate the GWP.

Navigating Through the Modules

MICRO SCALE

< 5,000 t CO_2e

< 5,000 t CO_2e

SMALL SCALE

5,000 to 60,000 t CO_2e

AND

Direct Emissions < 60,000 t CO_2e

LARGE SCALE

> 60,000 t CO_2e

> 5,000 t CO_2e

Navigating Through the Modules

A-BIOTIC
A-ENTERIC
A-MANURE
A-FERTILIZER

LARGE SCALE

> 60,000 t CO_2e

> 5,000 t CO_2e

A-BIOTIC Applicability Conditions

- Biotic sequestration MUST be included if emissions are significantly higher or sequestration is significantly lower under the project scenario than the baseline
- Optional in all other cases

- Where biotic sequestration is included, A-BIOTIC MUST be used:
  - In the US:
    - where direct emissions > 60,000 t CO_2-e annually; OR
    - Where reductions in emissions > 60,000 t CO_2-e annually
  - Internationally:
    - where reductions in emissions > 5,000 t CO_2-e annually

A-BIOTIC Data Inputs

- Tillage
  - type
  - depth
  - frequency
- Livestock
  - presence
  - type
  - manure application, production and management
- Grass
  - type
  - productivity
  - management
- CPES
  - trees and shrubs (field measurement)

A-BIOTIC Emissions Calculations

- Divided between:
  - soil carbon and carbon stored in grasses (above and belowground)
  - carbon stored in trees and shrubs (above and belowground)
- Soil carbon and grass storage calculated using a process model
- Tree and shrub carbon derived from field measurement using ACR tool CPES

A-BIOTIC Model

- Examples include Century, DayCent and Roth-C
- Must be studies (e.g. journal articles demonstrating use of model is appropriate in region where it is being applied)
- Model must have potential to determine soil carbon to an identified depth while considering:
  - Crop/grass type and productivity
  - Crop/grass management (including tillage)
  - Livestock presence, type and number
  - Manure applied, produced and management of manure application/production
- Modeling of herbaceous vegetation is an optional capability that must be used where present
- Validation of model required with limited field data sampling at each verification

CPES

- Trees and shrubs
- Stocks derived from field measurement
- Baseline stocks equal to stocks at start of project

Navigating Through the Modules

LARGE SCALE

A-BIOTIC
A-ENTERIC
A-MANURE
A-FERTILIZER

> 60,000 t CO_2e

> 5,000 t CO_2e

A-ENTERIC Applicability Conditions

- Enteric emissions MUST be included where with-project emissions are significantly elevated (see T-XANTE)
- Optional in all other cases
- A-ENTERIC MUST be used:
  - In the US:
    - where direct emissions > 5,000 t CO_2-e annually; OR
    - where reductions in emissions > 5,000 t CO_2-e annually
  - Internationally:
    - where reductions in emissions > 5,000 t CO_2-e annually

A-ENTERIC Data Inputs

- Number of livestock
- Body weight of livestock
- Information about different feed types:
  - Composition of annual diet (% of each feed)
  - Dietary ether extract
  - Gross energy intake
  - Dietary neutral detergent fiber

A-ENTERIC Emissions Calculations

- Divided by livestock sub-category:
  - Lactating cows
  - Dry cows
  - Heifers and steers
- Calculations based on empirical equations developed using animal and feed data collected in open-circuit respiration chambers from 1963 to 1995

Navigating Through the Modules

A-BIOTIC
A-ENTERIC
A-MANURE
A-FERTILIZER

LARGE SCALE

> 60,000 t CO_2e

> 5,000 t CO_2e

A-MANURE Applicability Conditions

- Manure emissions MUST be included where with-project emissions are significantly elevated (see T-XANTE)
- Optional in all other cases
- Where manure emissions are included, A-MANURE MUST be used:
  - In the US:
    - where direct emissions > 5,000 t CO_2-e annually; OR
    - Where reductions in emissions > 5,000 t CO_2-e annually
  - Internationally:
    - where reductions in emissions > 5,000 t CO_2-e annually

A-MANURE Data Inputs

- Type(s) of manure management system(s)
- Quantity of feces produced
- Properties of feces:
  - Volatile solids content
  - Manure pH
- Quantities of manure storage and loss
- Ambient temperatures

A-MANURE Emissions Calculations

- Calculations based on Dairy GEM
- Dynamic baseline
- Emissions dependent on manure system and time of year (ambient temperature)
  - CO_2: methane flaring from enclosed manure storage
  - CH_4: sum of emissions from:
    - Barn floors and open lots
    - Stored manure (covered, uncovered, dry stacks)
    - Manure applied to fields
    - Manure from grazing animals
  - N_2O: sum of emissions from:
    - Barn floors / dry lots
    - Unenclosed storage of manure / stacked dry manure

Navigating Through the Modules

A-BIOTIC
A-ENTERIC
A-MANURE
A-FERTILIZER

LARGE SCALE

> 60,000 t CO_2e

> 5,000 t CO_2e

A-FERTILIZER Applicability Conditions

- Fertilizer emissions MUST be included where with-project emissions are significantly elevated (see T-XANTE)
- Optional in all other cases
- Where fertilizer emissions are included, A-FERTILIZER MUST be used:
  - In the US:
    - where direct emissions > 60,000 t CO_2-e annually; OR
    - Where reductions in emissions > 60,000 t CO_2-e annually
  - Internationally:
    - where reductions in emissions > 5,000 t CO_2-e annually

Data Inputs

- Atmospheric Factors
- Daily meteorology
- Edaphic factors (e.g., clay content, soil pH)
- Cropping factors (e.g., crop type, planting and harvest dates)
- Tillage factors (e.g., date and depth of tillage)
- Fertilizer application factors (e.g., type and application rate)
- Irrigation factors (e.g., # irrigation events, date)

A-FERTILIZER Model

- No specific model is endorsed (e.g., DNDC, Daycent)
- Must demonstrate that model is appropriate for climate/agroecological zone in which the project is located
- Must quantify both direct and indirect emissions
- Output must be the fertilizer-derived emission at a specific point in time

A-FERTILIZER Emissions Calculations

- Direct N_2O emissions
- Indirect N_2O emissions
  - Annual nitrate leaching loss
  - Annual ammonia volatilization and nitric oxide emissions
- Emissions from fertilizer production

Leakage

A decrease in sequestration or increase in emissions outside project boundaries as a result of project implementation.

- Activity shifting leakage: caused by shifting of the activities of people within project area
- Market effects leakage: caused by shifts in supply and demand for the product and services affected by the project.

L-GLLM: Accounting for Leakage

- Estimates GHG emissions from both activity shifting and market-effects leakage
- Applicable to all project activities
- Requires estimation and justification of output/yield in baseline case; monitoring of output/yield in project case.
  - Required where project leads to >3% decrease in output

Activity Shifting Leakage

- Accounting for activity shifting leakage emissions is required where:
  - Baseline output exceeds project output by >3% and;
  - Baseline land owner / user purchases new fields, brings new fields into production, increases livestock population outside project boundaries, or is displaced from project area

Activity Shifting Leakage

- Must monitor all livestock operations of baseline land owners/users.
- Production should be reported;
  - where not possible, common practice should be used to determine per unit area / per head emissions and estimates of numbers of head.
- Same methods as in the emissions modules should be used, dependent on magnitude.
  - ➢ *E_AS* = summed emissions

Market Effects Leakage

- Accounting for market effects leakage emissions is required where:
  - Baseline output exceeds project output by >3%.
- Accounting method attempts to capture emissions associated with market-mediated response of producers outside project boundary.
  - Employs theory that ME leakage can be quantified using published estimates of price elasticities of supply and demand[1].

Murray, B.C., McCarl, B.A., Lee, H., 2004, 'Estimating Leakage from Forest Carbon Sequestration Programs, ' Land Economics 80:109-124.

Market Effects Leakage Factor

- Module defines the default market-effects leakage factor applicable to any project using this methodology, using derived equation.

$$LE_{M,t} = \frac{E_S}{E_D - E_S}$$

- E_S and E_D for dairy and beef sectors in US have been derived and published; all US based GLLM project activities must use the following values:.

	E_S	E_D
US Dairy Sector	0.075	-0.26
US Beef Cattle Sector	0.91	-0.61

- Projects located outside the US must use verifiable values for E_S and E_D, based on peer reviewed studies / local market data.

Calculating Market Effects leakage deduction

$$E\_ME = \left[\left(\frac{(Y_{P,t} + Y_{AS,t}) - Y_{BSL,t}}{Y_{BSL,t}} \right) * LE_{M,t} * e_{BSL,t} \right]$$

Where:

E_ME	Net greenhouse gas emissions due to market-effects leakage (t CO_2-e)
$Y_{P,t}$	Project output at time t; lbs/kg, gal/l, etc.
$Y_{AS,t}$	Output from production shifted to non-project areas at time t; lbs/kg, gal/l, etc.
$Y_{BSL,t}$	Baseline projected output at time t; lbs/kg, gal/l, etc.
$LE_{M,t}$	Market leakage factor at time t from equation 1
$e_{BSL,t}$	Baseline emissions per unit output (t CO_2e/ lbs/kg, gal/l output)

Total Leakage Deduction

$$E\_LK = E\_ME + E\_AS$$

Where:

E_LK	Net greenhouse gas emissions due to leakage (t CO_2-e)
E_ME	Net greenhouse gas emissions due to market-effects leakage (t CO_2-e)
E_AS	Net greenhouse gas emissions due to activity shifting leakage (t CO_2-e)

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Thank you!